



Review papers

Conceptualizations of water security in the agricultural sector: Perceptions, practices, and paradigms



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ABSTRACT

Conceptions of agricultural water security are conditioned by larger understandings of being and reality. It is still unclear what such understandings mean for perspectives on water security in general and on causes and solutions related to perceived water security risks and problems in agricultural sector in particular. Based on a systematic literature review, three conceptualizations of water security, related to different paradigms, are presented. Also the consequences of such conceptualizations for determining research objectives, research activities, and research outcomes on agricultural water security are discussed. The results showed that agricultural water security from a positivist paradigm referred to tangible and measurable water-related hazards and threats, such as floods and droughts, pollution, and so forth. A constructivist approach to agricultural water security, constituted by a process of interaction and negotiation, pointed at perceptions of water security of farmers and other stakeholders involved in agricultural sector. A critical approach to agricultural water security focused on the processes of securing vulnerable farmers and others from wider political, social, and natural impediments to sufficient water supplies. The conclusions of the study suggest that paradigms, underlying approaches should be expressed, clarified, and related to one another in order to find optimal and complementary ways to study water security issues in agricultural sector.

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Contents

1. Introduction	225
2. Materials and methods	225
3. Paradigm classifications	226
3.1. Positivism	227
3.2. Constructivism	227
3.3. Critical theory	227
4. Conceptualizing security on the basis of positivism, constructivism, and critical theory	227
4.1. Positivism and security	227
4.2. Constructivism and security	227
4.3. Critical theory and security	227
5. Perceptions of water security under different paradigms	228
5.1. Water security as an objective reality	229
5.2. Water security as a socially constructed reality	229
5.3. Water security as a critical theory reality	229
6. Discussion	230
6.1. Positivist agricultural water security	230
6.2. Constructivist agricultural water security	230
6.3. Critical theory agricultural water security	231

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7. Conclusion	232
References	232

1. Introduction

Water wars are coming! (Harrington, 2013). The issue of water security has attracted increasing attention over the past years. Growing water scarcity is increasingly constraining food production, causing adverse impacts on the goals of food security and human well-being (Rosegrant et al., 2009). Several groups, including UNESCO's Institute for Water Education and the Asia-Pacific Water Forum, have made water security a central research theme (UNESCO-IHE, 2009). In the past decade, the issue of water security has also come to the fore in several water management agendas, particularly associated with bioterrorism concerns (Jansky et al., 2008). The growing attention for water security has resulted in a significant increase in the employment of 'water security' scholars within the academic community. Accordingly, the number of scientific papers on water security has significantly increased in the last 25 years (Cook and Bakker, 2012).

Clearly, water security is of utmost importance, especially in the agricultural sector: agriculture uses approximately 70% of renewable water resources worldwide (Taylor, 2015) and will continue to be the largest user of freshwater resources through 2050 for all regions (Rosegrant et al., 2009). Furthermore, in water scarce countries, irrigation is vital to enhance crop production (Jhorar et al., 2009). However, the growing water scarcity is putting pressure on irrigation systems (Forouzani et al., 2012), yield, and quality. Moreover, water insecurity has irreparable effects on raw materials production, rural employment opportunities, rural development, etc. Consequently, any discussion about agriculture is incomplete without consideration of water availability (Taylor, 2015).

Different studies have been found to present a comprehensive review of the concept of water security in academic debates. Cook and Bakker (2012), for instance, analyzed differences in approaches to water security across academic disciplines such as natural, social, applied, and medical science. Liu et al. (2007) discussed definitions of water security, water resources security, and water environment security. They concluded that natural attributes, socioeconomic attributes, and cultural attributes were recurring elements of the agricultural water resources security concept. In addition, agricultural water resources security includes food security, agro environmental security, agro economic security, rural society security, etc. Based on a multi-criteria evaluation model to assess water security, Wang et al. (2014) used catastrophe theory to consider different management strategies with the aim of recommending the best water management strategy to achieve water security. Furthermore, Qiang et al. (2008) applied a water poverty index (WPI) including five key indices, namely resources, access, capacity, utilization, and environment, to evaluate regional water security. Liu et al. (2012) reviewed both international and domestic conceptualizations of water security using the DPSIR model – exploring Driving forces, Pressures, States, Impacts, and Responses as relevant factors of water security.

Not only researchers, but also societal actors put different accents when assessing water security. International organizations, such as the Global Water Partnership and the World Economic Forum, have, for instance, presented different definitions of water security. However, it is not clear where these definitions come from and how they are, or are not, related. This is important,

because definitions are selections that include those aspects that are considered to be important and thus play a role in deciding upon problems and solutions related to water security issues.

