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The *padu* system of community-based fisheries management: change and local institutional innovation in south India

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Abstract

As a commons institution, the *padu* system in Vallarpadam Island, Cochin, Kerala, defines the group of rights holders and resource boundaries and fishing sites. It is caste-specific, gear-specific (stake-nets) and species specific (shrimp). As used in Vallarpadam, and elsewhere in Kerala, Tamil Nadu and Sri Lanka, *padu* is characterized by the use of lottery for rotational access. The institution functions in providing equitable access, collective social responsibility, and rule-making and conflict resolution. The emergence of the institution in the study area is a response to change in markets and legislation in the 1970s. It may also be seen a response of fishing communities to keep their options open, that is, to be resilient.

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1. Introduction

Small-scale fisheries are often characterized by a diversity of gears that reflect the diversity of species and ecosystems in which they operate. These fisheries, and the communities that depend on them for their livelihoods, are also characterized by an assortment of local management institutions [1–3]. In south India and Sri Lanka, one of these management systems has survived and evolved for at least three centuries. The *padu* system of fishing site rotation manifests itself in at least three distinct geographic regions where fishers are utilizing stake nets to fish for shrimp in lagoon and estuarine ecosystems. Panini [4] describes *padu* as a traditional system of granting entitlements to eligible members of a particular community to undertake specific fishing activities in certain designated fishing grounds of the lagoon during specified seasons. Mathew [5] and Amarasinghe et al. [6] have documented two occurrences of the *padu* system, one in the Indian state of Tamil Nadu and one in Sri Lanka, respectively.

To put the *padu* system and use of coastal commons in perspective, we need to go into the basics of common property theory. Common property (common pool) resources share two characteristics: (a) exclusion or the control of access of potential users is difficult, and (b) each user is capable of subtracting from the welfare of all other users [7,8]. These two universal characteristics of commons are referred to as the *exclusion problem* and the *subtractability problem*, respectively. Thus, Ostrom et al. [9] define *common-pool (or common-property) resources* as “those in which (i) exclusion of beneficiaries through physical and institutional means is especially costly, and (ii) exploitation by one user reduces resource availability for others.”

Many systems of community-based resource management address exclusion and subtractability problems by devising collective action (e.g., Kurien [10], Johnson [3]). The key is the ability of a community using a common resource to limit the access of outsiders, and self-regulate its own harvest. Common property works through incentives. If members of a group are assured that future harvests would be theirs by right, and not end up being harvested by another group, they have the incentive to self-regulate. We expand on the two concepts.

Exclusion refers to the ability to exclude people other than the members of a defined group. Many marine

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tenure systems are designed to deal with exclusion, but stresses of population growth, technology change, and economic transformation may contribute to the breakdown of mechanisms for exclusion [7]. One of the important conclusions of the literature is that the legal recognition of communal resource rights is key to success, as in Japanese coastal fisheries [11]. Without legal protection, conflicts among competing groups are inevitable and local resource use rights fragile [12,13]. Problems of exclusion become especially important in an increasingly interconnected world in which local resource rights are under pressure. Hence, attention shifts to cross-scale institutional interactions to deal with impacts at a multiplicity of levels [14].

Subtractability refers to the ability of social groups to design a variety of mechanisms to regulate resource use among members. In many community-based management systems, users have devised self-governing rules, monitoring mechanisms, and sanctions. Much of the common property literature addresses the subtractability issue, and the ability of groups to make rules-in-use (institutions). Ostrom [15] lists eight design principles for effective community-based institutions, but there may be as many as 40 design principles or critical enabling conditions important for the success of commons institutions [16].

Common property analysis focuses on institutions, looks at access and self-regulation, and asks questions about rules and who has rights and control over a resource. These rights and relationships are rarely static. Rather, they tend to change over time in response to various influences. Hence, some researchers have started to study the dynamics and resilience of common property systems, instead of describing community-based institutions as if they were fixed in time. For example, Seixas and Berkes [17] focused on cycles of resource collapse and institutional change in a Brazilian lagoon fishery, in an attempt to understand governance systems as an adaptive process. The significance of this approach relates to the ability of a community to deal with change. A *resilient* system has the ability to absorb shocks and stresses and still maintain the functioning of society and the integrity of the ecosystem on which the society depends [18,19].

The purpose of this paper is to examine the *padu* system in the stake net fishing community on Vallarpadam in central Kerala, south India. The first objective is to analyze the local property rights system, with emphasis on its origins, evolution, functions and adaptability. The second objective is to investigate the wider context of *padu* systems by comparing the Kerala case to similar systems operating in south India and Sri Lanka.

After a brief background to the study methods, followed by the study area and people, we present our findings based on field research from the stake net

fishery on Vallarpadam Island. The comparison of some of the key characteristics of *padu* systems, as illustrated by the three case studies, shows that they are in fact similar in form and function. The comparison of the three cases not only provides an understanding of institutional design principles for small-scale fisheries and systems of fishing site allocation, but it also allows some generalizations about the ability of community-based systems to address exclusion and subtractability problems in coastal marine commons. We conclude with a discussion of the emergence of common property institutions in terms of resilience. We argue that institutional change may be seen in the context of dealing with impacts and building resilience to absorb shocks and stresses.

