The Role of Communication in Sustaining Cooperation within Commons Dilemmas: A Game-Theoretic Analysis

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Abstract:

Common-pool resources (CPRs), such as irrigation systems and fisheries, are characterized by rivalry in consumption and costly exclusion. Consequently, over-extraction and free-riding are often individually rational yet collectively destructive. This paper examines how communication can reshape these dynamics in two contrasted cases: Andean irrigation in Peru and the Newfoundland cod fishery. Small repeated-game models demonstrate that organized, open communication, coupled with visible signals and graduated penalties, reduces the benefits of defection or race benefits, increases anticipated penalties for straying, and increases perceived losses from suboptimal effort. The result is a lower threshold for the discount factor required to sustain self-enforcing cooperation. The research combines three mechanisms of failure (information frictions, power asymmetries, weak enforcement) and offers an implementable bundle, signal alignment, asymmetry guards, and rule-plus-talk, with clear roles, routines, and metrics. Consequently, the study provides an exportable institutional design for resource management agencies seeking to foster long-term, self-sustaining cooperation that reduces reliance on continuous and costly external policing.

Keywords: Communication; Common-Pool Resource Governance; Game-Theoretic Modeling

1. Introduction

1.1 Research Background and Motivation

Common-pool resources (CPRs) such as fisheries and irrigation exhibit rivalry in use and difficulty of exclusion. It creates an incentive for individuals to free-ride and over-extract: a concept articulated by Hardin called the Tragedy of the Commons [1]. The economic stakes of this phenomenon are substantial. In this regard, UNESCO states that agriculture draws around 70% of the freshwater around the world [2]. Excessive consumption of freshwater can be deemed responsible for a scarcity in the circulation rate [3].

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Hence, coordination failures among irrigators potentially translate to low farm productivity, higher drought risk, and costly conflict over allocation [4]. This forms the theoretical backdrop of this study.

In highland Peru, an old community-irrigation, locally known as Turno, allocates water across terraced valleys [5]. Yet climate change is tightening constraints as Peru has lost 22% of its glacier area alongside 12% of its freshwater volume [6]. This has shrunken dry season flows that these systems primarily depend on. In the Ica region of Peru, for instance, groundwater footprint accounts for 87% of the total blue water footprint for croplands, wherein 286 Mm3 of groundwater has been consumed under unsustainable conditions [7]. Additionally, in capture fisheries, several stocks have plateaued or declined since the mid-1990s. This encompasses mismanaged effort alongside emblematic collapses. According to Haedrich and Hamilton, around 40,000 workers and several communities were affected [8]. While the Northern Cod Adjustment and Recovery Program (NCARP), an effort worth $484 million, provided some assistance in terms of income during the moratorium, followed by the Atlantic Groundfish Strategy (TAGS) of 1994, which encompasses allocation worth $1.9 billion, the consistent federal effort was rather fruitless. This was testimony to the fact that several people and places were unable to find an effective substitute for cod. This paper thus presents two emblematic cases under the CPR setting: Andean Irrigation in Peru and the Newfoundland Fishery in Canada. The aim is to examine how communication reshapes strategic choices, such as how cooperation becomes self-enforcing rather than aspirational, and how all such contingencies can be avoided.

1.2 Literature Review

Research on CPR treats communication as an institutional mechanism that reshaped incentives. Across controlled CPR experiments with real resource users, Hoffman et al. show that communication sessions that are public and inclusive tend to generate more norm talk [9]. The latter includes rules, monitoring, and sanctions. This significantly increases the collective payoffs over any exclusive or club-like exchanges, thereby indicating that meetings often help groups coordinate on efficient equilibria rather than just merely expressing preferences. Additionally, sanction designs matter as well. Angelsen and Naime use field experiments framed across several countries to demonstrate the contingent effects of peer punishment, like proportionate, graduated sanctions that bring forth a sustainable rise in contribution [10]. Moreover, they also found that excessive or antisocial punishment provokes retaliation and erodes norms. This is evidence for the fact that enforcement must be credible; however, it should be measured to remain self-enforcing. Complementing these experimental results, Domínguez-Guzmán et al. detail the ethnography of irrigation across northern Peru [11]. They suggest that quotidian care work, which is used to maintain canals, post rosters, and deliberate budgets, has the potential to raise compliance when such practices are public and legitimate. This simultaneously ensures that head-tail asymmetries are moderated. These studies form a precise mechanism for this paper's game-theoretic framing: structured, inclusive communication raises the expected sanction (s), reduces positional or race advantages (a, g), and heightens the salience of system-wide losses (k). This lowers the discount factor for thresholds, which is necessary for sustained cooperation.

