Use of iterative games for predicting outcomes in Indian climate change policy framework: Case study of National Water Mission and Green India Mission

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ABSTRACT

The Government of India came out with its National Action Plans to combat climate change in 2008. The policies spanning the Eleventh and Twelfth Plans are expected to reach their outcomes by the year 2020. The goals have been documented in eight missions related to natural resource management and adaptation strategies headed by the related Ministries. We attempt to predict the likely outcomes of the policies in the eight action plans using Predictioneer's Game© and trying to identify the relevance of the political landscape and governmental as well as non-governmental actors in policy decisions

Keywords: Climate Change, Policy, India, Predictioneer's Game©, Stakeholders

INTRODUCTION

In recent years, a broad consensus has emerged in the scientific community that the current climate change is indeed anthropogenic. It is also agreed that virtually all of human society and global ecology is being affected. Agriculture loss, outbreak of diseases, loss of livelihoods and extinctions are just a few of the consequences of these unprecedented weather fluctuations. (IPCC SPM, 2014)[9]

While developed economies like that of Europe and the US are better equipped to combat climate change impacts, developing economies like that of India still need to develop skills/knowledge of experts to face this. A holistic research that can be transformed for remediation of on-ground issues that developing countries face is necessary. The urgency also arises from the fact that the demographics of India are inclusive of the second most populous country in the world containing 17.5% of the world's population, with over 1.21 billion

people (2011 census), and projected to be the world's most populous country by 2025, surpassing China by its population reaching 1.6 billion by 2050, making it even more vulnerable to climate change impacts. (US Census Bureau, 2011)[32]

Agriculture in the predominantly agrarian India society, with 70% of the population almost completely dependent on it, has of lately shown a continuous decline in the share of gross domestic product (GDP) even though spatially, it still remains the most widespread economic pursuit, claiming more than 40% of the country's total area (MoEF Executive Summary to UNFCCC, 2012)[16]. Agriculture will still continue to be important in India's economy in the years to come notwithstanding the secular decline in it's pro rata contribution to GDP. It is well known that agriculture would also be one of the most vulnerable areas of human activity to climate change. (Fischer et al, 2002)[5]

India's response to climate change has been mainly shaped by its participation in the international negotiations under the UNFCC in the last few decades. This has enabled India to form its stance in dealing with the domestic realities of climate change, which in turn influences the international scenario, where India - along with countries like Brazil and China - are major players in evolving global strategies against climate change (Goritz, 2013)[6]. India articulated its position internationally such as the Heilingendamm (2006) declaration when then Prime Minister Dr. Singh declared per capita emission in India would never exceed those of the developed west.

Subsequently, India formed the PM's advisory Council on Climate Change in 2007 to aid in preparation of its policy positions and its response on the ground. This along with various national level ministerial consultations and domestic climate change assessment studies resulted in the formation of the National Action Plan on Climate Change (NAPCC) in June 2008, revised in later years. The NAPCC charts eight missions - Solar Mission, Enhanced Energy Efficiency, Sustainable Habitat, Water Mission, Sustaining the Himalayan Ecosystem, "Green India", Sustainable Agriculture, and Strategic Knowledge for Climate Change, along with ongoing initiatives on Power Generation, Renewable Energy and Energy Efficiency, implemented and monitored by the respective ministries (NAPCC Mission Document, 2008)[17].

The NAPCC directed the Indian states to come up with their own State Action Plans on Climate Change (SAPCC) in 2010 (NAPCC Mission Document, 2008)[17]. Currently 3 state plans are under consideration, 9 have been endorsed and 1 has been implemented (MoEF website, 4/3/14), after approval from the Prime Minister's Council on Climate Change. Spanning across the Eleventh and Twelfth Plans, these missions were estimated to cost

approximately `2.3 trillion by the Government of India (Pahuja et al, 2014)[21] in the Twelfth Plan (2012-2017) alone. They give a broad outline to natural resource management in India by directing an intensive research into the existing situations in the respective mission domains. This further includes guidelines to formulate effective policies and facilitate its implementation through expert consultation and stakeholder dialogues thus ensuring successful continuity of the projects in the coming years.

Case Study

For the present National Water Mission (NWM) and Green India Mission (GIM) under the NAPCC by the Government of India are chosen as case studies for trying out the application of an iterative game model to predict the outcome.

The main interest in the former mission arises from the fact that water resources will be most crucially affected by the impending consequences of climate change. The Indian economy relies heavily on water for its power generation projects, sectoral requirements of agricultural fields and industries, as well as user demands from urban and rural households (Planning Commission, 2011)[22]. The government already spends most of its revenue for evolving efficient management practices for its natural resources and hence there is a need to evaluate the policy frameworks in place to ensure realizing its full potential. The response of this mission is primarily adapting to climate change or at least preparing to adapt to it.

