Internet Journal of Society for Social Management Systems Vol.12 Issue 2 sms19-5066
ISSN: 2432-552X
ORIGINAL ARTICLE

Impacts of Institutions for Irrigation Management on Sustainable Collective Actions

Shino Nishizawa[1*], Masahide Horita[2]

[1] Department of International Studies, Graduate School of Frontier Sciences,
The University of Tokyo
5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-0882, JAPAN

[2] Department of International Studies, Graduate School of Frontier Sciences,
The University of Tokyo
5-1-5 Kashiwanoha, Kashiwa, Chiba, 277-0882, JAPAN

[*]E-mail: shino.nishizawa@gmail.com

***Abstract*:** This paper aims at elucidating institutional factors that determine the sustainability of autonomous irrigation management systems from the perspective of natural resource governance. The cases are drawn from two regions in Myanmar: Western Bago and Sagain. The two regions are observed to employ distinctively different forms of irrigation management and governance, the former using a representation-based committee system and the latter delegating to a local 'canal leader' called the 'Myaunggaung.' We focus on how the differences between the systems in the two regions have come about, as well as their respective advantages and disadvantages. The specific research questions are: why is the canal leader system compatible with the Sagain region but not with the Western Bago region, and what institutional, geographical and cultural factors have contributed to the differences? We carried out a field survey to collect information from members of the local communities regarding their management of irrigation facilities. Employing Ostrom's model of collective resource governance, results of the field surveys are analyzed to elucidate key factors. It is concluded that four primary perspectives can best explain the observed differences between the two regions as follows: (1) characteristics and authority of decision makers, (2) conditions for becoming a decision maker, (3) accessibility of information, and (4) forms of cooperation in agricultural labor.

Keywords: irrigation management, common pool resources, collective actions, water user associations, Myanmar

1. Introduction

In Myanmar, where eight major rivers flow, nearly 90% of surface and ground water is used for agricultural purposes (JETRO, 2016). Agriculture, considered one of the most important industries in Myanmar, has played a significant role in both the

Received: 2019.07.31/ Accepted: 2020.01.10
Internet Journal of Society for Social Management Systems Published Date: 2020.07.20
Copyright©2019 Society for Social Management Systems.
All Rights Reserved.

domestic economy and overseas trade, as around 70% of the country's population engages in agricultural activity. Thus, the question of how people can maintain the commons—such as water resources—fairly for all resource users and avoid depletion of the resource caused by self-interested behaviors of individual users has received attention at both the national and community level. In four irrigation areas of the Western Bago region, which is located in the northern part of a delta area in Myanmar, an irrigation development project (part of overseas development assistance (ODA) by the Government of Japan) is ongoing. This project was launched because water scarcity has become severe in the surrounding areas due to malfunctioning and deterioration of irrigation facilities. It is reported that one of the factors causing the problem is that resource users, mainly consisting of farmers, have not been involved in the maintenance of the irrigation facilities. In particular, it was found that the conventional maintenance system implemented by the Government of Myanmar right after construction of the irrigation facilities did not last very long in the areas. In terms of maintenance of irrigation facilities, there are lessons from past projects all over the world indicating that project operators should design institutions for maintaining the facilities during its construction phase and that highly sustainable institutions are required for the facilities to be operated and maintained as planned (JICA; OPMAC, 2014).

It is also clear that it is crucial that resource users themselves participate in the maintenance of the facilities as a main actor for both sustainable maintenance and improvement of agricultural productivity. Therefore, it is necessary to understand actual conditions for success in sustainable maintenance in the Western Bago region from both the Government of Myanmar's and the resource users' perspectives, and to identify factors that hinder sustainability.

2. Objectives

In terms of irrigation maintenance, there is no panacea—no single institution or model which is applicable and effective in every case (Meinzen-Dick, 2007). Institutions must be designed and/or revised depending on the context and the socio-environmental conditions of the targeted area. This paper aims, with a focus on maintenance institutions, to identify factors or maintenance systems that enable sustainable collective actions where resource users cooperate for long lasting common benefit. We undertake a comparative analysis of the Western Bago region, located in a delta area, and the Sagain region, located in the central dry zone, this latter being one of the areas in which the conventional maintenance system has functioned successfully.