1.3 Research Gap

The majority of the existing scholarship on common-pool resources (CPRs) has focused on institutional correlates of success or bio-physical stressors in relative isolation. A great deal of it is case-bound irrigation or fisheries without a common analytic lens, and descriptive or correlational, with no clarity on how communication changes strategic incentives. Few articles formally trace communication to game-theoretic primitives that dictate cooperative equilibria-e.g., advantage of temptation—upstream bonus or race bonus, cost of expected sanctions, or perceived loss to the system-and test the mapping between contrasted CPRs. Similarly, although asymmetries (head- vs tail-enders; inshore vs offshore fleets) are often mentioned, few analyses measure their impact on cooperation thresholds or display how inclusive rule-making and graduated sanctions lower those parameters. Lastly, there is comparatively little work that concretizes models into working design, i.e., defining the minimal set of signals, meetings, and ladder of sanctions, and measures that define whether the cooperation threshold has been reached.

1.4 Research Framework

First, the paper profiles two CPRs: Andean irrigation and Newfoundland cod, to bring positional and race frictions to the surface. Second, the paper constructs two repeated-game models to obtain cooperation thresholds. Third, the paper diagnoses information frictions, power asymmetries, and weak enforcement by mapping them to parameters (a, g, c, k, s). Fourth, the paper suggests a communication bundle—signal alignment, asymmetry guards, and rule-plus-talk. Fifth, the paper defines implementation metrics to check whether discount factors surpass reduced thresholds in practice.

2. Case Description

2.1 Irrigation in the Andean Mountains of Peru

High-altitude Andean agriculture relied on gravity-fed canals. These divert glacial and seasonal flow to terraced fields. According to Budds and Hinojsa, since Peru's General Water Law was passed in 1969, local user organizations have been formalized into irrigation districts, also called distrito de Riego [12]. Additionally, a number of small user-based organizations manage locally managed water. They were known as juntas de usuarios—water user associations, comites de regantes—irrigation committees, and highland community water systems. These bodies allocate turns, maintain canals, collect fees, and coordinate with the state water authority. Note that around 10% of Peru's area is located in the coastal strip that lies between the Pacific Ocean and the Andes foothills (Costa), while 30% is mountainous (Sierra), and 60% comprises the Amazon watershed (Selva) [13]. The distribution of Peru's land is shown in Figure 1. While the coastal plains host larger schemes, the Sierra (Andean Highlands) is primarily characterized by several small, community-managed systems. Historically, these areas are in the order of a few hundred to a thousand hectares each. This has been an organizational pattern that endures and shapes day-to-day governance.

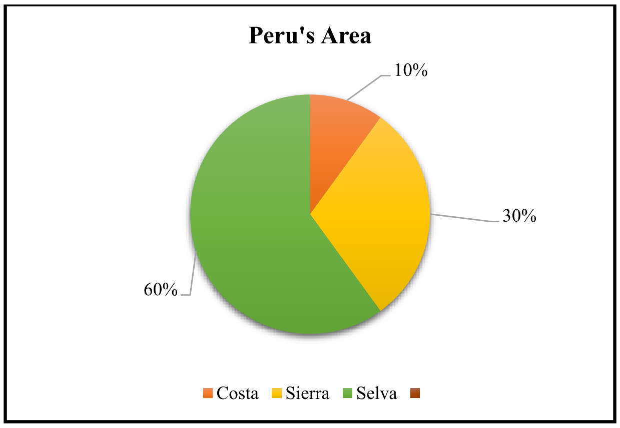

Fig. 1. Land Distribution in Peru [13]