2. Methods of study

The study community of *Vivekananda Chandrika Dheevera Sabha* was selected after visits to several locations in the area. Although the entire community was of the fishing caste and engaged primarily in stake net fishing, we focused our study on a particular subset of the community, the unlicensed stake net fishers, because of the community-based management institutions through which they regulated access to their fishing grounds and made rules among themselves.

The research methods utilized were primarily qualitative, mainly those characterized as rapid rural appraisal [20,21]. Details of the stake net fishery were gathered through a variety of methods, including participant observation and semi-structured interviews. Focus groups and key informant interviews were used for in-depth knowledge associated with the fishery (i.e. seasonal cycles and species details). Interviews with faculty at the local university, caste organization leaders and fisheries department officials provided some of the historical and administrative context for the fishery.

Interviews were the primary method used. A total of 58 semi-structured interviews were conducted, the majority of them with the unlicensed stake net fishers in the study community. About two-thirds of the target community was interviewed. Key informants in this group included leaders of the fisher organizations, and each was interviewed at least three times through the course of the research. We visited the homes of unlicensed fishers to explore livelihood details and to obtain further information on the functioning of the fisher organization. Also interviewed were officials from the state Fisheries Department, *Dheevera* caste organization and Cochin Port Trust.

Towards the end of the research period, we conducted three focus groups with 48 unlicensed stake net fishers. Since the meetings were coordinated to coincide with scheduled meetings of the three organizations,

participation was good, with over 50% of the unlicensed stake net fishers present. There were two main goals of the focus groups: to verify and cross-check details on seasonality, species harvested and gears used by fishers; and to conduct a brief survey of participants to obtain details on demography, occupational diversity and marketing. All the interviews were done in Malayalam through a translator, who was familiar with the overall project and its objectives, and who operated as a project partner.

Quantitative data regarding fishery statistics/records and maps of the area were obtained from the appropriate government offices (Marine Products Export Development Authority, District Fisheries Office—Ernakulam, State Fisheries Department—Trivandrum), and local universities (Center for Development Studies in Trivandrum and the Cochin University of Science and Technology).

3. The study area and people

South India is a rich setting for the study of community-based marine resource management systems [1,22–25]. The State of Kerala, with its traditions of social organization, high standards of social services and high rates of literacy, is where the citizen science movement in India started [26].

The Cochin Estuary (Fig. 1), where the research was conducted, is a 242,600 ha brackish water ecosystem (locally referred to as “backwaters”) that supports a multitude of livelihoods and a wealth of biodiversity.

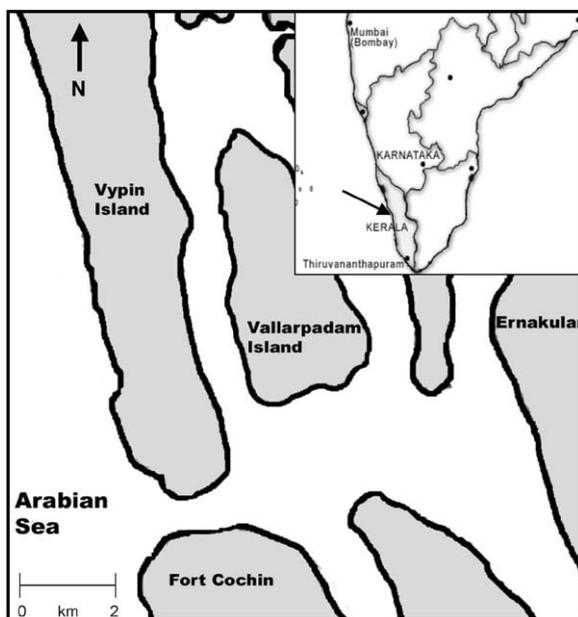


Fig. 1. The study area, Kerala State and the approximate location of Cochin.

The estuary and lagoon system is also home to one of the country's largest military and commercial ports and the city of Ernakulam (population over 700,000). One of the traditional livelihoods supported by this ecosystem is the inshore small-scale fishery. It is characterized by numerous types of fishing gear. The inshore fishery produces over 42,000 metric tonnes of fish per year, representing over 20 different species. The largest component of the harvest is shrimp, which makes up more than one-fourth of the catch [27].

Vallarpadam Island is located close to the mouth of the Cochin Estuary, and is a part of Mulavukad panchayat. It is accessible only by boat, with ferry services linking the residents with neighboring Vypin Island to the west and to the city of Ernakulam.¹ The study was carried out with the people of *Vivekananda Chandrika Dheevera Sabha* (henceforth VCDS), a caste community of Hindu fishers living on the northern end of Vallarpadam Island. The island is home to several other Hindu caste groups as well as a large number of Latin Catholic Christians, and the life of each community centres around the respective temple or church.

The residents of VCDS are members of the *Vala* fishing caste, a sub caste of the *Dheevera*. The 302 *Vala* families are represented collectively by a caste organization that serves to maintain the temple, organize festivals and provide leadership during wedding and funeral ceremonies. VCDS is linked with district and state level *Dheevera Sabhas* that serve as umbrella organizations and perform more of a political function, lobbying the state government on behalf of its members. The *Vala* caste represents the principal group of small-scale fishers on Vallarpadam. Of the 302 *Vala* families (1380 persons) in VCDS, 206 families gain an income from fishing while 117 families depend on fishing as their sole means of livelihood [28]. Fishers from this community predominantly utilize a single type of fishing gear, the stake net, or (in Malayalam language) *Ooni Vala*. They operate on seven distinct fishing grounds (called *Ooni padu*) surrounding the northern tip of Vallarpadam Island. In three *Ooni padu*, fishers operate without state-sanctioned licenses.