Although several studies have been carried out with the aim to assess water security, a systematic overview of assessing water security from different paradigms is still lacking. Neither had we found any study that systematically reflected the consequences of the possible different conceptualizations of agricultural water security for doing research in this field. For agricultural production, water security denotes that water should be available at a sustainable, stable rate and at a reasonable cost (Liu et al., 2007). However, acceptable, sustainable, stable rate and reasonable cost are not fixed concepts. From the perspective of different paradigms, questions such as, *What does acceptable mean for quality and quantity of water in agriculture?, Who can determine the acceptability of water in the agricultural sector?, How should one determine an acceptable quantity and quality of water?*, may lead to different answers.

Therefore, this paper aimed to present, compare, and analyze main approaches of agricultural water security, based on different paradigms, including how each conceptualization affected research objectives, methods and outcomes. The results can help researchers to become aware of implicit selections and choices that are being made, including the consequences for research questions, objectives and methods, leading to specific outcomes and recommendations for dealing with water security in agricultural sector. Besides, its outcome could be useful and assist policy makers to adjust their plans base on relevant concept of agricultural water security.

After a brief explanation of the methodology we continued to discuss a positivist, constructivist, and critical perspective on security in general, followed by a discussion on different conceptualizations of water security and water security in the agricultural sector. Finally the consequences of the conceptualizations for doing research in the domain of water security in the agricultural sector were explored.

2. Materials and methods

The literature review for this study was conducted on four fields: paradigms, security, water security, agricultural water security. In total, 30 keywords¹ were applied over 15 search queries on Scopus and Google Scholar to find results for each field and for combinations of fields. The frame of research is presented in Fig. 1.

On the basis of this systematic literature review, we first selected three main paradigms (positivism, constructivism, and critical theory) representing core differences, that also go for their ontology, epistemology, and methodology. The differences were presented in Table 1.

Subsequently, various studies of security were selected and related to the different paradigms which resulted in different conceptualizations of security in general. These conceptualizations

¹ The keywords were positivism, constructivism, critical theory, paradigm, security, water security, ontology, epistemology, methodology, water, agriculture, agricultural water security, research, conceptualization, definition, participatory, perception, behavior, reality, Index, concept, action, practice, availability, accessibility, quantity, quality, consequence.

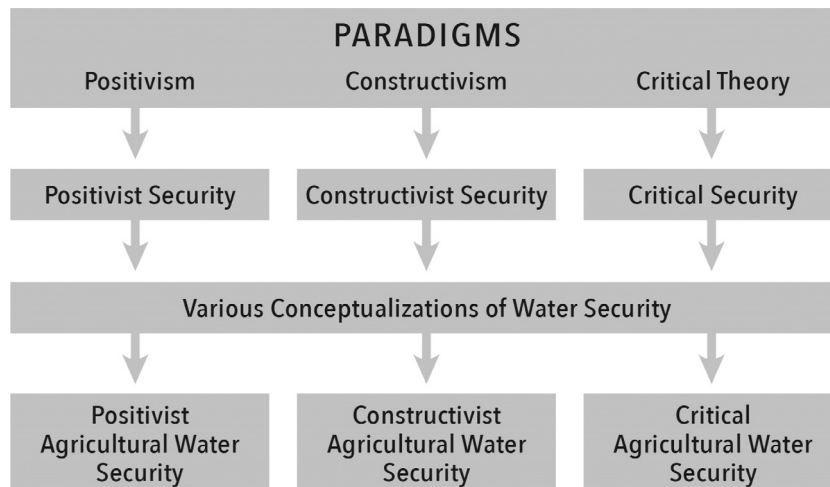


Fig. 1. The frame of research.

were then related to conceptualizations of agricultural water security in particular, as presented in Table 2. Finally, we explored the consequences of positivist, constructivist and critical theory conceptualizations of agricultural water security for research and practice, as summarized in Tables 3 and 4.

3. Paradigm classifications

A paradigm can be defined as a set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares them (Göktürk, 2009).

Paradigms are based on ontological, epistemological, and methodological assumptions (Greene and Caracelli, 1997). The use of a specific paradigm determines a specific research approach

(Morgan, 2007). Because different paradigms do not have a common theoretical language, they cannot be compared. Consequently, the question, which paradigm is the best, does not have an answer (Fazlıoğulları, 2012).

The positivist, constructivist, and critical theory paradigms were selected with the aim of elucidating different conceptualizations of water security and their consequences. Other related paradigms, such as post-positivism and the participatory paradigm, were also studied, but, according to Guba's (1990) perspective, the three first-mentioned paradigms were selected on the basis of their fundamental differences in ontological, epistemological, and methodological aspects. A paradigm classification, constructed from the basic components of positivism, constructivism, and critical theory is presented in Table 1.

Table 1

Three basic paradigms within the context of their basic components. Adapted from: Lincoln et al. (2011) and Fazlıoğulları (2012).

