Assessing the Utility of Rational Choice Theory in Least Developed Countries

https://www.e-ir.info/2016/07/08/assessing-the-utility-of-rational-choice-theory-in-least-developed-countries/

GEORGE SARIAK, JUL 8 2016

Better than Rational: Assessing the Utility of Rational Choice Theory in the Analysis of Development Dilemmas in the Least Developed Countries

*"What is common to the greatest number has the least care bestowed upon it. Everyone thinks chiefly of his own, hardly at all of the common interest."**[1]*** – Aristotle

Elinor Ostrum has argued "economics is a different type of science, based on the power of deductive theories derived from a minimum number of basic assumptions about the individual and how individuals are related to one another and a physical world."[2] The ambiguous concept of *rationality* is the central assumption of *rational choice theory* (RCT) a deductive theory that has defined mainstream economic and political theory over the last few decades. RCT has its basis in neoclassical economics, which in itself is greatly varied but is based on some key assumptions that form the basis of RCT. Neoclassical economics asserts an "emphasis on rationality and the use of utility maximization as the criterion of rationality", an "emphasis on equilibrium of equilibria" and a disbelief of "uncertainty" or at least "fundamental uncertainty."[3] *Rationality* and *utility maximization* are central to RCT as it assumes that individuals act rationally to "make themselves as well off as possible, given their tastes and the resources and knowledge that they possess."[4] The utility maximization aspect of RCT cannot always be thought of as wealth as an individual may exhibit altruistic behaviour in order to serve their self-interest, such as donating money to for the self-gratification of being charitable. Therefore "the minimal assumption required for this economic theory of human behaviour is simply that identifiable self-interest motivates the choosing individual."[5]

The use of RCT for formulating an understanding of the decision making process involved in various development dilemmas in low-income countries has been instrumental to policy makers and academics alike as it can "predict and explain actions."[6] RCT "informs individuals or, potentially, collectivities of individuals, about how best to achieve objectives-whatever these may be" thus RCT can be expressed as a prescriptive theory.[7] When exploring developmental dilemma in low-income countries "by assuming that everyone is rational" RCT "specifies the best strategy that every actor could adopt in situations characterized by particular structures."[8] One way in which RCT can be employed in international development studies today is to inform the understanding behind the decision making process of *collective action* pertaining to developmental dilemmas specifically common pool resources (CPRs).

CPRs "are systems that generate finite quantities of resource units so that one person's use subtracts from the quantity of resource units available to others."[9] CPRs are "sufficiently large that multiple actors can simultaneously use the resource system and efforts to exclude potential beneficiaries are costly."[10] CPRs are highly comparable to "public goods" which are "goods that everyone in a society can access."[11] However, unlike public goods, CPRs are *rival goods*, as "each person's use diminishes the enjoyment or advantage that the pool can provide to others and overuse can lead to its complete destruction."[12] What constitutes a CPR is vast and varied. The first distinction within CPRs are whether they are "provided by nature" such as "pastures" or if they are "constructed by humans" such as "roads".[13] Another important distinction refers to whether the "CPRs are renewable" such as "fish stocks" or "non-renewable" such as "minerals".[14] CPRs can also be distinguished between as local or global, for example

a bridge in a city is a CPR but so is the lower earth orbit in outer space. Certain CPRs given an "advantage" such as "catching fish for nutrition" whereas others "mitigate undesirable effects such as "the atmosphere absorbing greenhouse gases such as CO2."[15] The non-excludability and rivalrous nature of CPRs opens them to the issue of misuse and *free-riding*. Garrett Hardin's work on the *tragedy of the commons* purports the exploitation of CPRs "will occur in highly valued, open-access commons where those involved and/or external authorities do not establish an effective governance regime."[16] This open access commons can range from *domestic* small fisheries to the *international* high seas and outer space. The tragedy of the commons theory coincided "with the growing use of game theory" thus "appropriation from common-pool resources is frequently represented as a one-shot or finitely repeated, Prisoner's Dilemma game."[17] The Prisoner's Dilemma explores how the rationality of actors' decision-making effects their decisions in the use of CPRs. The Prisoner's Dilemma "is often used to describe the circumstances in which cooperative behaviour does not occur despite being in the collective interests of a group of people."[18]