4. Stake net fishery and the padu system

The dominant gear used in the small-scale inshore fishery is locally referred to as a stake net (*Ooni Vala*) and is used by small-scale fishers to harvest shrimp as they migrate from the estuary back out to sea. This gear

¹A bridge linking the islands of Muluvakad, Vallarpadam and Vypin to the mainland was under construction in 2002. This link will provide road access to the city and service a transshipment container terminal, which is slated for construction on the southern portion of Vallarpadam.

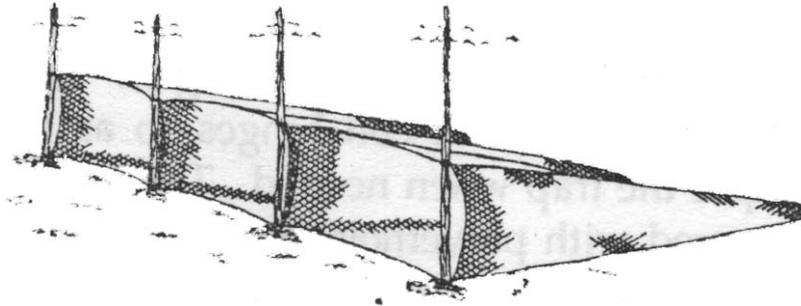


Fig. 2. The stake net (adapted from Rajan [35]).

accounts for 57% of the total catch in the estuary, and is the prevalent gear used in Kerala's backwaters, in which there are 12,900 nets [29]. The stake net is a bag-shaped trap net that is attached to permanent stakes that are fixed to the bottom. A typical stake net in the study area is a conical bag, 7–15 m long with a circumference of 16 m or more at the mouth. It is a passive gear that filters the outflowing tide (Fig. 2). The stakes are generally set up in long rows, called *Ooni padu*, in areas of strong tidal currents.

Each of the seven stake net fishing *padu* grounds at the northern tip of Vallarpadam Island has a specific name and a specified number of stake net fishing sites (Fig. 3). There are a total of 288 stake nets operating in these seven *padu* grounds, and 126 fishers utilizing them, all of them members of the *Vala* fishing caste, and all residents of VCDS. These 126 fishers can be further divided into two distinct groups—those who have state sanctioned licenses (48 fishers) and those who do not (78 fishers). Four of the *padu* grounds (consisting of 144 stake net sites) are used solely by the 48 licensed fishers. The sites in these four *padu* grounds are allocated to specific fishers and are never changed—i.e. the license is specific to the site in the *padu* grounds. Licenses for this group of fishers are renewed yearly by the Kerala State Fisheries Department for a nominal fee. The remaining three *padu* grounds (consisting of 144 fishing sites) are used by the group of 78 unlicensed stake net fishers. Table 1 provides a breakdown of each of the *padu* grounds by number of fishers and their legal status.

This study focuses only on the unlicensed fishers. These three groups of fishers, on three *padu* grounds, use a system of rotational access. The three groups are represented by *sanghams* (Malayalam for association or society). While the three *sanghams* share a common system for fisheries management, and fish the same waters with the same gear, they are not linked to each other. Rather, each *sangham* operates independently to assign fishing rights for the *padu* grounds in which their members fish. The three *sanghams* are not formally recognized by the state fisheries department, but they are registered with the State Registrars office at the High Court of Kerala. It is probably accurate to say that

sanghams are recognized by the Kerala State government, but that their actual functions for management of the fishery are not recognized. Following an examination of the evolution of the *padu* system and the *sanghams*, we discuss the main functions of *sanghams*.

5. Evolution of the *padu* system and the *sanghams*

The system currently in use among the unlicensed stake net fishers on Vallarpadam is not associated with the local *panchayat* (the lowest form of government organization) or the caste organization. This in itself is interesting, given Kerala's emphasis on decentralization of decision-making authority to the *panchayat* level. The fishers in the study community are using a community-based management system, and have created an independent institution—the *sangham*—to facilitate the *padu* system of fishing site allocation for each fishing ground. Stake net fishers from Vallarpadam do not refer to their management system as a *padu* system. However, since all of the locations for stake net rows in the vicinity of the island were named with “*padu*” as the suffix (which in Malayalam translates as “fishing site” or “spot”), and since there are other *padu* systems in South Asia (see Section 6), that is the term we use.

The Kerala Fisheries Department became autonomous in 1967 and attempted to institute licensing arrangements for the fishery, replacing an older system of land and fishing site holdings, called *pattayam*. Beginning in 1974, state legislation required state-sanctioned licenses for all fishing. In the stake net fishery, this officially replaced the *pattayam* system and is one of the factors that precipitated the situation in which the resource reverted to an open-access condition. The fisheries department lacked staff, money and equipment to enforce the legislation, resulting in two decades of conflict over access to the productive fishing grounds.

