

John Nash and his wife [died yesterday](#) in a cab crash while returning from a trip to Norway to receive a major mathematical prize. He is best known to the public because of the movie “A Beautiful Mind”, which described his struggle with mental illness. His concept of the Nash Equilibrium is basic to a great deal of economic theory. It also has a lot to tell us about environmental issues.

The fundamental idea is very simple. Consider a situation where a finite number of players (individuals, companies, countries) each has a finite number of possible strategies. The combination of strategic choices made by these players determines the payoff to each of them. Nash proved that there is always a defection-proof set of strategies. That is, knowing the choices made by the other players, no player would ever want to change its own strategy.

“Equilibrium” sounds like a good thing, but that is not necessarily so. Consider the “tragedy of the commons.” A contemporary example is provided by groundwater. Imagine a group of farmers in a drought who share an aquifer — not hard to do, since there are any number of such farmers within a few hours drive from my house. The farmers have a choice between zero, low, medium, and high use of groundwater. It’s easy to see that pumping the aquifer dry is a Nash equilibrium. Suppose all the other farmers are making high use of groundwater. For any one farmer to adopt a different strategy would be costly — less water for irrigation — and do almost nothing to preserve the ground water. Hence, they will all continue a high level of pumping, even though they might all be better off if they each engaged in only a medium or low amount of pumping, leaving more water for all of them in the future.

If we want to avoid this destructive outcome, we need to change the payoffs of the players. Regulation is one way of doing that — the high pumping strategy becomes unappealing it carries with a large government fine. Even without formal regulation, if only a small group of farmers is involved, they may be able to police each other and impose informal sanctions for excessive pumping. Or the farmers might be able to enter into a binding contract with each other to control pumping. Now the equilibrium is, if not beautiful, at least a lot prettier than the tragedy of the commons.

It’s not hard to see that many environmental problems have this structure, from water pollution to fisheries conservation to global climate change. In the absence of some scheme of governance, the Nash equilibrium is an ugly one. But environmental regulation can shift the equilibrium in a more beneficial direction.

Nash’s work has led to many further advances in game theory which have helped illuminate

problems of environmental governance. We regret his passing while paying tribute to his contributions, not only to the abstract world of mathematics, but to the practical problems of a crowded planet.