[19]

Both the Prisoner's Dilemma and the larger tragedy of the commons theory illustrate that "a rational individual strategy may lead to collectively irrational outcomes."[20] Therefore "rational choice theory- helps us understand humans as self-interested, short-term maximizers" and how this can have negative effects on development.[21] Although Hardin's article was published in 1968, and various measures have been suggested and implemented to better manage CRPs, many economists contend the tragedy of the commons theory "still applies in many situations today."[22] This essay explores how RCT can inform our understanding of recent developmental dilemmas in developing countries and that RCT is an important part of understanding and mitigating the tragedy of the commons involving the fisheries of the developing countries.

Writing in 2016 Margaret Wilson, Tyler Pavlowich and Michael Cox argue "small-scale fisheries employ 50 of the world's 51 million fishers and are responsible for over half of the annual marine catches around the globe."[23] Furthermore, "the majority are located in developing countries where limited resources and a high local dependence on the natural resource make effective management both more challenging and more critical."[24] The fisheries of developing countries "play a crucial role as a source of livelihoods, food security and income for millions of people around the world."[25] However recent empirical studies show that "the average state of global fish stocks is poor and declining."[26] A recent study by Costello et al., analyses different scenarios for the management of the world's

fisheries and the unadulterated rational exploitation of fisheries termed the *business-as-usual* management strategy "projects further divergence and continued collapse for many of the world's fisheries."[27] Boris Worm states that of the "4,714 fisheries assessed in the year 2012, only 32% remained at or above the biomass target that supports maximum sustainable yield (BMSY) whereas 68% have slipped below that critical threshold."[28] Staggeringly, "only 35% of stocks are currently fished at a level that would allow for recovery toward the BMSY target."[29] This means that "under current management, 88% of stocks would be overfished and well below their target biomass in 2050."[30]

Ostrum argues "to use rational choice as a theory of advice, one has to use it to predict and explain actions."[31] The developmental dilemma that is facing developing countries in this area is evident. The actions of why fishermen overfish in their fisheries eliminating species depleting the health of their own stock, hampering their own futures can be easily understood with knowledge of RCT. Fishermen may very well be aware of long-term impacts of their overfishing, however fishermen do not have an incentive to think of other fishermen in their fishery as those "who limit their catch lose if others do not."[32] Conversely as the previous evidence has shown "if no one limits his catch, everyone loses."[33] The payoffs attributable to the choice of whether to cooperate can be ranked from 1-4 with '1' being the most desirable outcome and '4' the least as illustrated in the previous table of a Prisoner's Dilemma. The table below has been adapted to show how rational choice leads fishermen to choosing a less than equitable outcome for all.

Rational choice theory suggests by not limiting your catch or by pursuing a self-interested uncooperative action will mean "a more favorable outcome regardless of the choice made independently by the other party."[34] A fisherman that does not limit their catch can incur the best case scenario from this CPR dilemma which would be *free-riding* from the benefit of another fisherman limiting their catch. Although the fisherman misses out on the mutually beneficial scenario of both parties cooperating, he/she is ultimately protected from pursuing a cooperative action whereas other fishermen defect. Soroos notes "ironically, when both actors choose to defect on the basis of this

logic, the outcome is only the third most desirable one for each.[35]" Ultimately, the Prisoner's Dilemma shows that "rational calculations of self-interest result in a sub-optimal outcome for the two parties" which has been the case of fisheries alongside other CPRs in developing countries.[36] "The free rider proposition asserts that in a wide range of situations, individuals will fail to participate in collectively profitable activities in the absence of coercion or individually appropriable inducement."[37] Therefore RCT gives developmental scholars the understanding of how best to prevent self-deprecating rationalism, prohibit free-riding and encourage interactions between actors to produce mutually beneficial outcomes for all parties involved in relation to CPRs.