	Positivism	Constructivism	Critical theory
Ontology			
Ontology is the theory of what exists (Kalof et al., 2008), referring to the nature of reality (Flowers, 2009)			
Nature of reality	Reality is to be discovered and comprehensible	Reality is socially constructed	Reality is comprehensible and was once plastic
Existence of reality	Reality exists objectively and externally	Reality is a product of the human mind and is socially developed There are multiple and sometimes conflicting realities	Virtual reality is shaped by social, political, cultural, economic, ethnic, and gender factors; reality crystallizes over time
Epistemology			
Epistemology examines the relationship between the one who knows, what is known (Guba, 1990), and what can be known (Kalof et al., 2008)			
Epistemology determination	Dualism and objectivism; findings are true	Transactionalism and subjectivism; findings are created as the investigation proceeds	Transactionalism and subjectivism; findings are value-mediated
Relation between investigator and investigation	Investigator and the investigated object are assumed to be independent entities	Investigator and the object of investigation are assumed to be interactively linked	The values of the investigator inevitably influence the inquiry
Methodology			
Methodology draws a comprehensive frame with the aim of determining methods to know reality, to achieve knowledge, and to define the steps in the research process (Fazlıoğulları, 2012)			
Praxis	Experimental and manipulative	Hermeneutical and dialectical	Dialogic and dialectical
Method	Quantitative research methods such as experiments and survey	Hermeneutical research methods such as in-depth semi-structured interviews and participatory observation	Action research, critical ethnography

3.1. Positivism

The positivist paradigm has been described as a philosophical attitude (Fazlıođulları, 2012) that follows a naive realism ontology (Guba and Lincoln, 1994). Positivism starts from the assumption that knowledge is valid only if it is based on observations of the external reality (Flowers, 2009). The epistemology of positivism is dualism and objectivism (Guba and Lincoln, 1994), and the methodology is empirical and manipulative (Fazlıođulları, 2012).

3.2. Constructivism

The aim of the constructivist paradigm is to understand the complex world from the perspective of individuals with their specific experiences. The ontological base of constructivism is relativism. From a constructivist viewpoint, two constructed realities can be distinguished: first-order realities² and second-order realities,³ corresponding, respectively, to Bohm's presented and represented realities (Bohm, 1996). Constructivism has a subjective and transactional epistemology. As stakeholders change, realities change as well (Onwuegbuzie, 2000). Constructivism relates to a hermeneutical and dialectic methodology (Guba and Lincoln, 1994).

3.3. Critical theory

The aim of a critical theory paradigm is to emancipate human beings (Fazlıođulları, 2012). The ontology of critical theory is historical realism, which indicates that a reality is assumed to be apprehendable. According to critical theory, reality was once *plastic*. It was shaped by a congeries of social, political, cultural, economic, ethnic, and gender factors over time, and then crystallized into a series of structures that are now (inappropriately) taken as real, but that can be changed (Lincoln et al., 2011).

The epistemology of critical theory is transactional and subjectivist. Findings are therefore value mediated (Guba and Lincoln, 1994). Regarding methodology, critical theory follows a dialogic and dialectical methodology that refers to the transactional nature of inquiry (Lincoln et al., 2011).

4. Conceptualizing security on the basis of positivism, constructivism, and critical theory

While security is of vital importance (Buzan, 1991), it is at the same time an essentially contested concept on which no consensus exists about its meaning. This conceptual vagueness makes it difficult to find common ground for discussion (Williams, 2008). In the following, we conceptualize security on the basis of the three paradigms discussed in Section 3, including what this means for perceptions of water security. Fig. 2 summarizes the results.

4.1. Positivism and security

Security studies have traditionally been dominated by positivist conceptualizations of security. The conceptualization of security starts with, and rests upon, a specific ontological commitment. From the nature of reality, security exists "out there", independent of the observer (Wolfers, 1962); security is achieved once threats to security have

been identified and prevented, or at least managed (Nye and Lynn-Jones, 1988). The focus is on protection through the use of power.

Two broad approaches to security research based on positivism have been described as strategic studies and security studies (Harrington, 2013). In strategic studies, emphasis is placed on traditionalists who take a military and state-centered view. From a strategic studies viewpoint, security is perhaps most succinctly summed up by Stephen Walt as *the study of the threat, use, and control of military force* (Harrington, 2013). In security studies, the agenda is widened by claiming security status for issues and referent objects beyond the military arena.

From a positivist view, security relates more to state than to people. The investigator and the security situation are assumed to be independent entities and investigators are capable of studying security without influencing it or being influenced by it. The positivist praxis in studying security is explanatory, using experiments and other quantitative research methods (Ulusoy, 2003).

4.2. Constructivism and security

In the post-Cold War period, various challenges to positivist approaches to security have arisen that entail a movement towards interpretive modes of analysis (Glover et al., 2011). From the perspective of constructed realities, security is related to individual or societal value systems. Every actor who talks about security assigns a specific meaning to the term. Once the perception of security has changed, and mutual fear has been overcome, security is achieved (Ulusoy, 2003).