Ethnographic work across Andean communities documents long-standing rules around a moral economy. This is considered to be an effective way to manage scarce resources that are also fluctuating and held in common [5]. They involve rules around fair rotation, proportional shares, and obligatory maintenance. These tie access to contribution and, in turn, embed water rights in social reciprocity. Recent analysis of the Colca basin shows how juntas administer tariffs and channel resources back to local committees for repairs [14]. However, they also face tensions over free use and equity between upstream and downstream users, alongside climate variability that impacts flows during the dry season.

2.2 Overfishing in the Newfoundland Fishery of Canada

Northern cod has underpinned Newfoundland and Labrador's economy for several centuries. However, after decades of heavy exploitation, the stock collapsed, as shown in Figure 2. This in turn triggered a 1992 federal moratorium that displaced several jobs and depopulated entire communities [15]. Rebuilding has been rather slow and has been influenced by shifts in ecosystems, notably capelin scarcity that affects cod mortality and recruitment. A report by Fisheries and Oceans Canada notes that capelin collapsed in 1991 and has yet to recover [16]. Moreover, the present size of stock is only 10% of the pre-collapse levels, while capelin is expected to remain at the current level over the next few years. This significantly impedes stock growth. As per Reuters, in June 2024, Ottawa reopened the 2J3KL northern cod fishery partially [17]. The Total Allowable Catch (TAC) was 18,000 tons: a quota that was cautious and far below the 25,000 tons threshold of the 1980s. Therefore, this frames the move as a milestone while also maintaining tight controls to avoid re-depletion. Overall, the current development is a process that entails a rather delicately managed transition from full closure toward adaptive co-management. It simultaneously encompasses advisory processes and monitoring that are predominantly intended to reconcile the livelihoods of the harvester with stock rebuilding.

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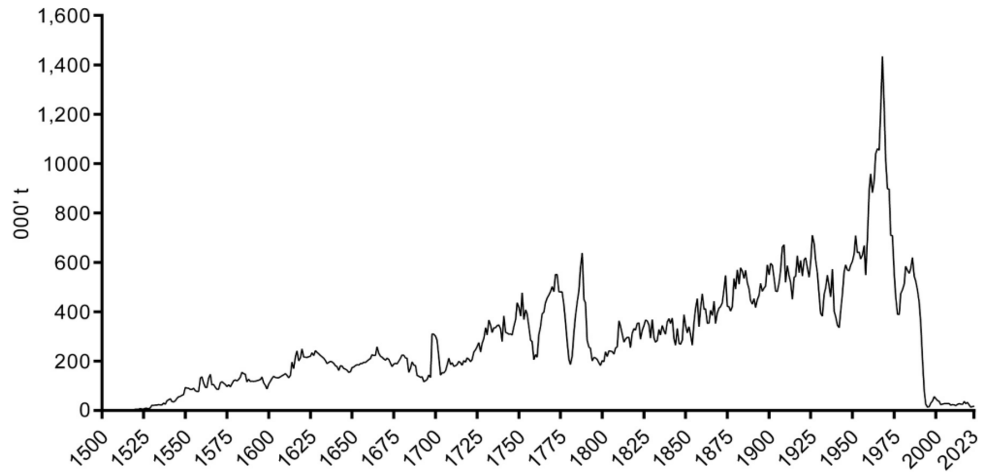

Fig. 2. Stock of Cod Collapsed in the 1990s [15]