GIM is probably the most significant in terms of emission reduction and may be the only one that mitigates by carbon removal from the atmosphere. It recognizes the serious impact that climate change has on the distribution, type and quality of natural biological resources of India and livelihoods of people associated to it.

Why Policy Evaluations and Prediction?

In spite of the fixed goals and strategies that the respective ministries have brought out as the solution to deal with the potential climate change risks, criticisms on the defined scope and cost effectiveness has been raised by many experts (Byravan and Rajan, 2012)[2].

The National Water Mission, among the goals to be achieved, mentions a need for 'Conservation by reducing Evaporation', at an estimated cost of `5 billion (National Water Mission Revised Draft, 2009)[19]. However the methodology to be followed in achieving this goal is not elaborated upon nor has a budgetary support for such an effort been provided so far. More importantly the Mission plan is silent on where any of the funds are going to be

sourced from. Thus, it is apparent that what eventually will be funded and implemented depends on the negotiations between the stake-holders at different levels of governance and non-governmental players.

Similarly the mission document ignores the influence of already existing practices – formal as well as informal - in water resource management such as water markets at local village levels (Manjunatha et al., 2009; Varughese, 2013)[10, 33] that could impact the water pricing scheme at the center, or the consequences of river interlinking projects that could threaten the very river basin (Iyer, 2012)[23]. It is further unclear whether these strategies of the mission comply or clash with the existing National Water Policy or National Water Framework Act[20].

For a resource as critical and crucial as water, any misdirection or misapprehension of facts leading to erroneous policy could pose serious losses across sectors and bring down the overall quality of life for its citizens. Water requirements for the nation are estimated to increase by ~120% by 2050 from the current rate and to facilitate which India will need to harness an additional of 475-950 km^3/yr over the present availability of ~500 km^3/yr (Gupta and Deshpande, 2004)[7]. This calls for immediate attention to water policies and management in light of population growth as well as climate change.

Similarly, the mission which focuses on afforestation i.e.; the National Mission for a "Green India" shows certain complacencies that may be problematic to other aspects of natural resource management. The goals meant to be achieved by the GIM include enhancing carbon sinks in sustainably managed forests and other ecosystems, adaptation of vulnerable species/ecosystems to the changing climate; and adaptation of forest-dependent communities, with a total budget of `46,000 crores to implement it (MoEF, 2010)[18]. Even though the reform agenda if implemented would improve governance the mission is a framework with insufficient details for implementation. Hence in spite of being one of the world's biggest afforestation programs, there seems to be little innovative and technical input into the afforestation project (Ravindranath and Murthy, 2010)[24].

The main limitation for the Government is a lack of understanding on whether the charted mission goals are likely to achieve its full potential in the given time period or not. This is where prediction can be a science to provide a rational basis to the cost-benefit analysis of various policies. Policy prediction can loosen the barriers which are faced during implementation of policies and also pave the way for efficient planning, managing risks, forecasting trends and contingency planning. This however should not be considered as an evaluation in itself, rather policy prediction is a preliminary analysis of actors/stakeholders,

negotiations and the influence of these components in decision making process.

Considering how decision makers put together most of the policies in consultation with other stakeholders related to the issue, game theory presents itself as an apt tool for policy evaluation and prediction, as seen in a recent case study of a coastal policy evaluation in the Netherlands (Hermans et al., 2014)[8]. In fact, ‘‘game theory is used in the study of conflict and cooperation. Concepts of game theory are applied whenever the actions of several agents are interdependent. These agents may be individuals, groups, firms, or any combination of these. The concepts of game theory provide a medium to formulate structure, analyze, and understand strategic scenarios.’’ (Turocy, von Stengel, 2002)[30]

Adding to existing studies that focus on the concepts of equity and co-benefits that drive the NAPCC (Dubash et al., 2013)[3], the game theory prediction model for policy decision making takes into account the approach, dimensions of the issue as well as interactions with respect to the actors involved. Hence policy predictions are no longer to be confined to social sciences but employed to enhance our scientific understanding, especially in environmental concerns (Sarewitz and Pielke Jr, 1999)[27].Most of the earlier prediction models were based on a Two-stage model, Control-Maximization model, Policy Change Maximization model or an integration of all these mathematical models. The Control Maximization represents the view that politics are primarily power driven, and the second, Policy Maximization, policy driven. In the static model (the Two-Stage), network relations are empirically investigated as in other policy-network models and used as a benchmark for evaluating the dynamic models. (Stokman, 1998)[29]. Later on game theory evaluation using multiple equilibria was found more pertinent for policy studies, as seen in a study of the Kyoto Protocol which was done based on the benefits and problems of international cooperation on environment concerns, the importance of studying coalitions between countries and influence of payoff on their interests that determine their final stance towards such a global policy..(Finus, 2002)[4].