3. Prior Research

Prevailing solutions to overcome the tragedy of the commons (Hardin) have been limited to either privatization or the imposition of government control. However, other potential solutions were recognized in the late 1980s after prudent examination of successful and failed cases of commons management (Berkes, 1985; Berkes et al., 1989; Feeny, 1990). The solutions pay attention to the local customs, rules and indigenous cultures that are assumed to be a key to successful management.

Agrawal (2001) proposed critical enabling conditions for sustainability of the commons. He collected these from several studies that contributed considerably to establishing a theory of sustainable maintenance institutions. In particular, two enabling conditions for successful commons management can be found in three studies that Agrawal considered important: "locally devised access and management rules" and "ease in enforcement of rules" (Baland & Platteau, 1996; Ostrom, 1990; Wade, 1988). Baggio et al. (2016) assessed the relevance of principles of institutional design, comparing successful and failed

cases of commons management and attempting to identify common features of both. They examined 69 cases, which were limited to irrigation management, fishery and forestry, and concluded that congruence between socio-environmental conditions and institutions is critical for successful management of any type of common resource, regardless of its traits.

When we refer to institutions in this paper, what do we mean? Two approaches that Ostrom (2005) presented in her paper *Understanding Institutional Diversity* are adopted to explain what institutions are. The vertical approach is a way to analyze rule sets at multiple levels that helps us to uncover important authority relationships and classify rules as operational rules, collective choice rules, and constitutional choice rules. This vertical approach recognizes that rule sets are themselves structured in hierarchical levels, as depicted in **Figure 1**. At the top of the structure, constitutional choices are the meta-rules over the other two types of rule. Nevertheless, these are also affected and controlled by unstipulated social norms and values just as operational rules refer to collective choices, and collective choices must be made in line with constitutional choices.

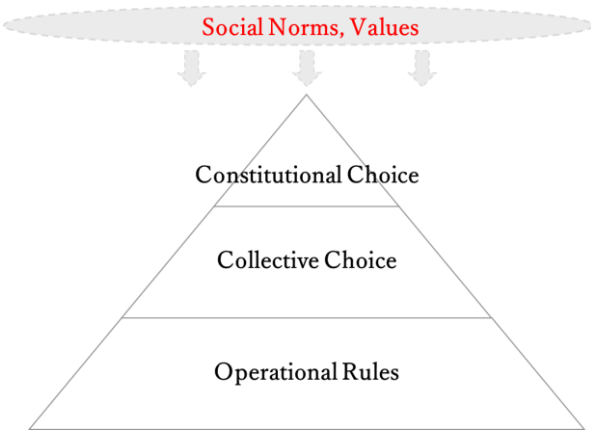

Figure 1. The vertical approach to understanding institutions.

Drawn by the author, based on Ostrom (2005)

The horizontal approach classifies rules according to their aims. The aims can be classified into one of seven broad types of rule: position, boundary, choice, aggregation, information, payoff, and scope.

Position rules, as the name indicates, define a set of positions which forms the connecting link between participants and authorized actions (Ostrom, 2005). Boundary rules define who is eligible to hold a position, the process that determines which eligible participants may (or must) enter positions, and how an individual may (or must) leave a position (Ostrom, 2005). Choice rules specify what a participant occupying a position must, must not, or may do at a particular point in a decision process (Ostrom, 2005). Aggregation rules determine whether a decision of a single participant or of multiple participants is needed prior to an action at a node in a decision process (Ostrom, 2005). Information rules affect the level of information available to participants and authorize channels of information flow among participants and the frequency of communication (Ostrom, 2005). Payoff rules assign external rewards or sanctions to particular actions and scope rules affect the scale of the outcome (Ostrom, 2005). Ostrom added that if a rule is not a position, boundary, information, payoff, or aggregation rule, then it is a choice rule if the aim is an action or a scope rule if the aim is an outcome. Each rule may supplement other rules and/or change its direction: in other words, the rules affect each other. However, we should note here that the comprehensive statement of every rule noted above does not guarantee successful commons management.