Regarding epistemology, the Copenhagen School,⁴ taking a constructivist view, considers security within the analytical framework of securitization, wherein security is defined as a social construction that is the outcome of a social process. Securitization predominantly examines how security problems emerge, evolve, and dissolve. This view regards security as a "speech act"; within this understanding, the utterance is itself the act (Balzacq, 2010). Other constructivist viewpoints may see security as constructed through processes of social interaction, but incapable of being defined narrowly as existing only within the speech act (Glover et al., 2011). Every constructivist reading of security consciously avoids an objectivist account of security threats (Harrington, 2013), as there is ongoing interaction between the investigator and respondents, as well as among respondents, that influences conceptualizations of security. In order to understand how security is experienced and interpreted in different contexts, the role of audiences, visual communication, and physical practices must thus all be examined (Glover et al., 2011).

The praxis of constructivism in studying security relates to understanding (Ulusoy, 2003), using conventional hermeneutical methods and techniques. A social constructivist reading of security attempts to broaden the security paradigm by claiming security status for a multitude of issues and referential objects in the economic, environmental, and societal realms as well as in the military and the political realm (Buzan et al., 1998).

4.3. Critical theory and security

The critical theory paradigm has an overriding concern with the failure of security studies to develop a normative, moral, and emancipatory dimension (Harrington, 2013).

Security is considered a socio-historical interpretation of reality based on the nature of reality. Critical theory seeks out the sources of contradiction and conflict in entities and evaluates their potential to change into different patterns (Manners, 2002).

² First-order or presented realities refer to the physically demonstrable and discernible characteristics, qualities, or attributes of a thing that are measurable and empirically verifiable. First-order realities require a set of linguistic agreements, understandings, and vocabulary for their existence (Ford, 1999).

³ Second-order or represented realities are created whenever we attach meaning, significance, or value to a first-order reality. Second-order realities do not reside in the facts or data of the situation itself, but are interpretations put there by observers, including their opinions, judgements, assessments, evaluations, and accounts. Even when first-order realities remain the same, it is possible to have different second-order realities (Ford, 1999).

⁴ The Copenhagen School of security studies tries to be the *via media* of constructivist approaches to security. The Copenhagen School places particular emphasis upon the social aspects of security (Diskaya, 2013).