The period from 1973 to 1980 appears as a critical time of change for the stake net fishery of Vallarpadam, as it was marked by conflict over access to the stake net fishery and the *padu* fishing grounds traditionally used

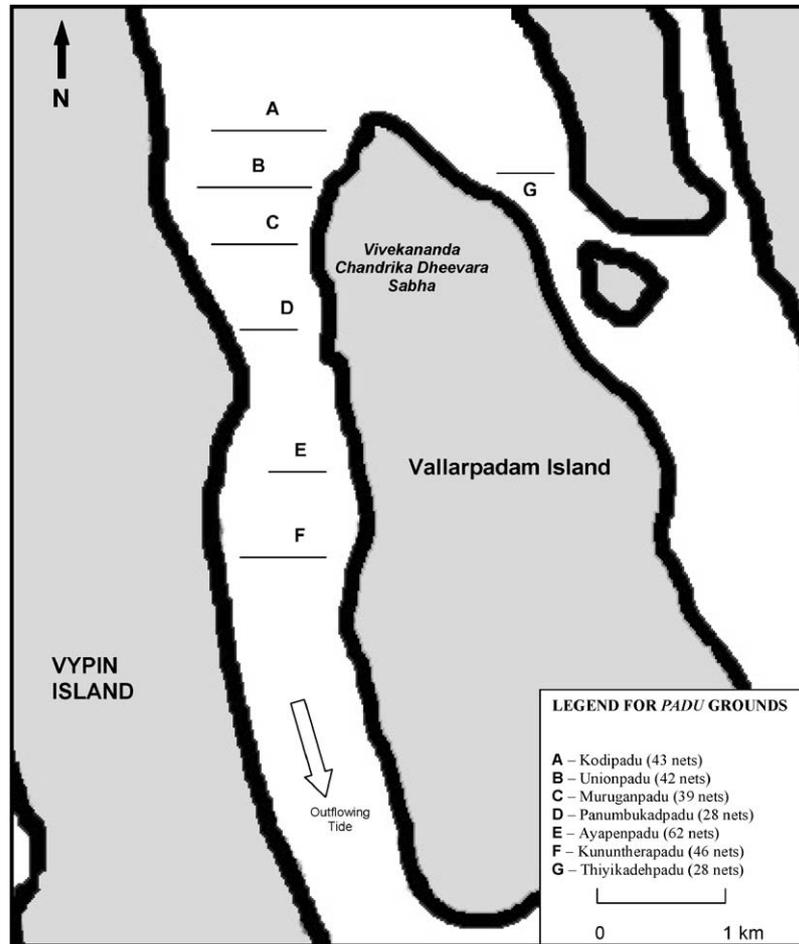


Fig. 3. The locations of the three unlicensed and four licensed fishing or *padu* grounds of Vallarpadam Island, Kerala.

Table 1
Details of *padu* fishing grounds, Vallarpadam Island, Cochin area, Kerala

| <i>Padu</i> ground name | Legal status | No. of stake net sites | No. of fishers |
|-------------------------|--------------|------------------------|----------------|
| <i>Unionpadu</i> | Licensed | 42 | 21 |
| <i>Panumbukadpadu</i> | Licensed | 28 | 15 |
| <i>Kununtherapadu</i> | Licensed | 46 | 6 |
| <i>Thiyikadehpadu</i> | Licensed | 28 | 6 |
| <i>Kodipadu</i> | Unlicensed | 43 | 21 |
| <i>Muruganpadu</i> | Unlicensed | 39 | 26 |
| <i>Ayapenpadu</i> | Unlicensed | 62 | 31 |
| Total | | 288 | 126 |

by residents of VCDS. In 1974, corresponding with the boom in global shrimp markets [1] and the new fisheries legislation, a group of 21 *Vala* families from VCDS installed a row of unlicensed stake nets 300m north of *Panumbukadpadu*, one of the traditional *pattayam* rows which had received license from the state. The fishers from *Panumbukadpadu* complained to the Kerala State Fisheries Department, asking them to remove the

stakes. The 21 families who had formed this row (*Unionpadu*) took the matter to the municipal courts and received a stay order based on the grounds that they were fishermen by profession (caste) and that this was their livelihood and their right as members of the *Vala* caste. This process finally concluded in late 1979 when official licenses were granted to the fishers from *Unionpadu*.

The precedent for challenging the state-sanctioned property rights regime for the shrimp fishery had been set and other challenges would soon follow. Three more rows of unlicensed nets appeared in the early 1980s, challenging the state for the right to fish shrimp based on traditional caste-based occupation as fishers. The establishment of these later three rows marks the culmination of collective action on the part of the fishers who wanted access to the stake net fishery (Table 1). Interviews with members of these groups confirm that they did so in order to cash in on the profits from the lucrative shrimp fishery. The challenge presented by these three groups differed from the earlier challenges, in that the fishers organized in order to present their collective claim to the stake net fishery as their caste-based right.

The first of the three *sanghams* to emerge in the early 1980s was made up of 21 families from VCDS who came together to form the stake net row of *Kodipadu*—a row with 43 unlicensed stake net locations. After a period of conflict, the *Kodipadu sangham* presented a petition to the High Court of Kerala in 1987 arguing for their caste-based right to the stake net fishery. As a result of their action, a stay order was issued which prohibited the fisheries department from removing their “illicit” stakes from the backwaters, but licenses were not granted. Following the issuance of this stay order, two other *sanghams* formed to claim similar rights, creating the unlicensed rows of *Ayapenpadu* (31 families) and *Muruganpadu* (26 families). According to interviews with *sangham* leaders, they did so based on the precedent set by the members of *Kodipadu*.