Then there is another question: why do we often find situations where common resources are not maintained collectively and sustainably by the local resource users? In order to answer this question, we need to look at the results of previous research about commons management. First, problems arise if the rules for maintenance cannot be changed or revised even when they are no longer congruent with the resource usage. Sustainable maintenance requires that resource users be able to change or revise the rules depending on their needs and in order to adjust to

changes in the surrounding environment and traits of the resource itself (Janssen et al., 2008; Osten et al., 2017). Second, problems also occur if nobody is punished when the rules are broken. And third, in a related way, problems arise if there is no one who monitors to identify when resource users are violating rules (Baggio et al., 2016; Gibson et al., 2004). Gibson et al. (2004) found that the sustainability of forestry activity is significantly related to regular monitoring and the existence of sanctions but not to the forest resource dependency of the local users. Fourth, following the rules needs to benefit resource users; if not, resource users will be likely to break the rules or will not even agree to establishing the rules. And finally, if resource users are not involved in designing the rules, the system is likely to fail. Some of the prior studies indicated that it was necessary for local resource users to easily modify and enforce rules as one of the conditions of sustainable commons maintenance, and Ostrom insisted that central governments should not undermine local authority but should make sure that the local people have autonomy to allow for the easy modification and enforcement of rules (Agrawal, 2001; Ostrom, 1990; 2005; 2008).

We need to note that securing the autonomy of the local people does not spontaneously guarantee the easy modification and enforcement of rules by those people. It has been revealed that regardless of the traits of the common resource, there is an inclination for self-organization to happen when there are some resource users who have entrepreneurial skills, are recognized as leaders, and are respected by other users based on prior collective actions (Ostrom, 2009). However, control by one strong local leader or elite over the commons tends to result in the establishment of rules that aim to protect their own personal interests (Ostrom, 2005). Therefore, in contrast to a local leader or elite as described above, an ideal leader for sustainable commons maintenance is often described as a person who is elected in a democratic manner and makes decisions impartially and fairly. In addition, although there may be leaders elected on behalf of all resource users, there will also be other leaders who coexist in the community and play their respective leadership roles on different occasions such as a powerful leader supported by multiple patron-client relations or a religious leader. Furthermore, the level of authority these leaders are allowed to exercise and what characteristics they have, and how these factors contribute to long-lasting cooperation for common benefit, are important topics for discussion.

4. Management of Irrigation Water in Myanmar

How is irrigation water managed in the villages of Myanmar? Irrigation water in Myanmar is supposed to be controlled by a canal leader called the ‘Myanggaung’ who is assigned by the Irrigation and Water Utilization Management Department, Ministry of Agriculture, Livestock and Irrigation (hereinafter referred to as the Irrigation Department). A canal leader is assigned to each water course, and each leader is responsible for organizing a water user association (WUA) with all those who use irrigation water from that same water course. The responsibilities of the WUA, however, are very ambiguous. Clear direction from the Irrigation Department is provided only for canal leaders; this consists of 12 clauses mainly related to the roles of securing order in water usage and covering miscellaneous duties of Irrigation Department officers. A canal inspector is an officer in charge of monitoring WUAs. Small to medium size irrigation systems have one canal inspector; large systems may have several inspectors. However, even if there are two or more canal inspectors in one system, each WUA is independent from the other(s). There is no entity covering all WUAs through the canal inspector. Moreover, there is no legally binding force such as the land improvement districts in Japan which are

authorized under the Land Improvement Act.

The former kings of Myanmar evidently paid special attention to the establishment of irrigation networks for paddy cultivation, as the irrigation systems in Myanmar were improved with better irrigation technologies in 1017 and have remained successful to date (Soe & Kyi, 2016). Subsequent to the entry of the British into Myanmar and during the attendant colonial period, a Public Works Department was established for all activities relating to irrigation (Soe & Kyi, 2016). The Burma Canal Act regulates irrigation, navigation and drainage in Myanmar, but it has no clause that explains the functions of WUAs or how to allocate irrigation water in WUAs. Enacted in the colonial period, the statute is no longer applicable or suitable to the present situation (Soe & Kyi, 2016). The canal leader system established under the colonial government can be observed in Sagain, whereas it is rarely observed in Western Bago. Moreover, hardly any systems of maintenance by local water users are found in Western Bago (JICA, 2015). The lack of maintenance of water courses by the local water users, which is particularly distinctive in Lower Myanmar, partly causes inadequate water flow downstream in the water courses as well as low efficiency of water use in cultivated land (JICA, 2015; Horino et al., 2007). Although quite limited in area, collective maintenance work can be seen in some parts of Western Bago. In these areas, instead of one canal leader serving as the only decision maker, multiple water users organize a committee or group for the maintenance and make decisions collectively. Currently, the characteristics of decision makers willing to form a committee and the water users' motivations to participate in such committees, remain ambiguous.

