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What does it take to collaborate over transboundary groundwater?

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Groundwater provides critical irrigation supply for farmers throughout the world, but sustainable groundwater management has often been elusive. This is especially true for transboundary aquifers which, unlike shared surface waters, are seldom regulated by international treaties. Given the widespread depletion of groundwater resources in arid and semi-arid regions and the intimate reliance on farming around the world, it is imperative that we develop improved understanding of the requirements for transboundary cooperation to emerge over shared aquifers. Building on existing theories on the management of shared resources, we hypothesize that the tendency of countries to enter into a multilateral groundwater sharing agreement depends largely on the following characteristics of the system: (1) risk of resource depletion, (2) shared objectives for aquifer management, (3) uncertainty and information sharing, and (4) trust between international partners. We evaluate these hypotheses using a coupled hydrogeologic - game theoretic model, which we apply to the Geneva aquifer (France and Switzerland) — one of the few current cases of successfully implemented international groundwater treaty. We design a two player, two-stage game in which each country makes a decision whether or not to enter into a water sharing agreement with the other country, incorporating the above characteristics into the expected utility function within the game. We analyze the game to test the sensitivity of the outcome across a range of possible scenarios, using the case of the Genevois aquifer to explore why collaboration initially failed (c. 1970) but ultimately succeeded (c. 1980). We demonstrate that the game adequately reproduces the trajectory (failure and success) of water sharing of the Genevois aquifer, and that the distinction between failure and success was related to characteristics (1)-(3). Although both parties in the agreement exhibited exceptional communication and trust, we further show via our model that a lack of trust between parties would have unlikely resulted in collapse of the agreement. We conclude by discussing a range of possible approaches to overcoming the four barriers described above. This research highlights areas of pragmatic concern for any state or country with a stake in a transboundary aquifer and how they may approach multilateral agreements, as well as directions for future research to encourage sound governance of transboundary groundwater.