Geoforum 87 (2017) 85–94

Contents lists available at ScienceDirect

Geoforum

journal homepage: www.elsevier.com/locate/geoforum

Challenging the Coproduction of Virtual Water and Palestinian Agriculture

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ARTICLE INFO

Keywords:
Virtual water
Water tenure
Efficiency
Coproduction
Structuration theory
Palestinian territories

ABSTRACT

The idiom of virtual water feeds a prolific literature now shaping the policies of national administrations and international organizations, including donors. This article explores the manner in which Palestinian agriculture and the concept of virtual water shed light on each other's coproduction. It opens the black box of virtual water to identify the underlying hypotheses. It invalidates these hypotheses using empirical research. Integrating structuration theory to an STS approach, it explores the manner the coproduction of an interpretive scheme, virtual water, is linked to the construction of a structure of power. Within the idiom of virtual water, flows exist only through the international trade of commodities while states are endowed with an annually renewed stock of water. We focus on the real flow of water from its emergence from the earth to its evapotranspiration by a cultivated plant. We demonstrate that social and political variables within water governance determine the volumes of virtual water flows far more than climatic or agronomic variables. The idiom of virtual water portrays Palestinian smallholders as inefficient water users while ignoring the manner they sustain food security and environmental sustainability. It legitimizes export oriented agribusinesses as their mode of production corresponds to the coproduction of the idea of efficiency underlying the concept of virtual water. These results allow us to reconsider smallholder agriculture as it exists in the Palestinian territories and what sort of policies can support it.

1. Introduction

The Middle East is considered a water scarce region and has been especially targeted by the discourse on virtual water. Allan has long urged Middle East states to devote their scarce water resources to non agricultural activities generating higher added value. He argued this would allow importing food from states better endowed with water resources, thus ensuring both environmental sustainability and food security. He designated the water necessary to produce such imported crops as "virtual water" because it was imported in a virtual manner together with the crops (Allan, 1992). The idiom of virtual water has fed a prolific literature that is now contributing to shape the policies of national administrations and international organizations, including donors (Barnes, 2013).

Opening the black box of virtual water reveals it treats water as an immobile stock embedded in the natural resources of a state. Within the idiom of virtual water, flows exist only through the international trade of commodities. They do not include the real flow of water from its source, through the land where farmers grow their crops, to the point it evaporates. Naming, defining and mapping are acts of ontological politics (Mol, 1999). Such acts shape power and authority. The rapid rise of the virtual water literature granted a scientific legitimacy to this concept, simultaneously cementing a social imaginary it embedded.

Science and Technology Studies (STS) have long demonstrated how knowledge and norms are co-produced. In other words, they are constructed through their mutual interactions. This means the manner we understand the world both results from and shapes the manner we wish to govern it. The term "coproduction" designates the manner the social order, on one hand, and our scientific understanding of the world, on the other hand, construct each other continuously (Jasanoff, 2004). Integrating feminist and post-colonial studies, STS explored the manner social orders are constructed and performed through various categories produced by science, such as race, gender or ethnicity (Rajagopalan et al., 2017). It thus paid attention to the construction of legitimacy in scientific thought, in technological choices and in political action (Jasanoff, 2017). This article explores the concept of virtual water as a scientific category that is co-produced together with the legitimacy of a specific form of agriculture.

This article explores the manner Palestinian agriculture, on one hand, and the concept of virtual water, on the other hand, shed light on their coproduction. It uses in depth fieldwork to challenge virtual water as a hegemonic interpretive scheme that is increasingly shaping our representation of sustainable agriculture and water management. We focus on the trajectories water can bifurcate into between the point it

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http://dx.doi.org/10.1016/j.geoforum.2017.10.011
Received 13 April 2017; Received in revised form 14 September 2017; Accepted 26 October 2017

emerges from the earth until the point it leaves the system.[1] We demonstrate that social and political variables within water governance determine the volumes of virtual water flows far more than climatic or agronomic variables. The decision processes, both collective and individual, that determine the paths water will flow into are embedded in both land and water tenure. Our results thus dispel several assumptions upon which the concept of virtual water relies. This article then explores the role this interpretive scheme is playing within a wider structure of signification that portrays agribusinesses embedded in global trade as the only legitimate and successful forms of farming. It demonstrates how it makes Palestinian smallholders appear illegitimate because the manner they sustain food security and environmental sustainability is portrayed as an inefficient use of water. This leads us to reconceptualize water differently. Treating it as a flow instead of a stock allows us to integrate the various institutions it flows through on its path between source and plant. It allows us to reconsider smallholder agriculture as it exists in the Palestinian territories and what sort of policies can support it.