The nature of Myanmar's agricultural communities greatly affects irrigation water management at the local level. Takahashi declares that agrarian society in Myanmar is similar to what Embree (1950) called agrarian society in Thailand and describes it as "a loosely structured social system" (Takahashi, 2015, p.20). In terms of forming cooperative groups in agricultural labor, Thailand (and also Myanmar) is a loosely structured society, as compared to the conventional and more strictly structured societies in much of East Asia (Embree, 1950). Even if a group is formed, it often tends to be ad hoc (Takahashi, 2015). Takahashi added that the ad hoc group can be found in/out of a village in Myanmar such as cooperative associations, religious groups, etc. (Takahashi, 2012). In the study, it was determined that it would not be difficult to form a group or establish an organization, but that it would rarely be possible to form a group that enabled sustainable collective actions.

5. Research Question and Methodology

Although the historical background and organizational principles of WUAs in Myanmar have been described by the Irrigation Department, comparative studies of different regions in Myanmar examining the characteristics that enable sustainable collective actions are still limited. Furthermore, the system of limited autonomy over water allocation under a canal leader who is assigned officially by the central authority is inconsistent with the conditions for successful commons management identified in the prior studies. However, the canal leader system has contributed to sustainable maintenance of irrigation facilities in the Sagain region for more than hundred years. Therefore, in this paper, we set out to answer two research questions: 1) Why is the canal leader system effective in the Sagain region but not in the Western Bago region. 2) What institutional, geographical and cultural factors have contributed to the differences?

We conducted interview research regarding irrigation systems in both regions on three different occasions. Interviewees were mainly water users who organized a group or a committee in the Western Bago

region, and canal leaders and water users in the Sagain region. Their answers were coded, classified, and reorganized in each category, so that we could attempt to extract theoretical factors. Regarding the methodology, thematic analysis (which is one of the methods of narrative analysis) and grounded theory approach were partly employed. The eight principles for successfully managing the commons provided in Ostrom's (1990) paper *Governing the Commons* were referred to as a framework in this study. These principles are: (1) clearly defined boundaries, (2) congruence between appropriation and provision rules and local conditions, (3) collective-choice arrangements, (4) monitoring, (5) graduated sanctions, (6) conflict-resolution mechanism, (7) minimal recognition of rights to organize, and (8) nested enterprises.

6. Results

6-1. Characteristics and authority of decision makers

One of the findings from the interview research is that each maintenance system varies in the authority given to and the number of decision makers. From sorting the position, choice, and aggregation rules we unveiled who makes decisions about water allocation rules in each system. There are multiple water users, organized into a committee or group, who are entitled to decide water allocation rules in Western Bago, whereas in Sagain there is one canal leader who is the sole decision maker on water allocation rules in Sagain. The committee members maintaining weirs A, B, and C in the irrigation system of Western Bago can decide water allocation rules. In weirs D and E of the region, water users collectively decide water allocation rules. If water users want to change the rules, most of the committees and groups permit every water user, including committee members and normal water users, to participate in a process of decision making about the rule change. In two irrigation areas in which we conducted interviews in Sagain, the canal leader is the only or predominant decision maker when a request for change in water allocation rules is made by water users in Sagain.

After sorting boundary and payoff rules, we find that the cost allocation between the canal leader and the water users for enforcing water allocation rules is not equitable, just as the power balance is unequal in Sagain. Specifically, moderate economic disparity between them can be recognized. For example, when the canal leader and the water users discuss the cost allocation, the water users tend to think it is natural that the canal leader should bear a higher cost in most cases.

> "*We clean the water course two times a year. I collect money from the water users to hire laborers for the cleaning. ⋯The total cost for the cleaning is negotiated between me [the canal leader] and the laborers, but additional charges will often be incurred after the cleaning. In that case, I bear all the additional cost. [The reason I will not collect extra money in advance is that] the extra money may cause distrust in me; people may think I would use it for something wrong.*"
>
> (Canal Leader A)

Canal Leader A also added that he believed bearing the unequitable cost allocation was one of his responsibilities. In contrast, the following answer by a member of the maintenance group at Weir D in Western Bago shows the members adhere to the principle of being bearing costs equally.