Considering their “illicit” status (the term locally used by the fishers themselves), *sanghams* are well organized. The structure of the *sanghams* includes a president, vice-president, treasurer and a secretary who are elected annually by the *sangham* members. The *sanghams* are registered with the State Registrar’s office at the High Court, and have a set of rules governing their operation. Formal meetings are held several times each year, during which issues related to the *sangham* are discussed, fishing locations assigned and rules made. The *padu* systems governed by the *sanghams* have three basic functions: facilitating equitable access, providing collective social responsibility, and providing mechanisms for conflict resolution and rule-making. We deal with each in turn.

5.1. Facilitating equitable access to fishing grounds

The stake nets are fished with the stakes planted in long rows. The location of the row in the channel is an important factor in determining the amount of catch, but equally important is the specific location of a net in the row. For example, the secretary of the *sangham* for *Ayapenpadu* (a row with 62 nets) identified stakes 15–21 and 45–52 as the best locations in the row. The President of *Muruganpadu sangham* stated that those fishing in the best locations could expect double the income as compared to those at other locations on the same row.

One of the key elements of the *padu* system is the attempt to redistribute the catch fairly among the fishers by rotating access to fishing locations. All of the *sanghams* in the study area have instituted a lottery system that rotates access to fishing locations to ensure equal opportunity to prime fishing locations.

Meetings are called once a year by the *sangham* for all members to draw lots. Participation is generally very high, as the lottery is important in determining a fisher’s livelihood for the coming year. The name of each fisher in the *sangham* is written on a small piece of paper, folded, and placed into a brass pot. For example, there

are 21 fishers in *Kodipadu* and so there will be 21 names in the pot. A second pot is filled with 21 folded pieces of paper, with the numbers one through 21. Members will take turns randomly drawing a name from the first pot and a number from the second pot to determine the location of one of the two nets. The second net location is determined by the same draw, so that if fisher A has drawn the number 1, he will fish at location 1 and 22 on the row. Fisher B, who has drawn number 2, will fish at location 2 and 23, and so on. The drawing of lots is repeated each year so that the chance at the prime fishing locations is randomized from year to year. This system is in place in all of the three *sanghams*.

An interesting variation to this system on one of the *padu* sites illustrates the adaptability of the system. Until 1996, there were 52 nets on *Muruganpadu* and 26 fishers in the *sangham*. Their lottery system operated as above with two nets per fisher. However, due to increased sedimentation of the channel in which their nets are located, it was decided collectively that the 13 net sites most affected by the increase in sedimentation should be removed from the row. This left the fishers with only 39 locations to share among the 26 members and required a modification of the lottery process. It was decided that locations 1–26 would be selected using the usual lottery arrangement, but that each of the nets from 27 to 39 would be rotated between 2 fishers who would share access to the location. The two fishers who were allocated locations 1 and 2 on the row would share location 27; those allocated 3 and 4 would share location 28, and so on. On any given day, fisher A would tie his net at the shared location and on the following day fisher B would use this site. The decrease in the number of net sites has meant less income, but the decision was arrived at collectively and allowed for all members of the *sangham* to maintain equitable access to the remaining productive locations.

5.2. Providing collective social responsibility

Each of the three *sanghams* has a measure of collective responsibility incorporated into its structure and function. These measures include financial support for families in the event of the death of a family member or on the occasion of a marriage. *Sanghams* make collective donations to the temple during important festivals. *Sanghams* implement shared responsibility for maintenance of the stakes on the row. These measures are supported in one of two ways. In *Kodipadu* and *Muruganpadu*, the *sangham*, and the funds required for the collective well-being of their members, are funded by auctioning a *sangham* net. In *Ayapenpadu* the funds are collected as the need arises. Each will be discussed below.

Kodipadu and *Muruganpadu* incorporate an additional net to their rows, a net owned by the *sangham*. It

is auctioned to members once every fifteen days on *Egadashi* (which is the beginning of lunar cycle and time of best fishing) when the nets are being set. The timing of the auction ensures that all members of the *sangham* are present and there is equal opportunity to participate in the auction. Each fisher places a bid in the silent auction, which is facilitated by the president of the *sangham*. The bids received depend largely on the season and the recent catch; fishers are aware of these details before submitting their bids.

The auction winner gains access to the *sangham* net for the next 14 days and is entitled to fish at the location until the following *Egadashi*. If the auction winner does not pay the *sangham* for his bid before the day of the next auction, one of his own locations will be auctioned for the next fifteen-day fishing cycle to make up for the amount owing. The money collected from the auction is used for the functioning of the *sangham*. It provides a bonus to all of its members during religious festivals (usually 250 rupees per family); funds for the Dheevara Sabha temple (1000 rupees per year); and the functioning of the community school. In addition, the *sangham* provides a donation to families in the event of a death or on the occasion of a marriage (500 rupees).

Ayapenpadu had a *sangham* net, but decided to remove it due to the increased sedimentation in the channel. The *sangham* continues to provide donations to members for weddings and funerals (500 rupees) but the money is obtained through informal collections from the members. Additional funds are obtained by charging a fee for renting out fishing locations. The locations can be rented out to other members of the *sangham* on a yearly basis. The renter and the owner must pay the *sangham* 500 rupees each to facilitate the transfer which must be cleared in writing through the *sangham*. This arrangement allows for the fishers to take on short-term work while maintaining their membership in the *sangham*. Until recently, such transfers were permitted only between members, but a new rule was made for the renting of fishing locations to non-members as well, provided they are *Vala* caste members.