2. Opening and locating the black box

The term "virtual water" was initially coined to designate the water embedded in commodities, such as cereals, that could be traded (Allan, 1992). This focus on trade distinguished the concept of virtual water from the pre-existing notion of hydric productivity. The concept relied on the substitutability of water. Water necessary to produce a crop was deemed to become available for another activity generating more added value if that crop was imported. Champions of virtual water, such as Hoekstra and Chapagain, argued that water scarce states should import water intensive commodities such as food to "save" their resources. They argued that estimating the amount of water needed to produce different crops in various countries was necessary to guide such states' commercial and agricultural policies. They developed a method based on FAO data on crop water requirements and crop yields (Hoekstra and Hung, 2005, p. 47). It considers that the average specific water demand (SWD) for a given crop (c) in a given state (n) could be calculated by dividing the crop "water requirement" (CWR) with the crop yield (CY):

$$SWD[n,c] = \frac{CWR[n,c]}{CY[n,c]}$$

The data from the FAO had not been designed to produce calculations of virtual water volumes. It aimed to inform farmers of the maximum yields as a function of irrigation calendars. Using it in this fashion, Hoekstra and Hung were turning it upside down. Their equation supposes that the irrigation calendar deemed by the FAO to maximize yield is systematically used by the farmers. The epistemic community that followed Hoekstra, which we will refer to as the "Delft school of thought", produced a prolific literature to assess the amount of virtual water contained in imported and exported crops. It applied this calculation method without challenging the underlying hypotheses.

These underlying hypotheses where rather extraordinary and wide sweeping. Such a calculation relies on the assumption that water is available on request for every farmer. Otherwise, farmers cannot provide the irrigation calendar that matches the specific water demand as it appears in the calculation method. This method also assumes that every farmer aims to maximize the vegetal mass. It assumes a monoculture on every plot of land. It assumes that a given crop only yields one product. It assumes that water serves only one use: the evapotranspiration of the crop that will be sold. Finally, it assumes that only climatic and agronomic variables determine the quantity of water that is necessary to produce a crop.

Such hypotheses rarely resist scrutiny. Agribusinesses with reliable and sizeable infrastructure may benefit from a supply of water on request when operating in very favorable conditions. Palestinian smallholders rely instead on shared springs or farmer managed shallow wells. In the Mediterranean area, spring flow varies widely through the year. This constrains the amount of water a farmer can access, as does the social organization allowing the farmer to access this spring. All Palestinian springs used in irrigation are shared according to "water turns". These are measured in terms of time periods during which the full flow of the spring is usually channeled towards a farmer's plot. Similarly, farmers relying on wells need to share with their neighbors, which constrains their access. As a consequence, most farmers either under irrigate or over irrigate in comparison with the ideal irrigation calendar embedded in the calculation of virtual water volumes. The Delft school recognized its general overestimation of the virtual water content of crops but didn't quantify it (Chapagain and Orr, 2009, p.1220). Moreover, farmers rarely aim to maximize vegetal mass. They usually prefer maximizing revenue, a goal that sometimes proves to be contradictory with maximizing vegetal mass. Field observation also shows that Palestinian farmers often mix crops within a single plot and often derive two products from the same crop. For example, corn provides cobs that are commercialized while the remaining stalks provide pasture for sheep. Only scientists who have never observed farmers may assume water has only one use. In Egypt, farmers need water to wash the salt off the land otherwise it becomes sterile (Barnes, 2013, p. 379). Palestinian greenhouse farmers use water in July and August to sterilize the soil. Finally, hypothesizing that climatic and agronomic variables alone determine the quantity of virtual water means assuming that water never flows through human institutions. This begs the question of how water reaches a plot of land after being abstracted. It constitutes a crucial part of the ontological politics of virtual water and will be challenged in the remainder of this article.

The coproduction of virtual water accommodated questionable assumptions because they were convenient for the epistemic community that championed it. Its calculation method proposed that virtual water flows could be detached from their contexts. This created the fictitious mobility of the concept. The controversy surrounding the underlying hypotheses constitutes a clear-cut case of ontological politics. This term designates conflicts involving different assumptions about what exists (Forsyth and Levidow, 2015, p. 141). Several hypotheses, however challengeable, proved very useful for the rapid rise to hegemony of the concept of virtual water and its accompanying calculation method. Many have demonstrated the inaccuracy of the assumption concerning the distinction between green water, naturally occurring in the soil, and blue water, channeled to the soil through irrigation (Fernandez, 2008, p. 54) (Perry, 2014, p. 121). Yet, calculations of the water footprint, an indicator the Delft school argues is wider than that of virtual water because it makes explicit the source of water that is used, rely on this distinction (Hoekstra et al., 2011, p. 167). The Delft school coined the term *water footprint* to describe the virtual water content embedded in products when they are consumed. It kept the term *virtual water* to describe water consumed through the production of the goods. The assumption concerning substitutability of water implied that imported virtual water would free up existing water for uses generating greater added value. Yet, examples abound that contradict this assumption. In the 1990s, in Jericho, the casino and the Intercontinental hotel channeled water previously used in irrigation to services deemed to generate a greater added value but most of this revenue actually left Jericho and the Palestinian economy as soon as it materialized (Trottier, 1999).

The epistemic community that promoted virtual water was concerned with international trade. It coalesced at a time when states had set up large databases concerning importations and exportations. In the 1990s, widespread computational capacities also appeared. This corresponded to a time when the FAO produced its own CROPWAT model that linked agronomic variables with climatic variables accessible online from climate stations around the world. As the databases were collected by states on a national scale, they allowed calculations

[1] Water leaves the system either through evapotranspiration through the leaves of plants, through evaporation from the soil or through reaching a sink such as the sea.