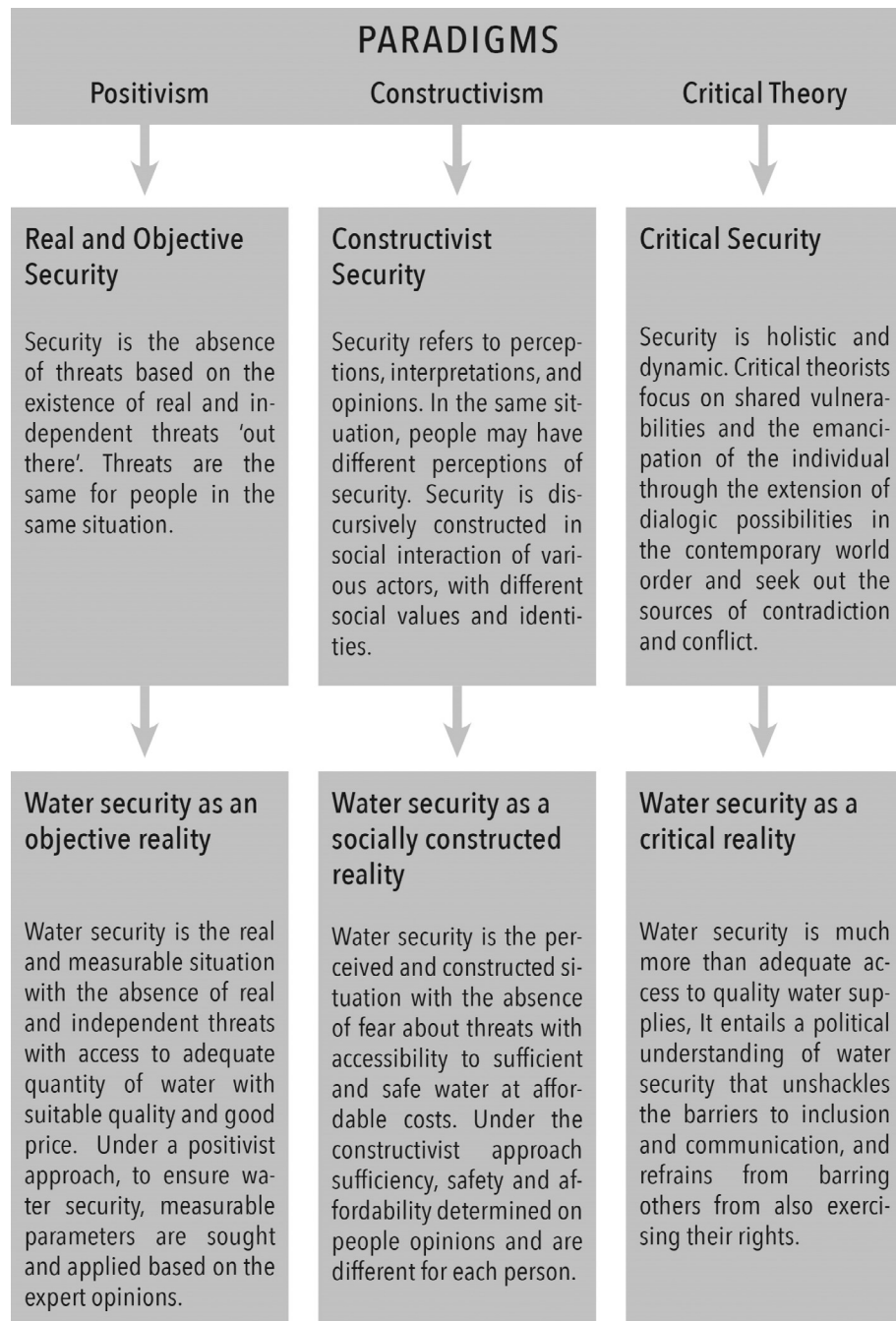


Fig. 2. Three conceptualizations of security and water security. Source: research finding.

Epistemologically, critical theory security studies try to play a part in (re)forming the historical and recent facts about security as a necessary foundation for reforming security (Booth and Vale, 1997). There are relations between the investigator and the objects of investigation, and values of the investigator and of situated others inevitably influence the inquiry. The praxis of critical theory in security research is dialogic and dialectical, using action research methods (Harrington, 2013). Critical theorists argue that rethinking security requires making the definition of the political a question, rather than an assumption (Krause and Williams, 1997). Thus, in critical theory, security is premised on the political nature of security, how understandings and practices of security affect social relations and the political order itself (Harrington, 2013). These theorists believe that a specific conceptualization of security is always for someone and for some purpose, and that it

is generally produced to serve the purposes of certain people and states in international relations.

The practical fulfillment of security as emancipation entails overturning structures of oppression or exclusion. The principal characteristics of this view are that it is radically cosmopolitan; that it is predicated on the rights and needs of the most vulnerable; and that security should not be achieved or preserved for some at the expense of others (Harrington, 2013).

5. Perceptions of water security under different paradigms

On the basis of the different conceptualizations of security, relating to the different paradigms, we now discuss perceptions and (research) practices of water security.

5.1. Water security as an objective reality

In the positivist paradigm, water security is defined as the absence of threats, based on the existence of real and independent threats (Harrington, 2013). Hence, water security has to do with real water-related hazards and threats, such as floods and droughts, pollution, and so forth (Pahl-Wostl et al., 2013). From a positivist perspective, water security is placed in a dominant narrative of state security (Harrington, 2013). Research involves a scientific analysis and an engineering of tools and methods in order to explain why particular decisions were made, resulting in specific courses of actions (Ulusoy, 2003).

Most water security researchers and policymakers started from the positivist paradigm. Water engineers, for instance, developed an understanding of water security as “guns, gates, and guards” to safeguard potable water and an effective water infrastructure. In Australia, well-known as having the world’s most arid climate, water security is commonly being defined as a concern about water availability (quantity) to be addressed by the national and state governments through a variety of mechanisms (Cook and Bakker, 2012). The World Bank also defined water security on the basis of the positivist paradigm, referring to the annual supply of 1 m³ of healthy drinking water for people, 100 m³ of clean water for personal hygiene, and 1000 m³ of water for agricultural, industrial, and environmental production. Thus, 1101 m³ of water annually for each person would provide water security (Zargarpor, 2012). Moreover, the national water thresholds classification asserted that countries with less than 1000 m³ of water available annually per person are chronically stressed and those with less than 500 m³ per year are beyond the water barrier (Lankford et al., 2013).

Interestingly, other studies that also used objective measurement indicators for assessing water quantity and water quality emphasized different numbers and figures. The Falkenmark Index, for instance, was defined as the amount of water available in a country per capita. Based on that index, a threshold value of 1700 m³ renewable water resources per capita per year is considered a no stress situation. Water supplies between 1000 and 1700 m³ lead to water stress. When supply falls below 1000 m³ per capita per year, a country is said to experience water scarcity, and, below 500 m³ per capita per year, absolute scarcity (Brown and Matlock, 2011).

Brauch (2013) as well considered several indicators of water security, including a test for dissolved oxygen (DO), which measures the amount of oxygen dissolved in water in terms of the number of milligrams per litre (mg/L) and by means of a pH test, measuring the alkalinity or acidity concentration in water. The specific conductance test measures the ability of water to pass an electrical current (Brauch, 2013). Also on the basis of the positivist perspective, Sullivan et al. (2010) developed the rural water livelihoods index (RWLI), including four key dimensions:

- Access to basic water services
- Crop and livestock water security
- Clean and healthy water environment
- Secure and equitable water entitlement.