In addition to the collective responsibilities mentioned above, *sangham* members also bear the collective responsibility for maintenance of the row. In all of the *sanghams*, a committee is appointed for row maintenance and stake replacement. At the time of year when locations are assigned, the *sangham* determines the state of repair of the stakes. Fishers are asked which stakes are in need of repair, and then a day is set for repair or replacement of the stakes. The process for replacing stakes requires two canoes and six persons. The *sangham* pays for the cost of the boat rental (if required) but the cost of the stake (175 rupees) and the wage for the committee member workers (50 rupees per person) is paid by the individual who has been fishing at the location. The replacement generally takes between one

to two hours and is undertaken when there is no tidal current.

5.3. Providing mechanisms for conflict resolution and rule making

The third function served by the *sanghams* is resolving internal conflicts among members, and making rules to facilitate the operation of the *sangham*. Conflicts within the *sangham* are dealt with during meetings called by the *sangham* officials. Issues are presented orally or in writing, and often center around the allocation of fishing sites, more specifically the right to use another fisher's location should he be absent at the time when the nets are set. When disputes between two parties could not be resolved informally, they are taken to the *sangham* for resolution, with the elected leaders serving as arbitrators. It should be noted that conflict resolution mechanisms only apply to fishers of the same row, as there are rarely instances in which fishers will set their nets on a different row. Since no formal linkages exist between the three *sanghams*, there is no mechanism to deal with such a conflict.

Ayapenpadu dealt with the problem of fishing rights to locations in the absence of right-holders, by allowing the boat partner of the absent fisher to set his nets at the location and keep the catch. In this case, the rules were informal and there were no sanctions in place to enforce them. If a member was sick or physically unable to set his nets, other members would set and collect his nets giving his family the full amount from the catch. A written application was required from the sick member to the *sangham* in order to facilitate this process and avoid misunderstandings and potential conflicts.

Kodipadu adopted a different approach to deal with the allocation of fishing rights to an absent member's location. At one of the *sangham* meetings that took place during the research period, a rule was instituted stating that when a fisher was absent, the fisher at the neighboring location (higher number) had the right to fish his location. The rule came about as a result of a specific conflict between two fishers that had been addressed in writing to the *sangham* officials. During the meeting, there was a heated discussion after which consensus was reached, a decision made and a sanction put in place to ensure compliance.

While the *padu* system attempts to ensure equitable access to the fishing grounds, it also prohibits fishing during the incoming tide when shrimp are migrating in from the sea to the backwaters. Fishers were keenly aware of the importance of allowing the shrimp to enter the backwaters to breed. As one fisher stated "if we take them now, we won't get the catch on the way out". Sanctions to enforce this rule were different for each *sangham* and ranged from written warnings to fines of

100 rupees. In the case of repeated infractions, offenders faced expulsion from the *sangham*.

6. Regional context of padu systems

A number of community-based fisheries have devised elaborate management systems that serve to address questions of equity, distribute access rights, and mediate conflict. Rotational access systems based on lottery are not unique to South Asia. Berkes [30] provides a case study of a small-scale fishery in Alanya, Turkey, in which local fishers devised a lottery system to allocate fishing rights to productive trammel net fishing sites in an equitable manner and to reduce conflict. The classical example of systems of rotational access is Alexander's [23] study of a beach-seining community in southern Sri Lanka. In a fishing community with only two good sites available for seining, fishers developed an elaborate rotational system of access for the equitable use of the limited fishing grounds. They did so by limiting the access to the fishery, numbering all of the nets used, and using a lottery to allocate sites. Alexander [23] uses the term *padu* to refer to fishing grounds, but we focus on two other *padu* systems that use stake nets and provide a direct comparison with the current case.

The word *padu* is used to mean “site” or “location” in Sri Lanka [23] as well as in Tamil Nadu and Kerala; more generally, the term refers to the system of rotational access in stake net fisheries [5]. According to the fishers of Pulicat Lake, Tamil Nadu, *padu* has been practiced since “time immemorial” [5]. The use of the term appears with reference to fishing sites in three distinct geographic regions: Pulicat Lake in the State of Tamil Nadu, south India; the Negombo Estuary in Sri Lanka [6], and our case from Kerala (Table 2).

Despite the diversity in approaches to allocate access, there are a number of characteristics that allow for comparison of these three *padu* systems. The first of these categories, people and institutions (items Ia–c in Table 2), identifies and describes the role of the *padu* system in defining a group of rights holders, its caste specific nature and the role of institutions in the functioning of the system. The second category (IIa, b) identifies and examines how the *padu* system determines boundaries for fishing grounds and further defines the actual fishing sites shared by members. The third category is about the operation of the *padu* system which is characterized by the use of specific gears to catch specific species and the use of a lottery system to allocate access to the fishing grounds.