Mesquita’s Predictioneer’s Game© is one such integrated model analysis tool, available as an online software that uses Bayesian updating and iterative analysis to come up with the player payoffs and player utilities to forecast the most opted policy position that improves the welfare of the stakeholders (Mesquita, 2010)[14], that has been used to demonstrate the efficacy of policy prediction. The inputs are based on structured model inputs that enable attributing scores to the stakeholders on features like influence, policy position, salience, flexibility, fixed position et cetera that shape their decisions towards the policy. The model then runs rounds of negotiation, assuming that self-interest shapes the logic for most action-based

policies. Based on reviews from previous users of this model, 90% accuracy was found on most short term issues (Iran-Iraq relations, efficacy of corporate mergers, to name a few). Accuracy of the model's predictions on long-term global issues like Kyoto Protocol[13] and carbon emissions are yet to be seen, however (Mesquita, 2009)[11].

Policy prediction as a tool could be an active step towards bridging the gap between environmental experts and decision makers, with helpful advice from the experts on carrying discussion with non governmental stakeholders on critical environmental matters in a direction that ensures successful settlement among all parties and policy decision making in an equitable and inclusive manner.

Will the Predictioneer's Game work in the Indian framework?

The question however arises, that given the diversity and complexity in terms of language, culture et cetera in a country like India, if any such effort is fruitful. To address this, two events of environmental consequence was selected from the domain of water conflict and afforestation program in India from the past years, and the Predictioneer's game was employed to see if the predicted outcome matched what really came out in the end.

Coca cola versus the people of Plachimada, Kerala

The long standing dispute between the villagers and panchayat of Plachimada (later on supported the State and Pollution Control Board) is a typical affair of water conflicts over industrial consumption and environmental degradation that in turn affects the local communities. Starting in 2002, the resistance over the Coca Cola plant's functioning and extraction of groundwater found success in 2006 when the plant was shut down permanently in the State(Bijoy CR, 2006)[1].

A game was run to simulate the possible outcomes of the first round of negotiation under the Congress government (2001-2006) and later, the Marxist government (2006-2011) with an issue continuum on whether the plant should be allowed to function with permissible levels of extraction or not. Scores were assigned based on the socio-political standing of various players (villagers, panchayat, Coca Cola) and study of provisions that empowered governance structures (Pollution Control Board, State Government) to take a stand. It was observed that in both games the final prediction was closer to the score that supported the elimination of any groundwater extraction by the Coca Cola plant. A slight difference towards that outcome was however noticed in the two governments; while the former showed scored in the upper range of the score, the latter came in the lower levels. This was also the final outcome of the issue where the local communities along with the authorities were able to

override the Court order to renew license and shut down the factory permanently.

Joint Forest Management (JFM), Andhra Pradesh

The JFM was implemented in Andhra Pradesh as early as 1994 (after being passed in 1992) to empower the very many forest dependent tribal communities. There has been a lot of criticism on the formulation of the JFM across the state, with accusations of deplorable tribal livelihoods and forest degradation arising due to this. (Reddy et al, 2004)[25]

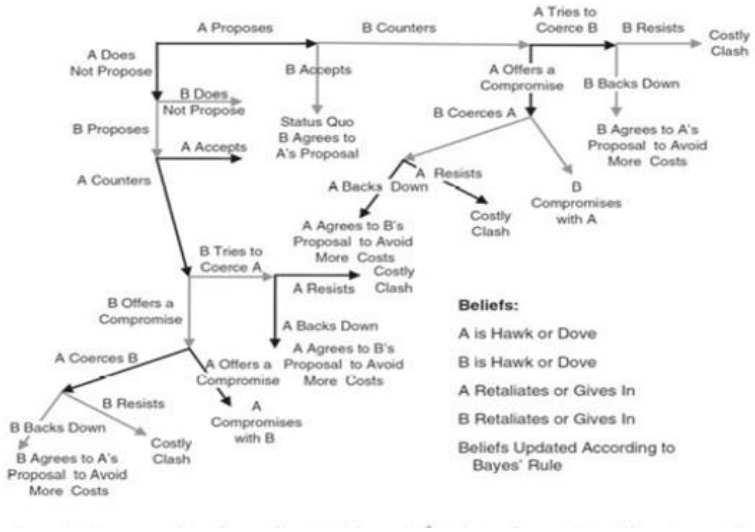
The policy issue that was taken into account to run the game was based on the division of rights and profits among state and tribal communities before the JFM was shaped in its final draft. The parties (State Government, Tribal communities, Forest Department, MoEF, NGOs and Panchayats) were assigned scores based on the core principle of JFM and the gains/profit motives, if any, that makes the player act in favour of the policy. The game result however showed that in spite of JFM coming into play, the State and Forest Department will still hold control of the forests in terms of revenue and structure, pointing to an overall inequity in the program. Recent reviews of the JFM in Andhra Pradesh have showed the same results showing that the policy has not delivered its initial intent of equitable forest management and protection (Saito-Jensen and Jensen, 2010; Saito-Jensen, 2007)[27,26].