Liu et al. (2012) used the DPSIR model to assess water security and reviewed the forefront progress of both international and domestic water security. They emphasized the seriousness of water security issues caused by a high intensity of human activity. Indicators were used, such as population growth rate (%), urbanization level (%), per capita GDP (%), rural families’ Engel’s coefficient (%), proportion of agricultural water (%), the amount of wastewater discharge per industrial value (m³/10⁴), water consumption per ten thousand GDP (m³/10⁴), etc. All these indicators measured observable aspects of water security. Qiang et al. (2008) applied water poverty as an index to evaluate regional water security, based on

2006 data. The WPI method includes five key indices: resources (R), access (A), capacity (C), utilization (U), and environment (E). Each key index consists of several sub-indices. From the WPI results, Qiang et al. (2008) graded water security for individual farms, using the mean deviation grading method. The results from their study provided basic information for decision making on rational utilization of water resources and regulations for a regional water safety guarantee system.

In a nutshell, under the positivist approach, to ensure water security, measurable parameters are sought and applied with the aim of developing policies that help improve water quality and quantity.

5.2. Water security as a socially constructed reality

According to constructivism, by labeling something a security issue, it becomes one (Warner, 2008). Water security is considered a complex problem because of the involvement of many actors with different backgrounds, interests, and opportunities, and therefore with different perspectives of both problems and solutions (Aarts and van Woerkum, 2006) that all have been constructed in numerous interactions.

A distinction can be made between real water security as a first-order reality and perceived water security as a second-order reality. The measurable quantities of water, the pH level, the depth of the well, and so on are considered first-order realities. Second-order realities are created by giving meaning to first-order realities from personal, cultural, and societal perspectives (Donohue et al., 2011). In line with the constructivist paradigm, perception is a major part of human intelligence and a key component in understanding human behavior. It is the mechanism through which a person evaluates external input, which, in turn, determines the person’s behavioral response (Cooper, 2003). Water security as a second-order reality is thus a perceived security. Grey and Sadoff (2007:548) defined water security as *the reliable availability of an acceptable quantity and quality of water for health, livelihoods, and production, coupled with an acceptable level of water-related risks to people, environments, and economies*. In the Second World Water Forum and Ministerial Conference held in The Hague, Netherlands, in March 2000, water security was interpreted as accessibility for all people to sufficient and safe water at affordable costs (Liu et al., 2007). Constructivists pay attention to epistemology and focus on how water security is discursively and socially constructed (Ulusoy, 2003), accepting different interpretations and inviting a dialogue among involved stakeholders. Consequently, an inclusive framing of water security should, at root, be human focused, with an emphasis on the individual (Mason and Calow, 2012).

5.3. Water security as a critical theory reality

Scholars, involved in critical theory security studies hold an ethical and radical perspective on security (Manners, 2002). Threats are considered the product of the politics of representation (Brauch, 2013).

As critical theory deals with how understandings and practices of security affect social relations and the political order (Nunes, 2012), water security becomes much more than adequate access to quality water supplies, although this is certainly a prerequisite. It entails a political understanding of water security that unshackles the barriers to inclusion and communication, and refrains from barring others from also exercising their rights (Harrington, 2013). Critical theory scholars noted that making water a state concern may be beneficial, but also harmful to local water security (Warner, 2014). The US Environmental Protection Agency, for instance, defined water security as prevention and protection against terrorism (Cook and Bakker, 2012).

Table 2
Conceptualizations of agricultural water security and their consequences for doing research. Source: research findings.

Positivist agricultural water security	Constructivist agricultural water security	Critical theory agricultural water security
<p><i>Ontology</i> There is the real and measurable water situation in the agricultural sector, such as the quantity of agricultural water, the pH level of water, and the depth of well, and also real water-related hazards and threats, such as floods, droughts and water pollution. Measurement and identification of water security and threats are discovered and comprehensible. Farmers in the same place and with the same water accessibility have similar perceptions of water security in the agricultural sector</p>	<p>Agricultural water security is subjective and constituted by a process of interaction and negotiation, inherited from specific conversational backgrounds (cultures, traditions, and institutions) and present in the media in which we are socialized. Perceptions of agricultural water security may vary among farmers within the same location and in similar situations</p>	<p>Agricultural water security is a virtual reality that is achieved by the process of securing vulnerable farmers to access adequate agricultural water and overcome the structural violence caused by political, social, and natural situations over time. It is simultaneously ensured that achieving water security neither deprives other people or part</p>
<p><i>Epistemology</i> Researchers are independent of farmers and can objectively measure water security without affecting it</p>	<p>Researchers affect perceived water security in agricultural sector and have the important role in shaping security perception about agricultural water</p>	<p>The values of the researcher inevitably influence the agricultural water security. Findings are value – mediated</p>
<p><i>Methodology</i> Quantitative research methods such as experiments and survey are the best methods to measure water security in agricultural sector. Researchers use exact indicators and indexes to measure water quantity and quality</p>	<p>Qualitative research methods and place-based approaches are preferred, using in-depth semi-structured interviews and participatory observation to understand stakeholders' perceptions of water security in agricultural sector from the specific contexts</p>	<p>Qualitative research method using dialogic and dialectical are common, such as action research and critical ethnography</p>

