Institutional Analysis of

Calaoaan Irrigation System

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The irrigation system in Calaoaan, located in Santa Cruz Municipality, Ilocos Sur, the Philippines, as documented by De Los Reyes (1980), represents a classic case of successful Common Pool Resources (CPR) management. Water scarcity and collective maintenance formed the core challenges of governance in the region's rice irrigation system, which irrigated three barrios, namely Calaoaan, Villa Laurencia, and Gabor. A total of 71 farmers depend on a single natural water source, the Canayon Creek. Their preferred rice varieties were the high-yielding ones developed by the IRRI. The system also supplied water to the 40 members of the upstream Bugbuga system. The absence of a formal water-sharing agreement between the two systems deepened the collective action dilemma, as both systems relied on water from the same source with limited flow during the dry season. There was no coordination between the non-member upstream Bugbuga irrigation system and the association of farmers. However, there was no reported tension in the original CPR. The transaction costs of managing the irrigation system, such as time spent in obras, monitoring the rotation schedule, attending meetings, and enforcing the rules, were collectively done by the farmers, which were essential for sustaining the irrigation system.

Part A: Static Analysis – Collective Action

1.1 The Commons Dilemma

Seasonal variations in water availability added to the complexity of the CPR management. During the wet season from July to November, Calaoaan farmers cultivated rice on approximately 150 hectares of land. When the creek dried up in December, farmers switched to tobacco cultivation and irrigated the land by pumping water from open wells. This seasonal variation in water flow produced both coordination problems and equity in water distribution.

Although there were no formal water rights or formal management authority, a cooperative association formed in the early 1940s manages the collective rules for water allocation, maintenance, and sanctions for rule violations. There were incidents of violations where farmers diverted water outside their assigned rotation or failed to participate in obras (collective labor for maintenance of the dam). Sanctions were not always strictly imposed, association leaders enforced those on several occasions that served as a warning to other members.

The Calaoaan irrigation system is a representation of how informal institutions, social structure, and rotational irrigation helped mitigate appropriation and provisioning of the CPR dilemmas in the absence of formal and legal recognition.

1.2 Biophysical Context (IAD)

1.2.1 Natural Infrastructure

The water was shared between the upstream Bugbuga system, serving around 40 users and the downstream Calaoaan system, serving 71 farmers without any formal water-sharing agreement. This shared dependency on a single source of water created natural constraints that shaped collective action among the Calaoaan Framers.

The highly seasonal rain-derived water flow during the July and November periods provided sufficient water for irrigating. During the dry season from December to June, the creek often dried up completely, forcing farmers to rely on pump-powered open-wells to irrigate tobacco cultivation. This pronounced temporal variability limits the system to one primary rice cropping season per year.

1.2.2 Hard Human Infrastructure

The dam was first built under the leadership of two prominent farmers in the 1940s. Presidential Arm on Community Development (PACD) provided technical support to construct the first concrete dam between 1964 and 1965. After it was damaged by a typhoon in 1967, the association reinforced the damage in 1968 with cement they received from the Green Revolution movement. The National Irrigation Administration reconstructed the concrete dam between 1972 and 1973 at the association's request.

This version of the dam includes;

- A two-kilometers long earthen main canal spread into six sub-canals.
- A total 71 take-off points consisting of 60 bamboo tubes and 11 rubber hoses, allocating one outlet per farmer.
- A concrete headgate that regulated water flow into the main canal.
- Secondary water distribution waterways managed collectively by the obras (group labor).

The concrete-built main infrastructure and the headgate of the dam remained stable over the years. However, the earthen canals needed regular maintenance and reinforcement to avoid land erosion and leakage. The structures embodied collective community investment in forms of labor and shared maintenance aligned with the long-standing norms of collective action for shared benefits.

1.3 Attributes of the Community

1.3.1 Social Structure

As stated earlier, the Calaoaan irrigation system is governed by an association of farmers, established in the 1940s. At the time of the study in 1980, the association had 71 members covering irrigation of nearly 150 hectares in three barrios, namely Calaoaan, Villa Laurencia, and Gabor. The association was led by a board of directors consisting of the Chairman, Vice-chairman, Secretary-treasurer, and seven other sectoral directors (arindador) who oversaw the small-scale CPR in three sectors: East, Center, and West. Only the Secretary-treasurer, who was the barrio treasurer of Villa Laurencia, held two positions. He maintained meeting minutes, member list, member yields, records of obras and collection of fines.

Social unity was reinforced by collective dependence on Canayon Creek, kinship ties, and norms of reciprocity. Rules were imposed primarily through peer-based monitoring and moral obligation, while sanctions acted as deterrents for water theft, selling of drainage water, absence from and tardiness during obras, and absence from meetings held after obras. In brief, the Calaoaan social infrastructure was defined by strong community trust, trust in stable leadership, and a strong tradition of obras that enabled effective self-organization in managing this small-scale CPR.

1.3.2 Human Infrastructure

The human infrastructure of Calaoaan was built on generations of collective farming experience and adaptive management by the farmers. Most farmers were smallholders with strong local knowledge of water flow, soil conditions, and cropping patterns and timing, which enabled them to coordinate effectively in varying rainfall. The leadership remained stable and strongly trusted by the community of farmers, with the Chairman, Vice-chairman, and sector directors oversaw the consensus-based rotational irrigation system rather than being managed by a formal authority.