> "*[The reason we needed to form a group is that] I cannot deal with rehabilitating our weir and paying the costs for hiring laborers to clean the water course by myself. ⋯If a member cannot afford to bear the cost, he/she will borrow money from other members. The member who borrowed the money will repay it later, for sure*."
>
> (A member of the maintenance group at Weir D)

In Western Bago, when someone returns anything that

was borrowed from another member, including money and preference over water allocation, the thing returned is the same thing that was borrowed. This is quite different from the canal leader system in Sagain.

6-2. Conditions for becoming a decision maker

In Western Bago, there is a leader for each group or a chair and a secretary for each committee. In some committees, there also is an accountant. Looking closely at position and boundary rules, the conditions for becoming a chair are different from those for other positions. To get the position of chair, the candidate is supposed to be one of the water users and a founder of the committee. Two of the five committees/groups in which we conducted interviews require the chair to be a village tract leader. The village tract leader participates in maintenance work on the water course in some of the committees, even if the village tract leader is not the chair of the committee. The oldest water user, with rich experience in weir rehabilitation work, is supposed to be the leader in the group at Weir D. Any water user who has the interest in becoming leader can serve as leader in the group at Weir E. However, the position of the leader in the group at Weir E is neither official, nor clear. Rather, the role is that of a ceremonial leader called "father/mother in the village" who is greatly respected by other people in the same community, facilitates meetings of the water users, and forms opinions. In terms of selecting other committee or group members, the basic prerequisite for becoming a member is to be a water user who has an interest in being a member.

On the other hand, the most important condition for becoming a canal leader is to have a cultivated field in the area downstream of the water course.

> "*[The conditions are] having a field downstream of the water course, having a relatively big field compared to others, and getting endorsement from the other water users.…The canal leader is expected to allocate water fairly to all water users.…A water user with a field in the upstream area of the water course is not trustable as a fair leader because the person might not work for the water users [with fields] further downstream. Even if many water users support a person [with an upstream field] to be the canal leader, it is not acceptable. Being a downstream water user is crucial.*"
>
> (Canal Leader B)

6-3. Access to information

We extracted position, choice, and information rules to clarify routes of communication for information about decisions and changes to water allocation rules. The information flow regarding changes in water allocation rules is different between the two systems. In the canal leader system, the information is concentrated in the canal leader in most water courses in the research. In most cases, the communication occurs only between two parties, the canal leader and a water user, without disseminating anything to the other water users. In the committee/group system, communication is not limited to that between two parties but involves all water users or at least all committee members. At Weir A, a request from the water users is discussed by all the committee members who collectively make a decision. The decision is then disseminated to all the water users through the committee member who also is the village tract leader. The difference in access to information between the two systems can be observed from whether they take and keep meeting minutes. More than half the committees/groups in Western Bago maintain meeting minutes. However, there is only one site where the water users take minutes in Sagain. There is a big gap between a canal leader and water users, not only in authority but also in information accessibility.

6-4. Forms of cooperation in agricultural labor

Cooperation in agricultural labor greatly influences the management of irrigation water. Between the two regions in this study, differences in forms of cooperation in agricultural labor can be found.

In general, there are two types of cooperation in agricultural labor seen in Myanmar. The first type is labor exchange between two parties without pecuniary transaction. For example, a person lends a cow to another individual who also owns one cow so that the borrower will be able to plow and level a paddy field with the two cattle. After the work is completed, the borrower will return the lender's cow and provide his/her own cow to the lender who uses the two cows to plow and level his/her own field (Takahashi, 2012). The feature of this type of cooperation is that it can be established only between two parties who are of almost the same economic status (Takahashi, 2012). This type of cooperation is formed in both the Western Bago and Sagain regions where plowing and leveling fields using draft cattle before the rainy season is necessary.