The economic theory of *collective action* is famously discussed in *the Logic of Collective Action: Public Goods and the Theory of Groups* by RCT theorist Mancur Olson who suggests that actors "will not act to advance their common or group objectives unless there is coercion to force them to do so, or unless some separate incentive, distinct from the achievement of the common or group interest, is offered to the members of the group."[38] In addition to this, Olson theorized that the possibility that "large groups form organizations to further their common goals" was highly unlikely.[39] Ostrom notes that Olson made a "provocative assertion" that "challenged a cherished foundation of modern democratic thought that groups would tend to form and take collective action whenever members jointly benefitted."[40] This RCT approach to collective action problems is known as the *zero contribution thesis*. Ostrom argues the zero contribution thesis "contradicts observations of everyday life" and it is evident that "empirical studies have posed a severe challenge to the zero contribution theory."[41] Transnational cooperation involving CPRs has invalidated Olson's assertion on more than one occasion. The formation of the Arctic Council, adherence to the UN Conventions on the Laws of the Sea, Kyoto Protocol are some examples to name a few. Ostrom offers an alternative to Olson's theory of collective action, which is not to say the Ostrom's *contribution thesis* approach is a departure from RCT. Shrestha argues Ostrom's work is still based on the "underlying assumption that individuals are rational actors who behave in their best self-interest to maximise material economic gain", therefore "Ostrom's work remains affiliated to rational choice perspective."[42]

Drawing on RCT and Hardin's tragedy of the commons, Ostrom understood how rationality has a tendency to produce irrational outcomes, central to the nature of the developmental dilemmas of CPRs in developing countries. RCT has therefore informed the ways in which self-interested rationality can be averted when it comes to promoting collective action toward sustainable development of CPRs in developing countries. As it stands, "Ostrom's design principles and the theory of common pool resource are becoming increasingly popular in the analysis of CPR and being used by many international organisations."[43] Hardin's solutions to an overexploitation of the commons were an "oversimplification" of the issue as he suggested "only two state-established institutional arrangements—centralized government and private property—could sustain commons over the long run."[44] Dietz, Ostrom and Stern argue that Hardin "missed the point that many social groups, including the herders on the commons that provided the metaphor for his analysis, have struggled successfully against threats of resource degradation by developing and maintaining self-governing institutions."[45]

Leaving the example of fisheries for the time being, anthropogenic climate change and environmental degradation are two areas of global or at least transnational concern that relate to CPR management. Although climate change in expressed as a global concern, it is only a global problem in the sense that issues are transboundary in nature. Neither the blame nor the implications of anthropogenic climate change are shared by all states equally. More often than not, the most developed countries are the greatest causes of anthropogenic climate change whereas the least developed countries play the smallest role in the blame yet are faced with the greatest extent of the effects. "The top 4 emitting countries/regions, which together account for almost two thirds (61%) of the total global CO2 emissions are China (30%), the United States (15%), the European Union (EU-28) (10%) and India (6.5%)."[46] These states are the greatest emitters of harmful greenhouse gasses (GHG) which cause global warming which leads to ocean thermal expansion and glacial melt, directly impacting sea level rise. The small islands of Tuvalu, Kiribati, Maldives and the Marshall Islands have "particularly strong incentives to have CO2 emissions reduced to prevent global warming because rising sea levels represent an existential threat to them."[47] However, since all states are unitary rational actors that serve their own self-interest, many developed industrial states by the logic of the RCT model should see that increasing their own economic security through increases in economic output and subsequent emissions is the rational choice.

Therefore “when nation states have the choice of contributing to a global effort to reduce GHG emissions, they face a strong collective action problem.”[48] As individual states seek to increase their individual economic security they release more harmful emissions that decrease global environmental security and future economic security. As in the Prisoner’s Dilemma, if a state decides to recognise the long-term impacts of climate change and decrease its emissions, other states may defect thus free-ride by pursuing a more robust and industrialised economy that generates greater levels of emissions whilst the cooperative state takes steps to cut emissions. Ostrom illustrates that “the conventional theory of collective action predicts, however, that no one will voluntarily change behavior to reduce energy use and GHG emission.”[49] However this has largely not been realised, the recent Paris Agreement that stemmed from the United Nations Framework Convention on Climate Change illustrates how successful collective action will be taken to mitigate a CPR developmental dilemma. The agreement “requires all countries—developed and developing—to make significant commitments to address climate change.”[50] The “countries responsible for 97 percent of global emissions submitted their climate commitments prior to the conference” now “these commitments will now be enshrined in the coming months once countries formally join the agreement.”[51] The Paris Agreement “contains provisions to hold countries accountable to their commitments and mobilize greater investments to assist developing countries in building low-carbon, climate resilient economies.”[52] Furthermore, “the new transparency regime is legally binding” and provides a mechanism for monitoring as “countries must report their greenhouse gas inventories and progress towards their emissions reduction targets every two years.”[53]