3. Analyzing the Problem

Both cases are common-pool resource (CPR) problems with rivalry in use and costly exclusion. In a one-shot appropriation or maintenance game, Nash Equilibrium will predict over-extraction, such as in a fishery, or under-provision of maintenance/flow-sharing, in irrigation. Across infinitely repeated interactions, cooperative outcomes become sustainable if the discount factor is high enough. It also manifests when players coordinate on punishment strategies. However, they still need to exhibit shared beliefs about the intentions of the other and about what counts as a deviation. Sometimes, even cheap talk can shift beliefs, create common knowledge, and enable coordination across trigger strategies and graduated sanctions. Laboratory and field research in CPR settings consistently show that opportunities for communication, which include negotiating rules, making public commitments, and planning monitoring, increase cooperation without any external enforcement [18]. Additionally, communication may also improve learning about the resource and actions of others, which in turn lowers uncertainty and supports adaptive rule-making over time [19]. This section thus diagnoses why cooperation is hard in the two common dilemmas. It presents the cases with explicit game-theoretic models and illustrates how communication changes incentives such that cooperation can be sustained at equilibrium. The two cases: Andean irrigation and Newfoundland cod fishery, although conceptually similar, differ in terms of positional power (head-enders versus tail-enders in irrigation) and in stock dynamics and race incentives (fisheries). In both, the one-shot Nash outcome is inefficient. Thus, communication, when coupled with monitoring and agreed-upon sanctions, lowers the incentive to deviate and also facilitates repeated-game equilibria with cooperative play.

3.1 Sustaining Cooperation through Communication: A Game-Theoretic Analysis

3.1.1 Andean irrigation: upstream-downstream maintenance and rotation

Players: An upstream irrigator (U) and a downstream irrigator (D)

Actions each season: C: cooperate - contribute to canal maintenance and respect the rotation; OR

Defect - free-ride and, if U, overtake water

Parameters (all > 0)

B: per-period benefit when the canal is maintained and rotation is respected.

c: private cost of contributing (labor/fee) to maintenance.

a: positional gain U can seize by taking extra flow when D cooperates (head-end advantage).

d: loss in output when any player defects (shortfalls, siltation, conflict).

s: expected sanction cost (social + monetary) for a defection, conditional on observable rules/monitoring.

Table 1. Payoff Matrix – Andean Irrigation

	D: C	D: F
U: C	(B − c, B − c)	(B − c − d, B − d − s)
U: F	(B + a − s, B − a − c − d)	(B − d − s, B − d − s)

(1) One-shot incentives

If D cooperates, U compares $B-c$ (cooperate) with $B+a-s$ (defect). With little to no sanction implying $s\approx 0$, and any $a+c>0$, U prefers to defect. If D defects, U is still weakly or strictly better off defecting. Symmetric logic holds for D once defection by U imposes d on both. Thus, (F, F) is the one-shot Nash Equilibrium under maintenance and inequitable deliveries (Table 1).

(2) Repeated Game with Trigger Strategies

Let both players agree to play C each season and revert to (F, F) forever after any observed deviation, also known as the grim trigger. Let $\delta\in(0,1)$ be the common discount factor.

Cooperation payoff per period: $\pi_C = B-c$

Deviation payoff for U when D plays C: $\pi_D = B+a-s$

Punishment payoff per period: $\pi_P = B-d-s$

Cooperation is subgame-perfect if the present value from sticking to C is at least the deviation value:

$$\frac{B-c}{1-\delta} \geqslant (B+a-s)+\frac{\delta(B-d-s)}{1-\delta}$$

ð $\delta \geqslant \delta_I^* \equiv \dfrac{a+c-s}{a+c+d}$

(3) Comparative Statics: What Communication Changes

Pre-seasonal canal meetings, publicly posted rosters/turns, and open budgeting convert tacit norms into common knowledge. They subsequently raise the expected sanction s given by (social pressure + fines actually collected). They also shrink a by making overtake legible, such as turn boards and flow logs. Both effects reduce δ_1^*. Hence, cooperation can be sustained even when players are moderately impatient. In other words, communication that is specific and mentions who, when, and how long factors, makes words bite, given they are public and coupled with light monitoring.