It is thus seen in these two cases, with the inputs chosen, the model yields predictions that appear to be in close agreement to what eventually transpired. This gives us some confidence that Predictioneer's Game would be a reasonable choice for predicting climate change policies of India. To summarize, the Predictioneer's Game could thus be a useful experiment for policy researchers and academicians in India, to envisage the likelihoods arising from our various policies, not only in the environmental sector and natural resource management, but also in terms of our roles in achieving environmental standards set by international pacts as well. Even then, whether the current policies would create a positive or negative wave of change is something that needs to be further analyzed and that is beyond the scope of this paper.

STUDY METHOD

The study was carried out to predict the possible outcomes of the National Water Mission and Green India Mission under NAPCC. Predictioneer's game was used to simulate the outcomes.

Structure of the Game



[Source: Bueno de Mesquita (2011, 71)]

Taking into consideration a single state game for a single pair of players while not displaying the source of uncertainty, nature assigns an initial probability of 0.5 to player types. The model applies Bayes rule so that the players can update their beliefs. The game ends when the sum of the players in the iteration is greater than the projected sum of the payoffs in the next iteration

Payoffs at each terminal node of a stage game are calculated as follows:

Let the probability that A prevails in an iteration of the A vs. B game =

$$P_B^A = \frac{\sum_{\{U(KA)|U(KA)>U(KB)\}} (C_K)(S_K)(U_{KA} - U_{KB})}{\sum_{K=1}^{n} (C_K)(S_K)\,|(U_{KA} - U_{KB})|}$$

where K is the 1 to n stakeholders (players), C is the influence of each stakeholder, S is the salience each stakeholder attaches to the issue, and U denotes utility with the first subscript (U_{KA}) indicating whose utility is being evaluated and the second the evaluation of utility relative to the other player's approach to the issue. (Mesquita, 2009)[11]

Game dimensions:

From the overall mission document, goals that could be quantified and scaled as inputs were selected to cater to the model's requirements. National Water Mission

1. National: Implementation of river interlinking projects and achieving integrated basin level management.
2. State: Construction of multipurpose hydro storage dams for groundwater, irrigation schemes; water metering and pricing.
3. PPP (Public Private Partnership): Models to employ desalination, water recycling, waste water treatment.

Green India Mission

1. National: Increased forest cover by 10 m ha of forest/non-forest lands and empowerment of communities by engaging them in forest management.

Game rounds: 4 – Assuming that negotiations will begin only in 2014 and will be carried twice in a year by the Planning Commission and Steering committee until the finalized goals are up for implementation after a final review in 2015.

Compilation and valuation of stakeholders:

A list of the stakeholders was established after reviewing the National Water Mission, MoEF's official publication on water resources and inputs from personal communication with experts from water resource management, academia, activists etcetera. Structured interviews were carried out through target and later respondent-driven sampling.

Parameters of veto and fixed positions of each stakeholder were evaluated with the help of available government policy documents and other available authentic literature. Scores were assigned based on careful evaluation of the on-document responsibilities, recent years of media documentation on various issues, and literature on resource management in India.

Potential Influence: The value assigned to each player in this column reflects the relative potential ability of each player to persuade other stakeholders to adjust their approach on the issue to be more in line with the influencer's perspective. The values typically will fall between 0 and 100 but they are not restricted to this range. The influence scores should not be thought of as percentages. Scoring for the players in the game is computed below by taking mean influence on other stakeholders given (Predictioneer's Game website manual)[12](for instance if game player A holds influence on *x* players out of the entire set *y*, his influence is calculated as *x/y* normalized to 100) as follows:

National Water Mission

Dimension 1: National: River interlinking projects, integrated basin level management	Dimension 2: State: multipurpose hydro storage dams for groundwater, irrigation schemes; water metering and pricing	Dimension 3: PPP: desalination, water recycling, waste water treatment
Ministry of Water Resources (MoWR) - 100 State Governments (SG) - 80 Planning Commission (PC) - 40 MoEF - 60 Community Based Organizations (CBOs) - 40 Engineers - 20 Foreign agencies - 20	MoWR - 50 SG - 100 Panchayat - 20 PC - 20 Ministry of Agriculture and Central Groundwater Board (MoA+CGWB) - 10 MoEF - 20 Industries - 40 Farmers - 20 Water User Associations (WUA) - 30 Foreign agencies - 10	MoWR - 75 SG - 100 PC - 50 MoEF - 50 Industries - 50 CBOs - 50 Engineers - 10 FA - 30