In light of this RCT has come in to question as certain actors “may often be better than rational.”[54] This is why Ostrom advocates “developing second-generation models of rationality.”[55] The “weakness of empirical support for the conventional theory of collective action” is justification for this as the results showed greater levels of cooperation than previous academics would have believed.[56] Ostrom argues that “reciprocity, reputation, and trust can help to overcome the strong temptations of short-run self-interest.”[57] The first way this is achieved is through communication “allows individuals an opportunity to make conditional promises to one another and potentially to build trust that others will reciprocate.”[58] Ostrom argues that “communication facilitates cooperation” by “transferring information from those who can figure out an optimal strategy to those who do not fully understand what strategy would be optimal”, “exchanging mutual commitment”, “increasing trust and thus affecting expectations of others’ behaviour”, “adding additional values to the subjective payoff structure”, “reinforcement of prior normative values”, and by “developing a group identity.”[59] Secondly “changing the rules of a game or using scarce resources to punish those who do not cooperate” can be effective in fostering cooperative arrangements.[60] It is clear that “most robust and long-lasting common-pool regimes involve clear mechanisms for monitoring rule conformance and graduated sanctions for enforcing compliance.”[61]

Revised notions of RCT and its place in collective action can have a huge impact on policy implications for the management of CPRs in developing countries. With this in mind, returning to the case study of fisheries RCT enlightens our understanding that the “current management practices are not just hurting biodiversity and our food supply; they also make poor economic sense.”[62] RCT shows that “the highly competitive open-access nature of many fisheries” is what “incentivizes overfishing because individual fishers are not guaranteed to see the benefits of leaving fish in the water.”[63] With RCT in mind new strategies have been formed to ensure MSY of fisheries in developing countries, most popular of all is the implementation of Rights-Based Management (RBM) which is “the allocation of rights to fishers, fishing vessels or fishing organisations.”[64]

RBM programmes consist of either *catch-based rights*, *input-based rights* or *area-based rights.* Catch-based rights use “a scientifically determined total safe catch level or Total Allowable Catch (TAC) for a fishery is divided and assigned to entities in the fishery.”[65] Input-based unlike the catch-based rights do not “focus on the catch removed from the ocean” but instead “measure and regulate the size and effort of the total fleet within a fishery” whether it be through the how long is spent at sea, the total number of boats or the amount of equipment used.[66] Area-based programmes “assign rights to a defined special marine zone and there are many examples of small-scale fisheries in developing countries that are managed under this type of system commonly referred to as Territorial Use Rights in Fisheries.”[67] It is evident that “fisheries managed with the objective of maximising economic returns should become rights-based” as “such systems can generate significant increases in wealth and positive incentives for sustainability.”[68] In line with Ostrom’s interpretation of averting the tragedy of the commons “case studies have

documented that when secure and durable rights are assigned, fishers are more willing to support measures to protect the health of the fishery and even invest in conservation activities."[69] RBM "incentivizes rebuilding of depleted resources because a larger stock makes a given share more valuable and pays greater dividends."[70] Therefore it can be argued that RBM has helped to "eliminate the 'race to fish' in fisheries whose objective is to create an economically efficient fishery." [71]

Developing counties that are not using their fisheries sustainably can learn from the RCT model and understand the way fishermen act in these situation. Ultimately, to move beyond rationality and successfully prevent a 'race to fish' requires successful management strategies to encourage cooperation in what is essentially a classic commons dilemma.[72] Already there have been cases with RBM strategies have proved to be a resounding success, therefore limiting access and providing fishermen incentives to cooperate will curb the irrational outcome of rational actors overexploiting this invaluable resource.