The second type of cooperation is observed only in the Sagain region where cultivation methods are somewhat different. Transplantation of rice seedlings is avoided by the direct sowing method employed in Western Bago, however, people in Sagain use the transplantation method. In Sagain, therefore, there are transplantation groups that consist of a leader and multiple workers (usually female). The workers are paid by the leader in advance and transplant rice seedlings within and outside of their community. The cooperation in these groups is formed based on binary relations between the leader and each worker; there is no unity as a group. Whereas the first type of cooperation is established only between two persons of the same economic class, in the second type there is a hierarchical gap between a leader and each worker (Takahashi, 2012).

These two forms of cooperation are found to have contrasting binary relations. The first type can be described as horizontal binary relations and the second type as vertical binary relations. This feature is relevant to the explanation of the difference between the committee/group system and the canal leader system. The committee/group system is formed by members who have the same level of authority and is based on the accumulation of horizontal binary relations; the canal leader system is formed with a canal leader and other water users who come from different economic classes and have different levels of access to authority, and is based on the accumulation of vertical binary relations.

7. Discussion

According to analysis of the interviews about water allocation rules in the two regions using Ostrom's eight principles, the following results are found.

(1) Collective choice arrangements

Decisions about water allocation are made by all water users collectively, or at least by multiple committee members, in Western Bago. However, in Sagain, the canal leaders at most sites make decisions alone.

(2) Minimal recognition of rights to organize

Most of the committees/groups are founded voluntarily by the water users and water users' autonomy regarding water allocation is therefore secured. Although there is one committee that was established based on the Irrigation Department's suggestion, the Irrigation Department was not involved in founding and operating the committee. Further, every committee/group in the Western Bago region attempts to reflect the opinions of all water users. The canal leader system in the Sagain region permits water users to maintain a water course according to the direction of the Irrigation Department. However, a canal leader who is elected by other water users is an authorized leader assigned by the Irrigation Department. Accordingly, authority concentrates in the canal leader. It seems that strong

local leadership by the canal leader is approved by the external authority.

From here, two factors which affect how different maintenance systems function in each region are proposed, based on the analysis of the four major differences described in the preceding sections.

(1) Difference in objectives and roles of the systems.

The objectives and required roles of the systems established in each region are different. Benefits for water users from establishing a committee/group are primarily the continuous maintenance of the weir and providing an effective countermeasure to fishers who open the water gate without the water users' permission. Only one committee was established to prevent conflicts over water allocation, and even this committee is currently dealing more with issues related to upgrading the weir and rehabilitating the water course. Moreover, the committee members who are skilled in agriculture give advice to other water users. Consequently, there are a large number of water users who have benefited from the activities of the committees/groups other than prevention of conflicts.

The canal leaders and water users, in contrast, have benefited from the canal leader system for its conflict resolution mechanism.

> "*[If there was no canal leader here] there would be conflicts all over the place. ⋯The water users often come and ask me to solve problems over water allocation⋯then I make a decision on each water allocation and its timing, depending on the condition of the water user's field. I emphasize fairness, and this is my responsibility*."
>
> (Canal Leader D)

Through the interview research, it was revealed that chronic water scarcity in the Sagain region has led to water conflict becoming a daily affair. Every actor, including the canal leader, water users, and Irrigation Department, is aware of it. This is in contrast to the Western Bago region, where every actor answered that the people here use water peacefully without any water conflict. Additionally, most of the interviewees answered that this peaceful status results from the mutual understanding among the water users. However, considering the amount of annual rainfall and the predictability of weather in each region, it seems the likely reason that water conflict is rare in Western Bago is because the water scarcity that people in Western Bago have faced recently is not particularly severe as compared to the absolute and chronic water scarcity due to topographical factors in Sagain. The canal inspector said that the authority of the canal leader in Western Bago has declined because the responsibility of the canal leader does not fit the needs of the local water users.

> "*Recently the roles of the canal leader have been undervalued among the water users. We encouraged or sometimes ordered the water users to choose someone to serve as the canal leader but we can see the canal leader is no longer respected by the water users and the canal leader himself loses his desire to work on maintenance and other responsibilities.*"
>
> (Canal Inspector A)

In this way, a collective decision-making system such as the committee/group system is compatible with the Western Bago region because the system established for common objectives such as continuous maintenance of the weir and to provide effective countermeasures for fishers can function as required based on the agreement among the members. A single decision maker system such as the canal leader system is compatible with the Sagain region because the decision-making system is required to ensure conflict resolution by an absolute, impartial, and fair mediator.