Green India Mission

In order to award values to the stakeholders for their influence, a survey based on stratified sampling taking occupation as a stratum, with at least 10 individuals from each stratum was carried out. Minimum of 10 members from corporate sector, litigation, concerned NGOs, professors and students from research institutes, government organizations were approached and an equal number of responses from each sector were used for further valuation of each stakeholder, final scores given as follows:

MoEF	100
Forest Departments	75
Ministry of Renewable Energy	25
Ministry of Tribal Affairs	38
Ministry of Rural Development	50
Ministry of Urban Development	50
Ministry of Agriculture	40
PC	35
Traditional Authorities	18
CBOs	25

Corporate and Business	10
Non Tribal (forest dependent) Communities	13
Tribal Communities	13
NGOs	13

Salience: Salience assesses how focused a stakeholder is on the issue. Its value is best thought of in terms of how prepared the stakeholder is to work on the issue when it comes up rather than some other issue to be dealt with. (Predictioneer's Game website manual) [12]

Flexibility/Resolve: Every stakeholder is assumed to care about two dimensions when addressing an issue. Flexibility/Resolve evaluates the stakeholder's preference for reaching an agreement as compared to sticking to his or her preferred position even if it means failing to reach an agreement. The variable ranges between 0 and 100. Higher values reflect greater flexibility; lower values greater resolve. (Predictioneer's Game website manual) [12]

Policy Position: The position preferred by each stakeholder on the issue, taking constraints into account. It is the position the stakeholder favours or advocates within the context of the situation.

National Water Mission

Dimension 1- National: River interlinking projects, integrated basin level management	Dimension 2- State: multipurpose hydro storage dams for groundwater (GW), irrigation schemes; water metering and pricing	Dimension 3- PPP: desalination, water recycling, waste water treatment
100- interlinking of all river basins 90- interlinking of any 7 river basins 80- interlinking of any 6 river basins 70- interlinking of any 5 river basins 60- interlinking of any 4 river basins 50- interlinking of any 3 river basins 40- interlinking of any 2 river basins 30- interlinking of any 1 river basin 20- Tributaries within state/adjacent states linked	100- explore all GW potential within state, construct storage dams to harness them; restore existing tanks + usage price, 90– explore all GW potential within state, construct storage dams to harness them + usage price 80- explore all GW potential within state, construct storage dams to harness them; restore existing tanks	100- favour PPP model for water efficiency and technology 50- neutral stance 0 - against PPP model

10- only tributaries within state are linked 0- no interlinking projects are undertaken	+ no usage price, 70-explore all GW potential within state, construct storage dams to harness them + no usage price 60- explore only 50% of GW potential, restore tanks + usage price 50-explore only 50% of GW potential, construct storage dams to harness them + usage price 40- explore only 50% of GW potential, restore tanks + no usage price 30- explore only 50% of GW potential, construct storage dams to harness them + no usage price 20- no further GW exploration, only restore existing tanks and storage facilities + usage price 10- no further GW exploration, only restore existing tanks and storage facilities + no usage price 0 – no implementation of any scheme	

Green India Mission

Scoring was done on various levels based on the players' position when it came to forestation and community empowerment.

100 -10mha forestation + community empowerment
90 - 10mha forestation+ no community empowerment
80 - 5mha forestation + community empowerment
70 - 5mha forestation + no community empowerment
60 – Forestation and restoration across 10 mha +community empowerment
50 – Forestation and restoration across 10 mha + no community empowerment
40 – Restoration of degraded forest + community empowerment
30 - Restoration of degraded forests + no community

empowerment

20- No preference to forestation + permission for private forests

10 - No preference to forestation + community empowerment

0 – no implementation of the scheme

RESULTS AND DISCUSSION

Output: (Detailed output file available on request; for detailed understanding of output variables please refer to the Predictioneer's Game website and book[11 12]).