References

Aristotle, *The Politics, And The Constitution Of Athens*, ed. by Stephen Everson (Cambridge, UK: Cambridge University Press, 1996) Arthur, Robert, David Agnew, Carl Harris, Tim Davies, Suzannah Walmsley, Francisco Leotte and Tom Peatman, *Towards sustainable fisheries management: international examples of innovation* (London: Marine Resource Assessment Group, 2010)

Baerlein, Tanja, Ulan Kasymov and Dimitrios Zikos, 'Self-Governance and Sustainable Common Pool Resource Management in Kyrgyzstan', *Sustainability*, 7, (2015), 496-521

Colin-Castillo, Sergio and Richard T. Woodward, 'Measuring the potential for self-governance: an approach for the community-based management of the common-pool resources', *International Journal of the Commons*, 9.1 (2015) 281–305

Cosmides, Leda, and John Tooby, 'Better than Rational: Evolutionary Psychology and the Invisible Hand', *The American Economic Review*, 84.2, (1994), 327-332

Costello, Christopher, Daniel Ovando, Tyler Clavelle, C. Kent Strauss, Ray Hilborn, Michael C. Melnychuk, Trevor A. Branch, Steven D. Gaines, Cody S. Szuwalski, Reniel B. Cabral, Douglas N. Rader and Amanda Leland, 'Global fishery prospects under contrasting management regimes', *Proceedings of the National Academy of Sciences of the United States of America*, 113.18 (2016) 5125-512

Dequech, David, 'Neoclassical, mainstream, orthodox, and heterodox economics', *Journal of Post Keynesian Economics*, 30.2 (2007) 279-302

Dietz, Thomas, Elinor Ostrom and Paul C. Stern, 'The Struggle to Govern the Commons', *Science*, 302, (2003) 1907-1912

Edenhofer, Ottmar, Christian Flachsland, Michael Jakob, and Kai Lessmann, *The Atmosphere as a Global Commons: Challenges for International Cooperation and Governance*, (Berlin: Mercator Research Institute on Global Commons and Climate Change Working Paper 1, 2013)

Fear, Josh and Richard Denniss, *Zero-sum game? The human dimensions of emissions trading*, (Australia: The Australia Institute Paper No.2, 2009)

Græger, Nina, 'Environmental Security?', *Journal of Peace Research*, 33.1 (1996), 109-116

Journal, 9.3 (1990) 619-639

Lowenberg, Anton D., 'Neoclassical Economics as a Theory of Politics and Institutions', *Cato Journal,* 9.3 (1990)

619-639

National Resource Defense Council, 'The Paris Agreement on Climate Change', National Resource Defense Council Issue Brief, (2015) https://www.nrdc.org/sites/default/files/paris-climate-agreement-IB.pdf (accessed 29th April 2016).

Olivier, Jos G.J., Greet Janssens-Maenhout, Marilena Muntean and Jeroen A.H.W. Peters, *Trends in global CO2 emissions: 2015 Report*, (The Hague: Netherlands Environmental Assessment Agency, 2015)

Ostrom, Elinor, 'A Behavioral Approach to the Rational Choice Theory of Collective Action Presidential Address, American Political Science Association, 1997'*, American Political Science Review*, 92.1 (1998) 1-22

Ostrom, Elinor, 'Collective Action and the Evolution of Social Norms', *The Journal of Economic Perspectives*, 14.3 (2000), 137-158

Ostrom, Elinor, 'Polycentric systems for coping with collective action and global environmental change', *Global Environmental Change*, 20 (2010) 550–557

Ostrom, Elinor, 'Review: Rational Choice Theory and Institutional Analysis: Toward Complementarity', *The American Political Science Review*, 85.1 (1991), 237-243

Ostrum, Elinor, 'Common-Pool Resources and Institutions: Toward a Revised History' in the *Handbook of Agricultural Economics*, 2.3 (2002) ed. by Bruce L. Gardner & Gordon C. Rausser

Purcell, Steven W., and Robert S. Pomeroy, 'Driving small-scale fisheries in developing countries', *Frontiers in Marine Science*, 2.44 (2015) 1-7

Shrestha, K.K., *Collective Action and Equity in Nepalese Community Forestry, PhD Thesis* (Sydney: The University of Sydney, Sydney, 2005)

Soroos, Marvin S., 'Global Change, Environmental Security, and the Prisoner's Dilemma', *Journal of Peace Research*, 31.3 (1994), 317-332

Wilson, Margaret, Tyler Pavlowich and Michael Cox, 'Studying common-pool resources over time: A longitudinal case study of the Buen Hombre fishery in the Dominican Republic', *Ambio*, 45 (2016) 215-229

World Wildlife Fund, Rights Based Management: Conserving Fisheries. Protecting Economies (2012) http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_rightmanagement_brochure_final.pdf (accessed 2nd May 2016).

