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Distributional considerations of international water resources under externality: The case of Ethiopia, Sudan and Egypt on the Blue Nile ☆, ☆☆

Ariel Dinar [a,*], Getachew S. Nigatu [b]

[a] Water Science and Policy Center, Dept. of Environmental Sciences, University of California, Riverside, USA
[b] Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, 335 E Street, S.W., Washington D.C. 20024, USA

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ABSTRACT

Common pool resources, such as international river basins with multiple riparian states, are hard to manage efficiently and equitably. In this paper, we suggest a methodology to assess the distributional aspects of various water allocation schemes applied to the Blue Nile in Africa. Based on previous analysis, a social planner allocation is found superior to the existing status quo in that it is inclusive, and expands the net benefit frontier of the basin. Water trade is introduced to demonstrate that such institution can alleviate the performance of existing institutions associated with the status quo and enable cooperation. Cooperative game theory concepts that address relative power of the riparian states in capturing incremental benefits from cooperation, such as the Core, the Shapley Value, and the Nash–Harsanyi (N–H) solution are compared under several scenarios, namely with and without water trade, and with and without existence of unidirectional externalities in the form of soil erosion and siltation impact. We find that the stability of Shapley and N–H benefits allocations are sensitive to the initial water rights allocation, which may explain the present caution of the basin states to be engaged in

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☆☆ Our analysis focuses on a subset of the Nile tributaries and Nile riparian states, which have been in the center of the conflict over the Nile water for quite a long time. Recently, 6 Sub-Saharan Africa Countries have joined the claims for Nile water. In addition, 2 new countries, South Sudan and Eritrea have been given independence and are now part of the group of 11 Nile Basin countries that claim their share of the water. In that respect, our analysis is partial as it addresses only portion of the Nile basin and part of the riparian states, however, in a well-defined geographical setting.

* Corresponding author.
E-mail address: adinar@ucr.edu (A. Dinar).

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cooperation arrangements. We also find that when a Core exists it is very small, which indicates also a fragile basis for cooperation.

1. Introduction

For many years, scholars have debated the issues of cooperative vs. non-cooperative solutions to common pool resource allocation [36]. The literature provides good examples, demonstrating that under certain conditions, cooperative solutions to common pool resource allocation problems produce a bigger payoff pie than in non-cooperation, which allows the parties (players), if they agree on the allocations, to increase their benefits from cooperation. The remaining question is whether or not the players find such allocations acceptable. Cooperative game theory literature distinguishes between games (arrangements) with non-transferrable utility (NTU), and games with transferable utility (TU) [19], which is often called by scholars in other fields "benefit sharing" [60].

One important aspect that has been neglected by many of those advocating for cooperation in common pool resource allocation problems is that even if the benefits from cooperation are significant compared with the non-cooperation state, there are reasons for the players to prefer non-cooperation. That is, players would prefer not to establish the grand coalition and rather find sub-coalitional arrangements, or even remain in the singleton (status quo) coalition stage. As suggested by Just and Netanyahu [28] for the general case, high coordination cost associated with cooperation of large number of participants, and by Gilman et al. [24], and Kempkey et al. [29] for the case of the La Plata, transaction costs embedded in the grand coalition arrangements and absence of proper institutions to secure country interests may impede cooperation.

Sharing international water has been a subject in the literature that demonstrates the dominance of cooperative behavior over non-cooperative behavior of the riparian states. On the other hand, many real-world efforts to support cooperation in international water shared basins do not yield results on the ground, which demonstrate the need for modifying cooperative arrangements. Examples include the Nile Basin Initiative (NBI) which, for more than a decade, has not moved the riparian states beyond the status quo despite of actual attempts to demonstrate to the riparian states the potential for cooperation and the significant potential of "benefit transfer" embedded in the cooperative arrangements [15,50,59].

In an early attempt to explain the reason for the rejection of a cooperative solution to an international water game, Dinar and Wolf [17,18] evaluated a possible water trade in the Nile Basin and the Jordan Basin between Egypt, Israel, and the Palestinian Authority. While the "cooperative dividend" was high and complied with stability, and individual and group rationality conditions, Egypt would reject the proposed solution because the incremental gains from cooperation do not reflect the role Egypt plays in that game [17] and based on the relative distributional gain among the other entities involved [48].

As with any other economic good, countries have the potential of allocating water to areas in which it produces the highest economic return [45]. Market-related policy instruments, if well designed and implemented, encourage economic agents to undertake conservation and protection efforts to accommodate changing patterns in society's demand [20]. Studies show that the problem of burgeoning water scarcity and deteriorating water quality could be solved if water is properly treated as an economic good [49]. In a regional setting, water markets are also used to promote economic development and political stability [55], increase income and crop yield [38], and improve income distribution [45].

Water markets are designed to address a wide variety of economic and ecological issues [17,9,7,11]. For the Nile River, in particular, the potential benefits of establishing regional water markets have been considered for long time [51,58]. Whittington et al. [55] underscored that trading water rights would be the single most notable innovation that could be introduced in a new agreement on Nile water. In addition, Abate [2] proposed a high economic value of trading water among the eastern and