3.1.2 Newfoundland Cod: Effort and the Race to Fish under a TAC

Players: Two representative vessels labeled vessel 1 and vessel 2

Actions: L - Low, conservative effort consistent with rebuilding and TAC pacing; OR

H – High effort/ race

Parameters (all > 0)

V: per-period profit when both pace effort (stock-safe, steady operations).

g: race gain from deviating to H when the other plays L (grabs a larger share early).

k: loss borne when any H is chosen (early closure, stock harm, congestion).

s: expected sanction cost under agreed rules (observers, landings audits, area/season closures) if deviating, as shown in Table 2.

Table 2. Payoff Matrix – Newfoundland Fisheries

	2: L	2: H
1: L	(V, V)	(V − k, V − k − s)
1: H	(V + g − s, V − g − k)	(V − k − s, V − k − s)

(1) One-shot Incentives

If the opponent plays L, deviating to H yields $V+g-s$ versus V from L; with weak s and any $g>0$, deviation becomes attractive. When the opponent plays H, racing does not improve the biological outcomes. Instead, it avoids being left with scraps. This makes H the weakest response. The race equilibrium (H, H) follows with low profits and stock risk.

(2) Repeated Gam with Pre-announced Rules

With the same grim-trigger logic as used in Case 1:

Cooperation payoff per period: $\pi_C = V$

Deviating payoff: $\pi_D = V+g-s$

Punishment path payoff: $\pi_P = V-k-s$

The cooperative equilibrium exists if:

$$\frac{V}{1-\delta} \geqslant (V+g-s)+\frac{\delta(V-k-s)}{1-\delta}$$

ð $\delta \geqslant \delta_F^* \equiv \dfrac{g-s}{g+k}$

(3) Comparative Statistics: What Communication Changes

Communication, in the form of joint science-industry meetings, published stock indices, and pre-announced in-season triggers, raises s by making sanctions predictable and credible, reduces g by coordinating start times, area rotations, or haul schedules (less first-mover edge), and also raises the salience of k, which demonstrates shared understanding that premature closure hurts everyone. Each change reduces δ_F^*, widening the feasible set for sustained restraint.

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3.2 Reasons Analysis of Cooperation Still Breaks: Three Mechanisms, Mapped to Model Primitives

3.2.1 Information frictions and noisy signals

(1) Diagnosis: In both cases, players act under uncertainty about others' behavior and about the resource state (canal flow; stock/recruitment). If monitoring is weak or signals are noisy, each player overweights the risk of being the 'sucker' for water, implying excessive use. In the irrigation model, that pushes U toward exploiting a and D toward withholding ccc; in the fishery model, it inflates the perceived race gain g and deflates the perceived sanction s ("they won't catch me").
(2) Model Link
Irrigation: noisier observation effective $s\downarrow$ (violations are harder to prove) and perceived $a\uparrow$ (head-enders can take water unobserved). From $\delta_I^* \equiv \dfrac{a+c-s}{a+c+d}$, both movements raise δ_I^*, undermining cooperation.
Fishery: uncertain stock and dispersed belief about recruitment $g\uparrow$ (everyone expects others to sprint) and/or $k\downarrow$ (underestimation of closure/stock harm), so $\delta_F^* \equiv \dfrac{g-s}{g+k}$ rises.
(3) What Communication Fixes
Common indicators agreed ex ante (flow logs at canal inlets/outlets; posted rotation rosters; public stock bulletins; capelin or bycatch indices) transform idiosyncratic beliefs into shared expectations.
Open meetings where indicators are interpreted together compress belief dispersion, which shrinks g, raises the expected sanction s (because deviations are now discoverable), and increases the perceived systemic loss k from over-effort.
In irrigation, transparent turn boards and simple gauges limit hidden overtake, effectively reducing a.