The *padu* system emerges as a general system with locally adapted institutions that address critical manage-

Table 2
Characteristics of the *padu* system, Tamil Nadu [4,5], Sri Lanka [6], and Kerala (this study).

| | Sri Lanka Negombo Estuary | Tamil Nadu Pulicat Lake | Kerala Vallarpadam |
|--|---|---|--|
| (Ia) <i>Padu</i> defines the group of rights holders | Four Rural Fisheries Societies (RFS) share access to the fishing grounds. Total of 345 eligible male fishers | Three villages share access to the fishing grounds. Total of 558 eligible male fishers | Three <i>sanghams</i> (society or association) allocate access to fishing grounds. Total of 78 eligible male fishers |
| (Ib) <i>Padu</i> is caste specific | All fishers are of the same caste and are Roman Catholic | Members of fishing caste— <i>Pattanavar</i> , both Christians and Hindus | All of the fishers are Hindu and members of the same caste— <i>Dheevara</i> . |
| (Ic) <i>Padu</i> specifies institutional basis of rights holders | The Roman Catholic Church facilitates sharing of fishing grounds between the four RFS. Each RFS then operates their lottery independently | Sharing of the fishing grounds among the three villages is organized by the caste organization. Individual villages operate the lottery independently | Each fishing ground operates independently; no coordinating institution. Lottery system run by individual <i>sanghams</i> |
| (IIa) <i>Padu</i> defines the geographical boundaries | Fishing takes place close to the opening of the estuary into the sea | Fishing grounds are located close to the estuary opening to the sea | Cochin Estuary, Kerala—India. Fishing grounds are located near the estuary |
| (IIb) <i>Padu</i> defines fishing grounds and sites | Two main fishing grounds which are divided into 22 fishing sites which can accommodate 65–68 stake nets | Three main fishing grounds which are further divided into 25 sites which can accommodate 56 nets | Three main fishing grounds are divided into a total of 78 sites which can accommodate 78 stake nets |
| (IIIa) <i>Padu</i> is gear specific | Stake-seine net | <i>Suthu Valai</i> (stake net) | <i>Ooni Vala</i> (stake net) |
| (IIIb) <i>Padu</i> is species specific | Shrimp—82% are sub-adults of paeneid shrimp; of these, 70% are <i>Metapenaeus dobsoni</i> | Shrimp—primarily <i>Paeneus indicus</i> | Shrimp— <i>Metapenaeus dobsoni</i> , <i>M. monoceros</i> and <i>Paeneus indicus</i> |
| (IIIc) <i>Padu</i> uses a lottery for site allocation | The four RFS rotate access to fishing sites on a daily basis using a seven day cycle and a yearly lottery to assign starting points | The three villages rotate access to the fishing sites on a daily basis within a monthly cycle of assigned days; yearly lottery | The three <i>sanghams</i> organize lotteries for allocation of access; lottery takes place once per year at the annual meeting |

ment issues for small-scale lagoon and estuary shrimp fisheries. Despite the similarities apparent in Table 2, there are two areas in which there remain significant differences among the three cases: cross-scale institutions (or nestedness) and legal recognition. Both are critical elements of Ostrom's [15] design principles for effective institutions, and both play key roles in facilitating the management of resources at the local level.

In the Negombo Estuary, institutions are nested (organized hierarchically) from the village to the lagoon level. Amarasinghe et al. [6] identify the facilitating and organizing role of the Roman Catholic Church with the four individual Rural Fisheries Societies (RFS) as one of the reasons for the effectiveness of the *padu* system. In the case of the Pulicat Lake fishery, the *padu* system links across several scales. The *panchayat* facilitates the *padu* system for three villages. The elaborate system of sharing allocates rights amongst the three villages, but is coordinated at the level of the fishing caste organization. This linkage addresses, and in most cases resolves, the competition for the limited number of fishing locations. In the case of the *padu* system on Vallarpadam, by contrast, each *sangham* operates independently. They are not linked to one another, or to any state or caste organization.

Legal recognition of traditional management represents a crucial step in empowering fishers to manage their resources. In the Negombo fishery, the four RFS have been given legal status by the *Negombo (Kattudel) Fishing Regulations*, and resource sharing practices are reinforced by government regulations [6]. In Tamil Nadu, legal protection is weaker. The fishers have the right to organize, but have no territorial use rights on the *padu* grounds. The community-based management system is not recognized by Tamil Nadu State law [5]. Finally, the Kerala case is weaker still. In the unlicensed stake net fishery on Vallarpadam, the three *sanghams* are recognized by the State, but have no standing before Kerala Fisheries Department. The "illicit" fishers have neither licenses nor legal authority to manage the fishery.

7. Discussion and conclusions

The comparison of the three *padu* systems is useful because it permits generalizations about factors that provide for successful resource management. In the Negombo fishery, shrimp fishers are able to resolve both the exclusion and the subtractability problems of commons management. They solve the exclusion problem through the limitation of membership in the four Rural Fisheries Societies (RFSs). All shrimp fishers are members of the RFSs, and all RFS members can harvest shrimp with stake nets. They are subject to the rules

made by each of the RFSs at the local level, coordinated across the four RFSs at the regional level, and backed up by the government. Hence, rules are nested across three levels of organization. The Negombo fishery has lived through cycles of conflict and crisis by being able to reorganize itself and adapt to new conditions. It appears to be biologically, economically and socially successful under these arrangements [6,31] not because these arrangements are perfect, but because they provide a measure of resilience for the local common property institutions.