The simulated data for the 4 rounds predict the possible outcomes of the game representing the National Water Mission and Green India Mission and its stakeholder negotiations for the remaining period in the twelfth plan –

National Water Mission

Dimension 1: National: River interlinking projects, integrated basin level management

Overall positions					**Round by Round Forecasts**				
Veto Player: MoWR	Round 1	Round 2	Round 3	Round 4		Rd 1	Rd 2	Rd 3	Rd 4
Veto player position	100	100	100	100	Smoothed Mean	57.31	52.81	47.03	43.22
Veto player flexibility	20	11.43	7.76	11.08	Round Forecast	59.97	54.66	43.81	42.64
Highest value	100	100	100	100	Utility Gain	[10.07]	[6.27]	0.16	0.56
Lowest value	0	4.2	4.65	4.91	Utility Gain2	2.25	[8.38]	[18.60]	[26.77]
Policy position range	100±20	100±10.9	100±7.4	100±10.54	End-Rule	1	1	1	1
Pivotal Coalition Membership					**Round by Round Summary of Actor Relationships**				

	Rd 1	Rd 2	Rd 3	Rd 4		Rd 1	Rd 2	Rd 3	Rd 4
row 1	MoWR	Stategov	citizens	for_agency	No_Dispute	23.81	9.52	1.9	1.9
row 2	Stategov	MoP			Status_Quo	6.67	9.05	2.38	3.81
row 3		Industries			Compromise	1.43	10.95	23.33	26.67
					Coerce	10	39.52	50.48	59.05
					Clash	58.1	30.95	21.9	8.57

The veto player's position is consistently at the score signifying the policy position advocated at 100 i.e., full implementation of the mission goal. Taking into consideration the pay off for other players and their policy position, a smoothed mean value of 57.31 is generated by the game, which is used to calculate the policy position ranges that will be acceptable to the veto player. This means that any player whose position coincides to a value within above 80 in the first round will have the chance to make credible proposals to the veto player during negotiations. However, there is a strong chance of the MoWR exercising its veto since the smoothed mean value is much lower than its acceptable range, unless the other game players accept the MoWR's policy position. The decrease in utility gain 2 values also shows that more than the veto player, it is the other players who would prefer reaching a settlement in the first round itself, since there is no further scope for negotiation and the veto player gains an upper hand with subsequent improvement in its utility gain, which could also give rise to coercion based on status quo, thus triggering the end rule.

We also find that the MoWR and State Governments mostly decide the course of the negotiation, and their coalition could outride the interests of all other game players in this dimension. However in this case state governments have not been given the power to veto, since the mission mentions only inter river basin transfer and management. It might be seen as a veto player in a situation where the central government is in coalition.

Interlinking of at least 4 or all of the river basins can therefore be carried out under the action plan. River interlinking has always been a sensitive issue in India. Conflicts between states like Tamil Nadu and Karnataka show how difficult the matter of sharing rivers is. It has been flagged as one of the more sensitive issues in the formation of the new state of Telengana from Andhra Pradesh. Hence this policy that aims towards centralizing river basin management and integrating the sources would be favoured by the governments in the current Indian scenario with existing water crisis, especially by states that are not river-fed such as Rajasthan, so as to ensure an even distribution of water throughout the country at all levels.

This is irrespective of the possible environmental consequences or economic costs of the policy in general.

Dimension 2: State: multipurpose hydro storage dams - Groundwater, irrigation schemes; water metering and pricing

Overall Positions					**Round by Round Forecasts**				
Veto Player: State Government	Round 1	Round 2	Round 3	Round 4		Rd 1	Rd 2	Rd 3	Rd 4
Veto player position	80	49.6	27.23	29.11	Smoothed Mean	59.49	51.92	40.94	35.3
Veto player flexibility	70	49	49	44.1	Round Forecast	66.74	52.24	36.77	33.82
Highest position value	100	79.31	68.06	60.05	Utility Gain	[4.83]	[0.28]	[2.37]	[0.40]
Lowest position value	0	4.41	6.1	6.91	Utility Gain2	9.6	6.64	[2.25]	[5.52]
Policy position range	80±70	49.6±36.7	27.23±30.36	29.11±23.43	End-Rule	1	1	1	1
Pivotal Coalition Membership					**Round by Round Summary of Actor Relationships**				
	Rd 1	Rd 2	Rd 3	Rd 4		Rd 1	Rd 2	Rd 3	Rd 4
row 1	Stategov	Stategov	Stategov	Citizens	No_Dispute	19.17	5	2.5	2.5
row 2	citizens	Industries	Industries	Wua	Status_Quo	9.58	27.5	17.08	25
					Compromise	5.42	10	25.83	23.75
					Coerce	9.17	31.25	42.5	38.75
					Clash	56.67	26.25	12.08	10

It is seen in this game that the smoothed mean of all players' position is 59.49, which lies in the acceptable range of the veto player's position (10 to 80). We can infer from these scores that since the veto player's position drops below the smoothed mean in the next round, the player accepts the outcomes based on general consensus in the first round itself and does not proceed to further discussions. Clash and coerce percentages suggest pressure to build up on the veto player in the likelihood of not closing off negotiations in round 1, which does not work in the favour of the veto player's standing and overall welfare of the players (indicated by utility gain 2). Hence the game terminates in round 1 itself. The fact that industries come in as a pivotal player in subsequent rounds itself indicate a possibility of clash/shift of

interests to their policy standing, which could prove disadvantageous in the future course,

