

Comparative Institutional Analysis of Small-Scale Fisheries and Irrigation Systems

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1 Part I: System Structure - Collective action

We compare three artisanal fisheries (Case No. 9: Lagoon fishery in Greece; Case No. 10: Kembong fishery in Thailand; and Case No. 15: Green turtle fishery in Nicaragua) and tangentially draw on three small-scale irrigation systems (Case No. 53 and Case No. 60 in South India, and Case No. 73 in Bangladesh) in order to understand the impact of hard infrastructure on the prospects of collective action with specific reference to the rules-in-use related to common pool resource (CPR) management. Based on the small subset of cases examined, we find that as the heterogeneity of hard infrastructure increases, efficiency achieved by regulation decreases due to the increasing incongruence between rules-in-use, appropriation and provisioning behavior, and local conditions.

1.1 The Commons Dilemma

- **Potential over-appropriation / poor coordination of appropriation:** In two of the examined fisheries (Nicaragua and Thailand), hard infrastructure (new fishing technologies) and improved access to markets has in the past and continues to facilitate local over-appropriation of scarce marine stocks (endangered green turtles and kembong). Large capital investments and ongoing maintenance costs for fishing equipment in the Greek fishery is driving rule breaking behavior and over-appropriation by cooperative fishermen, whereas poverty and lack of employment opportunities are leading independent Greek fishers to circumvent rules and overexploit marine resources.
- **Potential under-provisioning of public infrastructure:** All three fisheries are lacking effective monitoring and sanctioning mechanisms. Traditional harvesting norms are being eroded in both the traditional turtle and kembong fisheries by economic incentives driven by poverty and access to markets. Poorly structured and uncoordinated harvesting rules at multiple governance levels confuse who has authority and when (contemporary turtle and kembong). Lack of public infrastructure to provide, e.g., subsidies for, or lower tax rates on cooperative fishers reported catch rates, and create a social safety net and alternative income opportunities for independent fishers, represents an under-provisioning of public infrastructure in the Greek fishery.

1.2 Biophysical Context (IAD)

- **Natural infrastructure:** All three fisheries operate in coastal marine environments and target commercially valuable, yet increasingly rare, species. Except for the Greek

lagoon fishery which is spatially confined to an area of the lagoon that is 12.5 km (7.8 miles) long and 350 m (0.2 miles) wide that is leased to cooperative fishermen and an additional unleased area nearby that is legally accessible to independent fishermen, the fisheries in Nicaragua and Thailand operate across vast tracts of their respective coastal marine areas. Marine stocks targeted in the Greek lagoon are mullet, sea bream, eel, and sea bass. The Thai fishery targets kembong, a commercially valuable Mackerel species, and the Nicaraguan fishery focuses on endangered green turtles.

- **Hard Human-made infrastructure:** New hard infrastructure introduced in the Nicaraguan green turtle and Thai kembong fisheries includes turtle nets and motorized boats (Nicaragua), and nylon nets and outboard engines (Thailand). In Greece, cooperatives use motorized boats, fences, traps, and nets, while independent fishers are restricted to spears, long-lines, and non-motorized boats.

1.3 Attributes of the Community (IAD)

- **Social Infrastructure:** Traditional fishery governance norms, such as reciprocal food exchanges and seasonal harvest patterns (Nicaragua), and informal meetings in coffee shops and community sorting areas which facilitated collective action (Thailand) became obsolete due to new fishing technologies. In the Greek fishery, the targeting of the same fish stock by both cooperative and independent fishermen led to intense competition which was fueled by two factors: (1) unequal access to fishing technology by the two groups; and (2) the fishing technology of one group (cooperative fishers) effectively trapped and removed the resource for the other group (independent fishers).
- **Human Infrastructure:** Human infrastructure in the Nicaraguan and Thai fisheries was initially high due to the cultural relationships, skill, and local knowledge of marine sources that individual fishermen possessed. The introduction of new hard infrastructure (gear and motorized boats) (1) eroded cultural relationships by requiring less skill and local knowledge facilitating the entry of less experienced fishermen (Nicaragua) and (2) reduced the need for large numbers of team members per boat (Thailand). The human infrastructure of Greek independent fishermen is also high as they are widely known for their spear-fishing skill and it is believed to be adequate for cooperative fishermen. In all three fisheries, governance structures and rules-in-use are inadequate to curtail overexploitation of marine stocks.