The Pulicat Lake fishery in Tamil Nadu shares some of the characteristics of the Sri Lanka case. The three villages carry out their lottery activities at the local level, further facilitated by the caste organization. The entry into the fishery at both the village and lagoon level are dealt with, but the nagging exclusion problem remains. There is pressure on the fishery from non-locals, and conflict has increased steadily since the boom in shrimp markets in the 1970s [5]. Lack of State level involvement in the *padu* system, specifically the lack of legal recognition of its management functions, means that exclusion remains problematic. This, in turn, interferes with the ability of fishers to enforce their own rules [5].

The Vallarpadam fishery is even more problematic than the Tamil Nadu case because of the exclusion problem even in the immediate fishing area shown in Fig. 2. There is no mechanism for the three groups of "illicit" fishers to coordinate with one another. Each *sangham* is able to limit its own membership, but there is no mechanism for the overall control of fisher numbers in the area as a whole. This is because the government does not recognize the management role of the *sanghams* and does not even license them. However, it does not (or legally cannot) exclude them from the fishery, either. The three *sanghams* do not interact with licensed stake net fishers, with other gear groups, or with the various levels of government. Each *sangham* deals with subtractability through elaborate and well articulated rules to provide for equity, social responsibility and conflict management among its members. But the lack of legal recognition and cross-scale coordination means that subtractability remains a problem at the regional level, and may eventually result in an unsustainable fishery.

The differences among the three cases are summarized in Fig. 4. The Sri Lanka case shows full cross-scale governance from the local to the national level (there is no state level government in Sri Lanka). The importance of such cross-scale governance in matching the scale of management institutions to lagoon ecosystems has been documented elsewhere [32]. The Tamil Nadu case shows incomplete cross-scale governance and is intermediate between the Sri Lanka and Kerala cases. The Kerala case has no cross-scale governance, no active intermediate-level institutions, and no government—community co-management [13]. However, this is not to say

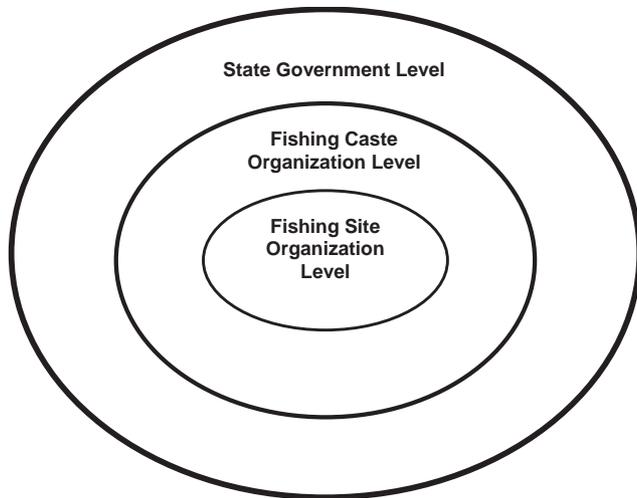


Fig. 4. Cross-scale institutional linkages in *padu* fisheries governance in South Asia. In Vallarpadam, Kerala, institutions are effective only at the fishing site organization (or *sangham*) level. In Pulicat Lake, Tamil Nadu, there are institutional linkages between fishing site organization and fishing caste organization levels. In the case of the Negombo Estuary, Sri Lanka, there are cross-scale institutional linkages that cut across all three levels, including the government fishery department level.

local governance has failed in the three Vallarpadam Island *sanghams* in Kerala. The *sanghams* do have a sophisticated set of locally adapted rules but fall short on cross-scale linkages.

Institutional development and linkages in the Sri Lanka case have a record going back at least to the 18th century. By contrast, the Vallarpadam fishery has a relatively short history of institutional development. The three *sanghams* only emerged in the 1980s, as a response to changes in state governance and shrimp markets in the 1960s and 1970s. However, chances are that the Vallarpadam area *padu* system was not a local invention or a novelty to emerge in the 1970s. Rather, it likely borrowed from ancient traditions of resource use to emerge as a post-1970 folk system. There is evidence to propose continuity. According to some fishers on Vallarpadam, the basic idea of a rotational, territorial use-rights system is age-old; as one fisher put it, “it is the system of our forefathers”. Indeed, elsewhere in the Cochin area, there seem to be other *padu* systems some of which may reach back earlier than the 1970s.

These *padu* systems may be seen as part of the dynamic diversity of locally adapted commons institutions for coastal resource management in south Asia. These institutions respond to various external drivers and seem to be changing all the time.

The formation of *sanghams* on Vallarpadam and the re-institution of *padu* may be seen as a response to change in markets and legislation. It is part of the attempt by fisher communities to improve their livelihoods and solve conflicts, and in general, to deal with the world around them [33]. It may in part also be a

response to compensate for the loss of resilience in the fishery.

There is evidence in the Vallarpadam fishery, and Kerala and south India in general [34], of a loss of gear diversity and species diversity in the catch. Such a reduction in options, with a resultant loss of resilience, makes the fishery vulnerable to economic and ecologic fluctuations. This is offset by the emergence of diversity in common property institutions (i.e., the *sanghams*) which help communities deal with change, as in the *Ayapenpadu* and *Muruganpadu sangham* examples. Diversity in local commons institutions, in turn, may help increase social resilience [18] and hence the resilience of the fishery as a whole. The challenge to resource management in the small-scale coastal fishery, then, is not to maintain stability, but to maintain diversity and flexibility.

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