Worm, Boris, 'Averting a global fisheries disaster', *Proceedings of the National Academy of Sciences of the United States of America*, 113.8 (2016) 4895–4897

Footnotes

[1] Aristotle, *The Politics, And The Constitution Of Athens*, ed. by Stephen Everson (Cambridge, UK: Cambridge University Press, 1996) p.33.

[2] Elinor Ostrom, 'Review: Rational Choice Theory and Institutional Analysis: Toward Complementarity', *The American Political Science Review*, 85.1 (1991), 237-243 (p.237).

[3] David Dequech, 'Neoclassical, mainstream, orthodox, and heterodox economics', *Journal of Post Keynesian Economics*, 30.2 (2007) 279-302 (p.280).

[4] Anton D. Lowenberg, 'Neoclassical Economics as a Theory of Politics and Institutions', *Cato*

Journal, 9.3 (1990) 619-639 (p.621).

[5] Ibid.

[6] Ostrom, 'Review: Rational Choice Theory and Institutional Analysis: Toward Complementarity', p.240.

[7] Ibid., p.238.

[8] Ibid.

[9] Elinor Ostrum, 'Common-Pool Resources and Institutions: Toward a Revised History' in the *Handbook of Agricultural Economics*, 2.3 (2002) ed. by Bruce L. Gardner & Gordon C. Rausser (p.1317).

[10] Ibid.

[11] Josh Fear and Richard Denniss, *Zero-sum game? The human dimensions of emissions trading* , (Australia: The Australia Institute Paper No.2, 2009) p.16.

[12] Ibid.

[13] Tanja Baerlein, Ulan Kasymov and Dimitrios Zikos, 'Self-Governance and Sustainable Common Pool Resource Management in Kyrgyzstan', *Sustainability*, 7, (2015), 496-521 (498).

[14] Ibid.

[15] Ibid.

[16] Elinor Ostrum, 'Common-Pool Resources and Institutions: Toward a Revised History', p.1317.

[17] Ibid., p.1318.

[18] Fear and Denniss, p.18.

[19] Marvin S. Soroos, 'Global Change, Environmental Security, and the Prisoner's Dilemma', *Journal of Peace Research*, 31.3 (1994), 317-332 (p.326).

[20] Sergio Colin-Castillo and Richard T. Woodward, 'Measuring the potential for self-governance: an approach for the community-based management of the common-pool resources', *International Journal of the Commons*, 9.1 (2015) 281–305 (p.284).

[21] Elinor Ostrom, 'A Behavioral Approach to the Rational Choice Theory of Collective Action Presidential Address, American Political Science Association, 1997'*, American Political Science Review*, 92.1 (1998) 1-22 (p.2).

[22] Colin-Castillo and Woodward, p.282.

[23] Margaret Wilson, Tyler Pavlowich and Michael Cox, 'Studying common-pool resources over time: A longitudinal case study of the Buen Hombre fishery in the Dominican Republic', *Ambio*, 45 (2016) 215-229 (p.215).

[24] Ibid.

[25] Steven W. Purcell and Robert S. Pomeroy, 'Driving small-scale fisheries in developing countries',*Frontiers in*

Marine Science, 2.44 (2015) 1-7 (p.1).

[26] Boris Worm, 'Averting a global fisheries disaster', *Proceedings of the National Academy of Sciences of the United States of America*, 113.8 (2016) 4895–4897 (p.4895).

[27] Christopher Costello, Daniel Ovando, Tyler Clavelle, C. Kent Strauss, Ray Hilborn, Michael C. Melnychuk, Trevor A. Branch, Steven D. Gaines, Cody S. Szuwalski, Reniel B. Cabral, Douglas N. Rader and Amanda Leland, 'Global fishery prospects under contrasting management regimes', *Proceedings of the National Academy of Sciences of the United States of America*, 113.18 (2016) 5125-512 (p.5125).