1.4 Rules in Use (IAD)

1. Position Rules:

- Any male indigenous Miskito capable of engaging in turtle harvesting activity. (Nicaraguan turtle fishery/traditional and contemporary)
- Registered members of fishing cooperatives (Greek lagoon fishery)
- Any male resident of Messolonghi, Etolico, and Neochori (independent fishers in the Greek lagoon fishery)
- Any male Malay who owns a kolek and/or is accepted as part of a kolek team (Thai kembong fishery/traditional and contemporary)

2. Boundary Rules:

- Open access (Nicaraguan turtle and Thai kembong fisheries)
- Specifically designated area of the lagoon legally assigned to cooperatives via a government leasing agreement (Greek lagoon fishery)
- Specifically designated area of the lagoon in which independent fishermen are allowed to harvest marine stocks by law (Greek lagoon fishery)

3. Choice Rules:

- Indigenous Miskito may hunt, fish for turtle, or do both (traditional Nicaraguan turtle fishery).
- Indigenous Miskito must comply with harvesting rules at various government levels (contemporary Nicaraguan turtle fishery).
- Indigenous Miskito may choose to ignore existing harvesting laws and restrictions without any repercussions (contemporary Nicaraguan turtle fishery).
- Cooperative fishermen may fish in the leased areas of the lagoon specifically assigned to their cooperative (Greek lagoon fishery)
- Cooperative fishermen may utilize motorized boats, fences, traps, and regular mesh nets.
- Independent fishermen may fish in the unleased area of the lagoon (Greek lagoon fishery).
- Independent fishermen must utilize only spears, long-lines, and non-motorized boats (Green lagoon fishery).
- Boat steerer must decide when to fish (daily and annually) and when to finish fishing (traditional Thai kembong fishery)
- Malay fishermen must register their boat with the government to access the fishery.
- All fishermen may choose to ignore existing harvesting and gear restrictions in their respective fisheries.

4. Aggregation Rules: None.

5. Payoff Rules:

- Food for community or cash for nuclear family (traditional Nicaraguan turtle fishery).
- Cash income generation through commercial turtle harvesting activity (contemporary Nicaraguan turtle fishery).
- Cooperative fishermen must pay 25 percent tax rate on gross catch income as lease fee to government (Greek lagoon fishery).
- Share distribution of catch among members of koleks with surplus sold at market (traditional Thai kembong fishery).
- Cash income generation (contemporary Thai kembong fishery).

6. Scope Rules:

- Cash payments by turtle factories in the traditional Nicaraguan turtle fishery may have hastened transition to new hard infrastructure and motivated year-round harvesting of green turtles (Nicaraguan turtle fishery). No evidence of scope rules in Greek and Thai fisheries.

7. Information Rules:

- None evident in the Nicaraguan turtle fishery.
- Greek cooperative fishermen must declare their gross catch in order to be assessed a 25 percent tax rate (Greek lagoon fishery).
- Information on current market trends and fishing conditions taken into consideration by steerer of kolek before heading out to sea (traditional Thai kembong fishery)
- Licensing of boats by Thai government after introduction of outboard engines (contemporary Thai kembong fishery)

1.5 Summary

We hypothesized that as the heterogeneity of hard infrastructure increases, efficiency achieved by regulation decreases due to the increasing incongruence between rules-in-use, appropriation and provisioning behavior, and local conditions. Although drawing only on a small subset of fishery and irrigation cases, such a trend can be observed. In the fisheries cases, hard infrastructure and market access served to replace traditional social norms that carefully balanced resource appropriation with poorly coordinated regulations at multiple governance levels. This in turn has facilitated rule-breaking and over-exploitation for individualistic economic gain. Even when access rights are clearly defined, as in the Greek lagoon fishery, unequal access to new technologies served to create social strife as the high cost of fishing gear incurred by cooperative fishers facilitated over-appropriation which, in turn, reduced resource availability to the technologically disadvantaged independent fishers leading to more rule violations. In all fisheries, the ineffective implementation of rules and/or the lack of proper monitoring and sanctioning mechanisms further magnify existing appropriation problems. In the irrigation cases, private hard infrastructure gave wealthy irrigators an advantage and reduced the ability of irrigators to enforce water regulations. In contrast, harmonizing the appropriation infrastructure led to reduced monitoring and sanctioning costs and better rule implementation.

2 Part II. Dynamic Analysis - Robustness

This institutional analysis is based on a case comparison of existing case studies within the SES Library. Accordingly, any updates that were provided through the original case studies were included in this report.

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