The management capacity of the community was based on obras, where farmers collectively repaired canals, shared skills, and coordinated irrigation schedules. These repeating works functioned as informal training that strengthened both competence and social cohesion of the community. In brief, the human infrastructure of Calaoaan reflected

a mix of embedded ecological knowledge, leadership strength, and mutual learning that allowed the system to sustain and perform despite limited technical support or legal recognition of the association.

1.4 Rules in Use

1.4.1 Position Rules

a) The Chairman and Vice-chairman supervised the overall operation and maintenance of the system.
b) The Secretary-treasurer maintained meeting records, obra attendance, and fines.
c) Three Sector-directors for East, Center, and West zones were responsible for water distribution.
d) The farmers (association members) contributed labor and followed the rotational schedule. The NIA provided periodic technical assistance but did not manage operations.

1.4.2 Boundary Rules

a) Membership of the association was spread across 150 hectares of rice-cultivating lands.
b) Membership was subject to owning or inheriting land that reinforced the continuity among member households.

1.4.3 Choice Rules

a) Set and enforced by the association, the East sector must receive water on Monday–Tuesday, the Center sector must receive on Wednesday–Thursday, and the West sector must receive on Friday–Sunday.
b) Association members must attend the weekly obras during the wet season but were only excused from joining the meeting unless summoned by government authorities, had become sick, or had to attend a baptism, wedding, or funeral rite, and other essential obligations.
c) The absentees must pay fines for repeated violations, suspension of irrigation rights.
d) The farmers must not sell or steal irrigation water.

1.4.4 Aggregation Rules

a) Election of office bearers, obra schedule, and sanction revisions were made collectively by majority consensus in biannual general assemblies.

1.4.5 Scope Rules

a) By participating in and complying with the rotational allocation of the irrigation water and obra system, every member of the association got an equal share of water and mutual benefits from the obra.
b) Each farmer had one dedicated takeoff point connected to the main canal from where he received his share of irrigation water.

1.4.6 Information Rules

a) The Secretary-treasurer kept the meeting minutes, obra records, and the yield reports accessible to the association members.
b) Informal communication and observation during fieldwork ensured quick detection of rule violators, reinforced by close social ties among association members who lived in proximity.
c) Public announcements of the rotational schedule in meetings ensured transparency, thereby mitigating conflicts in accessing irrigation water.

1.4.7 Payoff Rules

a) Non-compliance resulted in fines ranging from ₱2 to ₱30, depending on the nature of offense (ranging from non-attendance in obras and meetings and stealing or selling of water) and output of rice yield.

b) Persistent offenders risked being brought before a formal higher authority, such as the court, community censure or higher fines.

1.5 Vulnerability Assessment

The system's dependency on a single source of water created by seasonal rainfall and the lack of water rights, and absence of formal water sharing agreement with the Bugbuba community make the Calaoaan Irrigation System institutionally vulnerable. Although there is no evidence of withdrawal of water by the upstream Bugbuba community, the Calaoaan irrigation system is vulnerable in the event of drought, prompting the Bugbuba community to withdraw water for their own water security. Being positioned on the upstream, the Bugbuba community had control over the water flow to the downstream.

Additionally, the system's reliance on groundwater for water-intensive tobacco cultivation during the dry season is highly likely to reduce groundwater levels and reduce the land fertility by exhausting nitrogen and potassium, making the landscape ecologically vulnerable. As a consequence of the introduction of tobacco by the colonial Spanish regime, farmers most likely improved soil conditions for rice cultivation in the later years, thereby increasing rice production costs.

1.5 Summary

The Calaoaan irrigation system is a fine example of how, in the absence of a formal governance system, a small-scale and locally managed system can form and operate efficiently. The system was built on community cohesion and mutual trust, operating successfully without any formal or legal recognition. The system's locally enforced rules sustain a functional CPR under seasonal scarcity. However, the system was dependent on exogenous drives such as the Presidential Arm on Community Development (PACD), the Green Revolution movement, and the National Irrigation Administration to sustain shocks.

2 Last Update:

Calaoaan is a barangay in the city of Candon, in Ilocos Sur province. Its population 2020 Census was 2,608 according to the 2020 Census. Although there is no specific mention of the population of Calaoaan at the time of writing the original CPR in 1980, it can be assumed that the population has significantly increased. This suggests the possible existence of an improved irrigation and soil management system. No evidence could be found on whether the same association still exists, first formed in the 1940s. However, according to the National Tobacco Administration (NTA) of the Philippines website, there is an existence of Communal Irrigation System covering three barrios Calaoaan, Villa, Laurecia, Lantag (CAVILALA)[1]. The CAVILALA system supports 120 farmers in cultivating tobacco across 78 hectares of land. In 2015, the system received ₱ 10,000,000.00 under the Small Farmers Irrigation Support Project[2] for Small Tobacco Farmers, indicating a reliance on exogenous drivers such as the NTA.

Case Contributions

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[1] Services. (n.d.). https://www.nta.da.gov.ph/irrigsupport.html

[2] https://www.dbm.gov.ph/images/pdffiles/NTA.pdf