

Rules vs. Discretion in the Management of Multipurpose Dams

William Ottenheimer, Graduate Research Assistant
Michael Brady, Professor, School of Economic Sciences
Jonathan Yoder, Professor, School of Economic Sciences
Kirti Rajagopalan, Assistant Professor, Biological Systems Engineering

Background: Research Agenda

When do, or should, institutions take a more rules versus discretion-based approach in managing complex systems?

> When do the courts play a larger role in creating or changing rules?

> > Does managerial omplexity lead sed use



Background : Energy Relevance

- •Hydropower is a key driver of economic activity in the Pacific Northwest.
- •Many hydropower dams are operated for other purposes as well.
- •How do dam operators formally and informally balance these competing demands?



Background : Broader Relevance

- Public health
 - contagious disease management
 - pharmaceutical drug trials and approvals
- Monetary policy
 - setting of federal funds rate
- Global trade
 - degree of reliance on rules-based approach (WTO).
- Environmental management
 - biodiversity
 - endangered species



Background: Rules vs. Discretion

- **Rules-based approach**: *ex ante* specify the action taken in all potential states of the world.
- **Discretion-based approach**: assign authority to individual, or a group of individuals, to choose the action to take in responding to events.
- Contract theoretic view: all contracts are incomplete in practice, but some are more incomplete than others.
- **Tradeoff**: flexibility to manage based on best available information vs. predictability for planning.

• Famous Kydland and Prescrott (1977) result showing the benefit of rules.

Background : Rules and Dams

- Rules are prominent in dam management
 - Rule curves
 - Transboundary water agreements such as the Columbia River Basin Treaty.



- Discretion
 - Patterson and Doyle (2018) show significant rule curve deviation in U.S. Army Corp of Engineer Dams. Why?





Background: Multipurpose Dams

Most federally managed dams have multiple official purposes.





Operational Purpose Frequency



Background: Legislative

- •Dam purposes authorized by Congress as the first step in exercising the "power of the purse".
- •Description of legal authority assigned to an agency to act towards a specific objective.
- •Necessary to specify purposes to receive budget authority.



Background: Legal

- •Legal challenges can be made towards:
 - Authorizing legislation
 - The Constitution
- The Constitution:
 - does not oblige the government to provide social goods.
 - does provide protections against harmful government actions.
 - Fifth Amendment: Just Compensation Clause
 - Takings Clause
 - Liability (torts)



Research Question: Multipurpose dams and legal risk

Grigg (2020). J. Leg. Aff. Dispute Resolut. Eng. Constr. 12(3)

"The new challenges faced by USACE expose a fissure in the notion of multiobjective operation of water facilities. This idealized notion must face the reality that meeting one objective may cause failure to meet another objective. This problem cannot be resolved by technical means alone; political, legal, and financial approaches should be developed in order to avoid sending every issue to the courts."



Our research question

- •Before exploring economic solutions to multiobjective management, let's confirm that it does lead to more lawsuits.
- •<u>Testable hypothesis</u>: Dams with more objectives, after controlling for other factors, are more likely to experience lawsuits over their management.



Data

- Create dataset of relevant USACE caselaw.
- Query Court Listener Database
- Returns a synthesis of opinion
- Cases filed in U.S. District Courts
- If appealed to Federal appellate then lower court case is dropped to avoid duplication.
- Filter to cases involving USACE and dam operations.
- Complications
 - Search by separately by all 500+ USACE dams and associated reservoirs.
- Application of AI (Claude)
 - Determine whether a case is over dam operations or something else like workplace discrimination.



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Preliminary Results

•232 cases traceable by docket IDs

- •29% of 537 USACE dams have an associated case.
- •Dependent variables:
 - Time-to-event: time from dam construction to first case
 - Count data: number of cases associated with a dam.
- Explanatory variables
 - Purposes: # of purpose, purpose combinations.
 - •USACE division









Cases Over Time

Preliminary Results

Table 1: Cox Proportional Hazard Model

	Dependent variable: Case Enactment
Operating Purposes	0.251^{**} (0.102)
FloodControl	-0.184(0.397)
WaterSupply	-0.078(0.675)
Irrigation	0.113(0.508)
Navigation	0.436(0.329)
Hydroelectric	0.628^{**} (0.301)
SouthWestern	0.503^{*} (0.304)
SouthPacific	0.124(0.395)
SouthAtlantic	-0.429(0.362)
GLOR	-0.689^{**} (0.286)
Mississippi	-0.581^{*} (0.329)
NorthAtlantic	-0.986(0.630)
FloodControl:WaterSupply	-0.019 (0.683)
FloodControl:Irrigation	-0.511 (0.558)
Navigation:Hydroelectric	-0.308(0.420)
Observations	537
\mathbb{R}^2	0.135
Max. Possible R ²	0.965
Log Likelihood	-859.338
Wald Test	82.670^{***} (df = 15)
LR Test	77.913^{***} (df = 15)
Score (Logrank) Test	98.571*** $(df = 15)$
Note:	*p<0.1: **p<0.05: ***p<













Preliminary Results

Table 2: Poisson Count Model

	Dependent variable: Count of Cases
Operating Purposes	0.352^{***} (0.107)
FloodControl	-0.777^{***} (0.278)
WaterSupply	-0.485(0.544)
Irrigation	-0.072(0.373)
WaterQuality	-0.476(0.396)
Navigation	0.057(0.246)
Hydroelectric	0.519^{**} (0.262)
SouthAtlantic	-1.721^{***} (0.323)
NorthAtlantic	-2.367^{***} (0.607)
Mississippi	-1.810^{***} (0.277)
SouthPacific	-0.956^{***} (0.307)
GLOR	-2.062^{***} (0.266)
SouthWestern	-0.850^{***} (0.231)
NorthWestern	-1.297^{***} (0.268)
FloodControl:WaterSupply	0.342(0.556)
FloodControl:Irrigation	-0.324(0.416)
FloodControl:WaterQuality	0.180(0.400)
Navigation:Hydroelectric	$-0.013\ (0.317)$
Observations	537
Log Likelihood	-413.915
Akaike Inf. Crit.	863.830
Note:	*p<0.1; **p<0.05; ***p<









Pink: single purpose dam

0

1

Blue: 2 or more purposes

Survival function







Discussion and Limitations

- Multipurpose dams more likely to experience litigation.
- Working to include settled cases.
- Time varying factors: do cases follow anomalous streamflow events?



Future Research

- Should multiobjective management be abandoned?
- •What is the effect of legal decisions on rules and operations?
 - Do agencies formally change rules to reflect successful legal challenges?
 - How have legal challenges altered operations and prioritization of purposes including energy?
- Forecasting: will rapid improvements in forecasting due to machine learning increase liability risk for the USACE?
- •USBR vs. USACE: Why are there differences in preferences for rules vs. discretion between agencies?