6. Discussion

So far, our literature study has shown that different paradigms lead to different conceptualizations of security and thus of water security as well. We will now discuss the implications for water security perceptions in the agricultural context, as well as for doing research. Table 2 summarizes agricultural water security perceptions, including the consequences for studying water security in the agricultural sector.

6.1. Positivist agricultural water security

From a positivist conceptualization, agricultural water security is explained in terms of facts that are to be obtained by eliminating context factors. Lautze and Manthrihilake (2012), for instance, using data from FAO AQUASTAT 2007, considered two sub-indicators which are (1) water availability per capita, and (2) water withdrawal per capita. Water availability per capita, provides an indication of the total water available for agricultural production: greater water availability per capita implies greater water security for agriculture. Water withdrawal per capita provides an indication of how much control a country possesses over its water resources. To assess relative water security, countries were ranked and divided into five groups. A score between 1 and 5 was then assigned to each group, 5 representing greater water security for agriculture and 1 representing less water security (Lautze and Manthrihilake, 2012). Facts about the level of agricultural water security are used to explain, predict and control water security for agricultural production.

Research objectives based on a positivist paradigm include measuring agricultural water security at international and national level and testing hypotheses about water security and the factors that could affect it, with the aim of predicting water security, identifying the real threats to water security, and controlling these threats. Research actions include the identification of a set of variables about agricultural water security. Variables should in advance be clearly understood and defined by the researcher, and exact measurement indicators should be used to assess the real water situation in terms of quantity and quality. Research tools such as questionnaires, surveys, measurements, and other instruments are used to collect numerical or measurable data. Pri-

marily deductive processes are used to test pre-specified concepts, constructs, and hypotheses. Research outcomes represent the real situation and generate numerical data or information.

6.2. Constructivist agricultural water security

Based on the constructivist conceptualization, agricultural water security is considered to be inter-subjective, constituted by a process of interaction and negotiation and thus inherited from conversational backgrounds as constituted by cultures, traditions, institutions) as well as by the media in which we are being socialized. Agricultural water security is considered a dynamic concept, which means that its interpretation may vary among farmers, even within the same location and in similar situations (Liu et al., 2007). Interpretations depend on who perceives it, which actors have been involved in securing water, and what is perceived as secure.

To decide what should be considered acceptable water quality and quantity for agriculture Pahl-Wostl et al. (2013), using a constructivist approach, suggested a place-based assessment of perceptions and interpretations of concerned stakeholders. Liu et al. (2007) believed that agricultural water security has cultural attributes, indicating that different groups have different expectations about the yield and value of agriculture and, thus of the water quantity and quality that should be pursued. In other words, different groups of stakeholders have distinct demands for water quality and quantity and make use of different approaches to access water; they also have different responses to the question whether the agricultural water resources are safe, and what the safety level of agricultural water resources is or should be (Liu et al., 2007). Consequently, perceptions of water security in agricultural contexts are based on farmers' own assessments including their fears (or absence of fear) concerning threats and future conflicts regarding water (Ma et al., 2015; Huang et al., 2011).

Research objectives based on a constructivist paradigm include understanding agricultural water security on the basis of perceptions of involved stakeholders, interpreting social interactions and variables that form these perceptions, and knowing how understandings and practices of security affect social relations and especially farmers' beliefs, attitudes, and behaviors in relation to water, being the main stakeholder group. Research actions include the place-based understanding of concerned stakeholders'

perceptions. The researcher has only a rough idea about the variables in advance and uses primary data-gathering instruments and strategies such as individual in-depth interviews, structured and unstructured interviews, focus groups, narratives, content or documentary analysis, participant observation, and archival research. Primarily inductive processes are used to formulate theory or hypotheses. Research outcomes provide detailed descriptions of farmers' and other stakeholders' perceptions of agricultural water security. These perceptions include opinions, experiences, interests, associations, feelings, and fears, related to specific contexts, and explain the way farmers and other stakeholders actually deal with water and water-related issues.

6.3. Critical theory agricultural water security

From a critical theory perspective, water security in agricultural contexts is conceptualized as the process of securing vulnerable farmers from the structural violence caused by the political, social, and natural impediments to adequate water supplies needed for sustainable agriculture, while simultaneously ensuring that the means by which water security is achieved neither deprives others nor degrades affected ecosystems or the environment (Harrington, 2013). The practical fulfillment of agricultural water security from a critical theory perspective requires the freeing of farmers from arbitrary structures preventing them from living as they would otherwise wish.