3.2.2 Power Asymmetries and Unequal Appropriate Rights

(1) Diagnosis: Positional or organizational advantages allow certain users to extract more while bearing fewer costs. In irrigation, head-enders can physically intercept flows; in fisheries, larger, better-equipped fleets may capture quota shares or influence rules. If powerful actors expect softer enforcement or can externalize costs, the temptation to defect rises for them, and the expected sanction falls.
(2) Model Link
Irrigation: Asymmetry directly increases *a* (head-end capture), and if elites are less punishable, it reduces *s* for that subset. Both shift δ_I^* upward, making cooperative rotation fragile.
Fishery: Fleet asymmetry raises *g* (greater marginal benefit from early effort) and may depress *s* (lower detection probability given capacity to game rules). δ_F^* rises accordingly.
(3) What Communication Fixes
Voice and visibility. Formal seats for tail-enders/small boats in assemblies and advisory bodies ensure that rules (rotation length, area openings) are negotiated, not announced. Communication alone is insufficient; rule codification is required.
Equity clauses. In irrigation, proportional turns are anchored to plot size, and downstream vetoes for schedule changes are lower a. In fisheries, community caps, area-based rotations, or set-asides for inshore fleets reduce g.
Transparent budgeting. Earmarking canal fees back to local maintenance raises legitimacy and boosts s (communities enforce what they view as fair).

3.2.3 Incomplete Enforcement and the Absence of Graduated Sanctions

(1) Diagnosis: Even when users agree to cooperate, punishments must be credible and proportional. All-or-nothing threats ("we'll shut you out forever") are commonly time-inconsistent or socially unacceptable. Without a ladder of graduated sanctions, small infractions go unpunished, signaling that larger deviations will also be tolerated.
(2) Model Link
In both models, weak enforcement enters as low s, raising δ_I^* and δ_F^*. Moreover, in practice, players observe actions with noise; harsh triggers invite frequent, mistaken punishments, which can unravel cooperation.
Graduated sanctions allow s to being positive and credible even for first offences (small fine/reordering within the roster; temporary area closure), increasing expected costs of deviating without requiring draconian measures.
(3) What Communication Fixes
Rulebooks made in meetings: Actors co-define what counts as a breach, who observes, and how penalties escalate. This transforms cheap talk into institutionalized talk - words that change payoffs.
Rapid feedback loops: Posting sanctions and compliance outcomes sustains reputational pressure (a social component of s).

3.3 Cross-Case Mapping: Parameters, Problems, and Levers

Table 3. Cross-Mapping

Model primitive	Economic meaning	How the problem shows up	Communication-based instrument	Directional effect
s	Expected sanction for deviation	Weak/slow enforcement; “nobody gets caught”	Co-authored rule books; posted rosters/stock bulletins; observers; published sanctions	$s\uparrow ?\ \delta_I^*,\ \delta_F^*\downarrow$
a	Head-end positional gain (irrigation)	Upstream overtake; opaque schedule changes	Transparent turns; simple flow gauges; downstream veto on rule changes	$a\downarrow\Rightarrow\delta_I^*\downarrow$
c	Contribution cost (maintenance)	Low attendance at faena; fee evasion	Collective work planning; fee earmarking; reciprocity reminders	Effective $c\downarrow\Rightarrow\delta_I^*\downarrow$
d	Loss when anyone defects	Siltation; conflict; tail-end crop loss	Joint diagnosis of last season’s losses; public maintenance reports	Higher perceived $d\Rightarrow\delta_I^*\downarrow$
g	Race gain from deviating (fishery)	Early sprinting; crowded grounds	Staggered starts; area rotations; transparent haul schedules	$g\downarrow\Rightarrow\delta_F^*\downarrow$
k	Systemic loss from high effort (fishery)	Premature closures; weak rebuilding	Pre-announced HCRs; bycatch/capelin triggers; in-season reviews	$k\uparrow\Rightarrow\delta_F^*\downarrow$

In irrigation (Table 3), the main levers are a and s in fisheries, g, k, and s dominate. Communication is not an add-on; instead, it is a delivery mechanism that makes these levers operational. It does so by coordinating expectations, specifying monitoring, and legitimizing sanctions.