Despite citizens not being of much relative influence in the game, a coalition is seen as possible in round 1 along with the state governments. This indicates that the policy is picked off by respective citizens at local levels and hence their interests could in the end still affect the final shape of the policy, even if they do not exert their influence on any other player initially. Considering the current groundwater crisis and the mismanagement of most of these sources, what this means is that whether a target area can be included under the mission for groundwater exploration can be deemed possible only with a general consensus from the local citizens of the area, due to the their perception of the pros and cons of this exercise.

Thus the prediction points to state governments preferring to focus more on water storage and water pricing and only limited groundwater exploration. Extraction might be limited by citizen demands. This comes in accordance with the fact that state governments need to ensure a uniform water supply across sectors and users. Enhancing the quantity of water available for everyone is thus a high priority goal, and hence more preference likely to be given by all stakeholders alike in a proper management measures for the water resources.

3. PPP: desalination, water recycling, waste water treatment

Overall positions					**Round by Round Forecasts**				
Veto Player: Planning Commission	Round 1	Round 2	Round 3	Round 4		Rd 1	Rd 2	Rd 3	Rd 4
Veto player position	10	10.13	10.12	10.23	Smoothed Mean	19.22	19.16	17.98	17.22
Veto player flexibility	50	25	12.5	6.25	Round Forecast	18.93	19.51	19.05	15.39
Highest position value	20	20	19.98	19.98	Utility Gain	4.66	3.75	3.54	0.92
Lowest position value	10	10.07	10.11	10.22	Utility Gain2	27.74	21	13.16	[4.77]
Policy position range	10±5	10.13±2.48	10.12±1.24	10.23±0.61	End-Rule	1	1	1	1
Pivotal Coalition Membership					**Round by Round Summary of Actor Relationships**				
	Rd 1	Rd 2	Rd 3	Rd 4		Rd 1	Rd 2	Rd 3	Rd 4
row 1	Media	Industries	MoWR	MoWR	No_Dispute	45.45	20	0	0
row 2	for_agency	for_agency	stategov	Stategov	Status_Quo	18.18	25.45	35.45	29.09
					Compromise	0	4.55	16.36	21.82

Coerce	0	13.64	33.64	38.18
Clash	36.36	36.36	14.55	10.91

As this is a policy position reflecting concurrence or opposition towards introduction of PPP models in water management, the outcome in general is not extremely critical for the players. Hence, the game does not pose problems in resolving. Even though the smoothed mean indicates a general favour towards PPP models, the veto player position range is slightly lower to a neutral stance, which shows that there is a chance for compromise and agreement towards shaping this mission goal only after careful deliberation. Overall utility gains is high throughout suggesting positive playoffs to all the game players alike and lesser chances of significant clashes.

The game outcome suggests that there could be no immediate implementation of PPP models. PPP models in areas of water management like recycling, desalination, water pricing et cetera is still a novel concept that is only being tried and tested (as in the case of the Nemmeli desalination plant in Chennai) in recent times. As sources of fund is currently directed through the Government, large scale implementation of such high-cost efficiency models by the government are yet to be seen in the Indian water sector. Media and foreign agencies have been picked off as potential game changers in this dimension, an interesting feature since these players can determine the success of such negotiations by ensuring positive reach to the public as well as sufficient fund flow to upcoming projects.

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Overall Positions					**Round by Round Forecast**				
Veto player: MoEF	Round 1	Round 2	Round 3	Round 4		Rd 1	Rd 2	Rd 3	Rd 4
Veto player position	80	67.79	67.79	67.79	Smoothed Mean	48.01	44.92	40.2	38.25
Veto player flexibility	20	13.08	10.06	12.77	Round Forecast	51.92	44.09	38.73	37.77
Highest player position	80	67.79	67.79	67.79	Security Forecast	40	36.27	32.91	32.63
Lowest player position	0	9.69	13.44	14.45	Utility Gain	[1.80]	[2.09]	2.09	2.33