[28] Worm, p.4895.

[29] Ibid.

[30] Ibid.

[31] Ostrom, 'Review: Rational Choice Theory and Institutional Analysis: Toward Complementarity', p.240.

[32] Colin-Castillo and Woodward, p.282.

[33] Ibid.

[34] Soroos, p.326.

[35] Ibid.

[36] Ibid.

[37] George J. Stigler, 'Free riders and collective action: an appendix to theories of economic regulation',*The Bell Journal of Economics and Management Science*, 5.2 (1974), 359-365 (p.359).

[38] Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups* , (U.S: Harvard University Press, 1965) p.2.

[39] Ibid.

[40] Elinor Ostrom, 'Collective Action and the Evolution of Social Norms', *The Journal of Economic Perspectives*, 14.3 (2000), 137-158 (p.137).

[41] Ibid., p.138.

[42] K.K., Shrestha*, Collective Action and Equity in Nepalese Community Forestry, PhD Thesis* (Sydney: The University of Sydney, Sydney, 2005) p.61.

[43] Ibid.

[44] Thomas Dietz, Elinor Ostrom and Paul C. Stern, 'The Struggle to Govern the Commons', *Science*, 302, (2003) 1907-1912 (p.1907).

[45] Ibid.

[46] Jos G.J. Olivier, Greet Janssens-Maenhout, Marilena Muntean and Jeroen A.H.W. Peters,*Trends in global CO2 emissions: 2015 Report*, (The Hague: Netherlands Environmental Assessment Agency, 2015) p.4.

[47] Nina Græger, 'Environmental Security?', *Journal of Peace Research*, 33.1 (1996), 109-116 (p.112).

[48] Ottmar Edenhofer, Christian Flachsland, Michael Jakob, and Kai Lessmann, *The Atmosphere as a Global Commons: Challenges for International Cooperation and Governance*, (Berlin: Mercator Research Institute on Global Commons and Climate Change Working Paper 1, 2013) p.19.

[49] Elinor Ostrom, 'Polycentric systems for coping with collective action and global environmental change',*Global Environmental Change*, 20 (2010) 550–557 (p.551).

[50] National Resource Defense Council, 'The Paris Agreement on Climate Change', National Resource Defense Council Issue Brief, (2015) https://www.nrdc.org/sites/default/files/paris-climate-agreement-IB.pdf (accessed 29th April 2016).

[51] Ibid.

[52] Ibid.

[53] Ibid.

[54] Leda Cosmides and John Tooby, 'Better than Rational: Evolutionary Psychology and the Invisible Hand',*The American Economic Review*, 84.2, (1994), 327-332 (p.329).

[55] Ostrom, 'A Behavioral Approach to the Rational Choice Theory of Collective Action Presidential Address, American Political Science Association, 1997', p.3.

[56] Ostrom, 'Polycentric systems for coping with collective action and global environmental change', p.551.

[57] Ostrom, 'A Behavioral Approach to the Rational Choice Theory of Collective Action Presidential Address, American Political Science Association, 1997', p.1.

[58] Ibid., p.6.

[59] Ibid., p.7.

[60] Ibid.

[61] Ibid., p.8.

[62] Worm, p.4895.

[63] Ibid., p.4896.

[64] Robert Arthur, David Agnew, Carl Harris, Tim Davies, Suzannah Walmsley, Francisco Leotte and Tom Peatman, *Towards sustainable fisheries management: international examples of innovation* (London: Marine Resource Assessment Group, 2010) p.20.

[65] Ibid.

[66] Ibid.

[67] Ibid.

[68] Ibid., p.9.

[69] World Wildlife Fund, Rights Based Management: Conserving Fisheries. Protecting Economies (2012) http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_rightmanagement_brochure_final.pdf (accessed 2nd May 2016).

[70] Worm, p.4896.

[71] Arthur et al., p.80.

[72] Ibid.

Written by: George Sariak
Written at: Swansea University
Written for: Dr. Gerard Clarke
Date written: May 2016