4. Suggestions

The primary aim is to convert communication into an instrument that changes payoffs by lowering the temptation to defect and raising the expected cost of non-compliance. This will ensure that the cooperative outcomes classified in section 3 become self-enforcing. Therefore, the proposals map one-for-one to the problems and model primitives that have been identified earlier. These include:

i. Signal alignment to reduce information frictions ($\downarrow a,\downarrow g,\uparrow k,\uparrow s$)

ii. Asymmetry guards to rebalance appropriation rights (($\downarrow a,\downarrow g,\uparrow s$)

iii. Rule-plus-talk to institutionalize graduated sanctions ($\uparrow s$)

4.1 Signal Alignment: Shared Indicators and Meeting Routines

4.1.1 Common indicators with fixed publication schedules

Irrigation in Peru: Install simple staff gauges at intakes or outlets while maintaining boards that list user orders and time windows. Additionally, posting weekly flow blogs and faena attendance sheets at the committee house via WhatsApp or SMS may also improve communication.

Fisheries in Newfoundland: Pre-season release of stock and capelin indices alongside bulletins on CPUE, bycatch, and area closures are expected to improve communication. Moreover, summaries of vessel monitoring that show aggregate effort by area may keep all fisheries within limits and prevent overuse.

4.1.2 Structured meetings that interpret the signals

Irrigation in Peru: Irrigation can include pre-season assembly to finalize rotation, service days, and fee earmarks. Additionally, they can hold fortnightly five-minute canal hurdles at the headworks to confirm and finalize the upcoming roster and not issue.

Fisheries in Newfoundland: Fisheries should receive a pre-season science-industry briefing, in addition to 20-minute check-ins, which can be either virtual or dock-

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side. A briefing on indices and compliance will be given. Moreover, an immediate micro-brief should be given when conditions worsen.

4.1.3 Clear data responsibilities

The leader of the gauges, the one who ought to post blogs, and those who should compile all bulletins should be clear and known. It is also crucial to rotate the roles each month to ensure that legitimacy and learning are maintained.

Commonly observed signals that are transparent help compress belief dispersion about flows or stocks. For instance, it has been observed that voluntary disclosure of climate actions across entities tends to experience more positive stock market reactions [20]. The same can apply to irrigation and fisheries as well. In irrigation, the visibility of turns directly reduces the head-end advantage a. On the other hand, across fisheries, coordinated disclosure deflates the race gain g and raises the salience of system-wide losses k. Public posting and repeated discussions raise the expected sanctions s by making deviations legible and socially costly. Collectively, these movements lower $\delta_I^* \equiv \frac{a+c-s}{a+c+d}$ and $\delta_F^* \equiv \frac{g-s}{g+k}$, thereby enlarging the parameter space wherein cooperation is stable.

4.2 Asymmetry Guards: Rebalance Rights and Voice

4.2.1 Voice guarantees in rule-making

Irrigation in Peru: It is imperative to reserve explicit tail-end seats on the comisión board. Additionally, a downstream concurrence is necessary for any rotation change that might occur mid-season.

Fisheries in Newfoundland: It is crucial to formalize inshore representation on advisory panels and area councils. Additionally, the creation of a small-boat caucus can also help table items on the agenda.

4.2.2 Equity rules that cap positional rents

Irrigation in Peru: The turns should be proportionally codified as per plot size. Moreover, for weeks during which water is scarce, pre-agreement on priority rotations is crucial to protect all tail-enders and ensure they receive the minimum. Earmarking a fixed share of tariffs is mandatory to facilitate the maintenance of tertiary canals.

Fisheries in Newfoundland: Adoption of area rotation or staggered starts is necessary to smooth out the first-mover edges. The setting of the community quota sets aside and fills the gear/engine gaps across sensitive areas.

4.2.3 Budget transparency

Publishing quarterly statements of inflow and outflow, as well as what was collected (fees/fines) and how it has been financed for maintenance and monitoring, are significant steps to ensure transparency and increase trust. This helps in linking visible benefits to contributions.