Proposal range	80±16	67.79±7.6	67.79±5.47	67.79±6.81	Utility Gain2	2.21	[8.40]	[9.00]	[1.95]
Pivotal Coalition Membership					Veto Min	80	67.79	67.79	67.79
	Rd 1	Rd 2	Rd 3	Rd 4	Veto Max	80	67.79	67.79	67.79
row 1	Ministryof Environment Andforest	MinistryOf Environment andforest	Ministryof Environment Andforest	Ministryof Environment andforest	End-Rule	1	1	0	0
					Round by Round Summary of Actor Relationships				
						Rd 1	Rd 2	Rd 3	Rd 4
row 2	Forest Department	Forest Department	Forest Department	Forest Department	No_Dispute	18.68	5.49	5.49	5.49
					Status_Quo	7.14	14.29	20.33	26.92
row 3		Traditional Authorities	Ministryof TribalAffair	Ministryof RenewableResources	Compromise	8.24	20.88	25.27	24.73
					Coerce	13.19	37.91	41.21	34.07
row 4		Community Based Organisations	Traditional Authorities	Ministryof TribalAffair	Clash	52.75	21.43	7.69	8.79
row 5			Community Based Organisations	Traditional Authorities					
row 6				Community Based Organisations					

The structure on the issue is a highly polarized one with the MoEF being a powerful actor whose position is far powerful from everyone else except the State Forest Department. In the first round, the smoothed mean predicted outcome is 48.01 and the Ministry of Environment is at position 80 with flexibility of 20. Hence the ministry can accept proposals from players within a range of 64 to 96 in the 1st round. The utility gains, evaluates whether the set of veto players, expect to improve their welfare in the next round or not by comparing the sum of their utilities across all player positions. Utility gain for the veto player in rounds 1 and 2 are -1.80 and -2.01 respectively. Therefore the ministry likely to prefer ending the discussion in the first round itself and settle for the proposal range computed above, to avoid further

decrease in its welfare. The game shows high values for coercion and clash among game players, while chances of a no- dispute settlement are relatively low. This indicates that there could be a unilateral imposition of costs by one player on another who then gives in rather than resist or to a player who gives in to another in anticipation of the other imposing unacceptable costs if they don't give in. The pivotal coalition shows that MoEF and State Forest Department are the two highest players on the scale. These players are in the pivotal coalition in each round, suggesting further that they are well positioned to exercise the veto. And hence ultimately the policy outcome is most likely to be moulded in their agenda towards the issue, which is dependent on the independent actors.

It can be thus concluded that the State Forest department is flexible toward the realization of the outcome of the policy in the proposal range preferred by the MoEF and hence is a pivotal player along with the MoEF on either partial or full achievement of the policy proposition. This coalition is instrumental in influencing other stakeholders for facilitating the policy implementation irrespective of their initial resolve.

Since the final policy position is only close to the positions of MoEF and state forest departments, it is likely that the only reason the game terminates is because the MoEF exerts its influence to bring the other players around to their preference. However there is likelihood that a future disagreement in the local levels could arise at later negotiations, if any, or implementation, where pivotal members like Gram Sabha and community based organizations would consequently play a major influence in shaping or scrapping the Green India Mission.

CONCLUSION

Policy predictions aid the decision makers to take calculated risks that are beneficial to the system, in a more cost effective and rational way, keeping in mind what every stakeholder demands of it. Prediction results are indicators to any skewed or biased positioning among players that could lead to an unfair policy; for instance, the GIM prediction indicates a heavy power play imposed by MoEF and Forest Departments in achieving the goal of doubling the forest cover in India, which comes to clash with the interests of non governmental structures involved. In a democratic setup such as ours, pointing out to this fallacy in decision making can lead to a formalized and balanced negotiation setup among stakeholders, reducing chances of status quo hindering fair play. In fact, the general indifference that most non governmental stakeholders (citizens, especially) have towards policy decisions can be

remediated through proper incentives and institutional setups. It also can help decision makers to get rid of time inconsistencies during planning and implementation, since every stakeholder aims to create and overall improved welfare through the policies.

The current study has certain limitations, mainly being in the selection of players within broad terms and not being region- or actor-specific. Due to this limitation, the current results present a broad perspective of the issue and not any specific pointed outcome, except that policy prediction as a science helps analyze the utilization success of a policy from the stakeholder perspective.

Another significant feature of carrying out prediction in a democratic setup such as India's is that most of the times, the government's policy approaches is influenced by the agenda of the individual political party in power, and sometimes of the opposition parties as well. These are prone to fluctuations throughout a ruling term – for instance, during election period, the government might be more interested to keep the vote bank secure by providing policies catering public benefits, as well as power and revenue generation, whereas long term goals are merely a bonus.

A prediction is hence not an end, but a starting step towards helping environmental experts and decision makers to efficient problem solving and reform mechanisms. Therefore, this paper is merely an attempt to direct attention towards the immense possibilities lying in the domains of policy predictions and game theory for the future of scientific research inclusive of environmental concerns in India - and a way to help establish efficient policy framework in light of climate change implications in the coming years. It is a step towards facilitating negotiations in a scientific manner and using the concept of stakeholders in a productive setup, instead of letting it remain on paper as a mere institutional concept.

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