Research objectives based on a critical theory paradigm include: securing vulnerable farmers from the structural violence caused by political, social, and natural factors, and seeking to identify the effects of power, inequality, and conflict on the availability of water

for them. Research actions require a dialogue between the investigator, the farmer, and other related stakeholders. Interactive and transformative actions are based on dialogue and reciprocity. Research outcomes of agricultural are valued, mediated, and related to the empowerment of farmers, emancipating and freeing farmers from arbitrary structures that can lead to insecurity. Table 3 summarizes the consequences of different agricultural water security perceptions for research objectives, actions and outcomes.

The three paradigms clearly play a vital role in research of agricultural water security issues. Operationalization of the water security concept thus requires procedures to be designed and targets to be set for what acceptable water security in agricultural sector means when approached from a specific paradigm. Pahl-Wostl et al. (2013) distinguished four domains that should be taken into account that make stakeholders sensitive for differences in the kind of knowledge used, the institutional setting, and the actors involved in the process, which are:

- Scientific analysis and expert judgement
- Economic cost–benefit types of analysis
- Place-based assessment of perceptions of concerned stakeholders
- Invocation of widely shared societal norms (Pahl-Wostl et al., 2013).

Each paradigm results in a specific logic and framing of acceptable water security in agricultural sector, including whom can and should determine it, and how it can be assessed.

Table 4 summarizes questions, related to the study of acceptability of water security in agricultural sector from different paradigms.

Table 3

Consequences of conceptualizations of agricultural water security on research objectives, actions and outcomes. Source: research findings.

Research objectives	Research actions	Research outcomes
<i>Positivist agricultural water security</i> Measuring agricultural water security Identifying the factors affecting water security Predicting, identifying and controlling threats to water security	Identifying a set of variables Using research tools such as questionnaires Using primarily deductive processes	Numerical data about observable factors, affecting water security
<i>Constructivist agricultural water security</i> Understanding agricultural water security related processes Understanding the relation between water security and farmer's behaviors	Place-based understanding of stakeholders' perceptions Using research tools such as interviewing and participatory observation Using primarily inductive processes	Detailed descriptions of farmers' perceptions
<i>Critical theory agricultural water security</i> Identifying effects of power, inequality, and conflict on the availability of water	Un-going dialogue between the investigator, farmers and other related stakeholders is the main action	Actions for empowering and emancipating farmers

Table 4

Questions relating to acceptability of water security in agricultural settings. Source: research findings.

Paradigm	What does acceptable quality and quantity of water in agriculture?	Who can determine the acceptability of water quality and quantity in the agricultural sector?	How should one determine an acceptable water quantity and quality in different contexts?
Positivist	“What is acceptable” is a scientific and engineering question and relates to using algorithms, models, and tools for water allocation decisions	<ul style="list-style-type: none"> • Scientists • Engineers 	<ul style="list-style-type: none"> • Scientific analysis and expert judgement • Cost–benefit analysis
Constructivist	“What is acceptable” is a social decision, not a scientific one, and relates to different interpretations by different groups	<ul style="list-style-type: none"> • Farmers • Other stakeholders involved 	<ul style="list-style-type: none"> • Place-based assessment of perceptions of concerned stakeholders
Critical theory	“What is acceptable” relates to political, social, economic, and administrative systems in place to determine societal negotiation	<ul style="list-style-type: none"> • Farmers • Politicians • Scientists 	<ul style="list-style-type: none"> • Invocation of widely shared societal norms • Stakeholders' place-based assessment

7. Conclusion

Agricultural water security is an ambiguous concept that is interpreted in different ways. Our study has shown that, depending on the paradigm underlying perspectives on security in general and water security in agricultural sector in particular; different research objectives, research actions and research outcomes can be expected. Identifying the paradigms, underlying research and the interventions that follow from it, is of utmost importance for discovering shortcomings of a particular paradigm, as well as how different paradigms may complement each other. It is appropriate to use a positivist conceptualization of agricultural water security when the aim is to know specific measurable indicators of the quantity and quality of water, used in agricultural sector. Such indicators are needed when comparing situations in different regions. A constructivist conceptualization of agricultural water security is useful for understanding water security perceptions of farmers and other stakeholders, underlying their water-related behaviors. Finally, using a critical theory conceptualization of agricultural water security is suitable when the research objectives have to do with the relation between water security and social and political conflicts, as well as with the need to empower stakeholders to achieve equal access to water. For a more complete picture when studying agricultural water security, we recommend researchers and policymakers to unravel the paradigms, underlying research and discuss these in order to value them in terms of their shortcomings as well as their complementarities in order to make wise choices in specific cases and contexts.

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