Equity rules and voice shrink the unilateral benefit from opportunism, which stands for a in irrigation and g in fisheries. This, in turn, raises the perceived enforceability of sanctions (s) as rules are co-authored and are therefore legitimate. Fee earmarking lowers the effective contribution burden c as users see their payments return as service. This further reduces δ_I^*.

4.3 Rule-plus-talk: Gradually, Credible Enforcement

4.3.1 A short, co-authored rulebook

Four pages or fewer, written and adopted in an open meeting, that define: the action space (turn lengths, service duties; effort pacing rules), the evidence standard (gauge photos, roster signatures; VMS and landing reports), a graduated sanction ladder.

4.3.2 Sanction ladders that bite early but fairly

Irrigation in Peru: (i) written warning; (ii) move to the end of the roster or small fine; (iii) temporary suspension of one turn; (iv) season suspension.

Fisheries in Newfoundland: (i) written warning; (ii) 48-hour area closure or deduction of future days; (iii) week-long closure or quota deduction; (iv) season closure/referral for prosecution.

4.3.3 Commitment devices

Irrigation in Peru: Escrow maintenance fees at season start, alongside making water releases contingent on proof of faena contribution.

Fisheries in Newfoundland: Pre-filed effort plans and minimum observer/electronic monitoring coverage with random audits.

4.3.4 Rapid feedback and conflict resolution

A two-person ombudsperson panel should be created with one individual from each side. They will rule within 72 hours on disputes. Additionally, posting weekly compliance dashboards that name rules which have been enforced and highlight penalties that have been applied collectively preserves reputational pressures.

Graduated sanctions raise s in a way that is feasible to execute repeatedly and is socially acceptable at the same time. Additionally, commitment devices make deviation costly at the moment of choice. Moreover, as monitoring and penalties are pre-announced, players often internalize expected costs, and cooperation no longer relies on moral suasion alone.

5. Conclusion

The study demonstrates here that communication is not just expressive; it alters payoffs in common-pool environments. In Andean irrigation, pre-season meetings, turn boards, and open budgeting diminish the upstream positional advantage and make sanctions credible, decreasing the cooperation threshold in the repeated game. In the Newfoundland fishery, science–industry briefings, open stock/Capelin indices, and pre-announced triggers reduce the race-to-fish advantage, increase the anticipated cost of rule-breaking, and amplify the perceived loss from too-early closures. In all cases, three frictions account for breakdowns: information frictions, power asymmetries, and incomplete enforcement, and each can be addressed through a communication-centered bundle: signal alignment, asymmetry guards, and rule-plus-talk (graded, feasible sanctions and plain commitment devices).

The contribution of this study is two-fold. Theoretically, the study graphs communication onto primitives, temptation payoffs, sanction likelihoods, contribution cost, and system loss parameters, making theory clear about the way talk, cues, and enforcement change self-enforcing cooperation's discount-factor thresholds. Empirically, it formulates the model in actionable design with roles, routines, and metrics (e.g., variation in turned-delivered length, compliance dashboards, CPUE stability). The model offers ministries, river-basin authorities, and fisheries managers a mobile playbook for reviving output and trust and staying clear of costly top-down law enforcement.

The study is based on secondary data and stylized models that simplify heterogeneous preferences, multi-species interactions, and climate shocks to simple parameters. Errors in monitoring and social networks are handled implicitly instead of being modeled. Future studies should (i) gather original data on content of communication, frequency of meetings and sanction incidence; (ii) incorporate imperfect public monitoring and network structure into the repeated-game; (iii) subject minimum bundles to field pilots (randomized roll-outs of gauges, rosters, observer coverage); and (iv) assess distributional effects so that reforms advantage tail-enders and small-boats without introducing new inequities. By iterating between measurement and model, policy can advance from plausible design to auditable, self-enforcing cooperation in fisheries and irrigation alike.

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