(2) Difference in the forms of cooperation in agricultural labor.

A different character of binary relations is partly

attributed to a difference in the forms of cooperation in agricultural labor. As mentioned in the previous section, the transplantation group which illustrates vertical binary relations can be seen only in Sagain because the cultivation method that prevails in Western Bago does not entail transplanting rice seedlings. The relationship between the canal leader and the water users also can be described as vertical binary; the canal leader has great authority to make decisions about water allocation and conflict resolution. The reason why the canal leaders can fulfill these duties is because they are respected by other water users and trusted to exercise the authority. Most of the irrigation water in Myanmar is used for agricultural purposes, so the forms of cooperation in agricultural labor substantially affect the forms of cooperation in water resource management. The congruence between these forms of cooperation is key to understanding what kind of system is compatible with each region: the canal leader system is more compatible with the Sagain region than the Western Bago region.

8. Conclusion

In this study, we attempted to shed light on the reasons why the canal leader system implemented by the Irrigation Department is compatible with the Sagain region but not with the Western Bago region, where the latter is facing a water scarcity issue because of non-participation by resource users in the maintenance of the irrigation facilities. The results from this study show two factors that are useful in exploring possible answers to the original questions stated above: (1) incongruence between the needs of the local water users in the Western Bago region and the roles that the canal leader can play, and (2) congruence between the forms of cooperation in agricultural labor in the Sagain region and the canal leader system.

The analysis provided a notable implication regarding one of Ostrom's principles—minimal recognition of rights to organize—specifically, that a greater degree of autonomy does not always contribute to successful commons management. Furthermore, whether the autonomy will be exercised depends considerably on the character of the decision maker or leaders in the system. The conditions for successfully managing the commons such as "locally devised access and management rules" and "ease in enforcement of rules" will change their meaning depending on the allocation of authority. Moreover, the ideal decision maker or leader will vary depending on the local needs, culture, and means of livelihood.

Acknowledgements

The authors would like to thank the Irrigation and Water Utilization Management Department, Ministry of Agriculture, Livestock and Irrigation in Myanmar for accepting multiple research interview requests. We would like to thank all interviewees in both the Western Bago and the Sagain regions. We are also grateful to all members of Sanyu Consultants Inc. who worked for the project for supporting us in conducting field research in Myanmar.

References

1) Agrawal, A. (2001). Common property institutions and sustainable governance of resources. *World Development, 29* (10), 1649-1672.

2) Baggio, J. A., Barnett, A. J., Perez-Ibarra, I., Brady, U., Ratajczyk, E., Rollins, N., … Janssen, M. A. (2016). Explaining success and failure in the commons: the configural nature of Ostrom's institutional design principles. International Journal of the Commons, 10(2), 417–439. DOI: http://doi.org/10.18352/ijc.634

3) Baland, J. M., & Platteau, J. P. (1996). *Halting degradation of natural resources: Is there a role of*

rural comminities? Oxford: Clarendon Press.

4) Berkes, F. (1985). Fishermen and 'The Tragedy of the Commons'. Environmental Conservation, 12(3), 199-206. doi:10.1017/S0376892900015939.

5) Berkes, F., Feeny, D., Acheson, J., & Acheson, J.M. (1989). The benefits of the commons. *Nature, 340* (6229), 91-93.

6) Embree, J.F. (1950). Thailand: A loosely structured social system. *American Anthoropologist, 52*, 181-193.

7) Feeny, D., Berkes, F., McCay, B.J., & Acheson, J.M. (1990). The tragedy of the commons: Twenty-two years later. *Human Ecology, 18* (1), 1-19.

8) Gibson, C.C., Williams, J.T., & Ostrom, E. (2004). Local enforcement and better forests. *World Development, 33* (2), 273-284.

9) Hardin, G. (1968). The Tragedy of Commons. *Science, 162*, 1243-1248.

10) Horino, H., Myo, Z.Z., & Matsuno, Y. (2007). Actual conditions and development prospects of on-farm water use in Myanmar. *農業農村工学会全国大会講演要旨集*, 364-365.

11) Janssen, M.A., Goldstone, R.L., Menczer, F., & Ostrom, E. (2008). Effect of rule choice in dynamic interactive spatial commons. *International Journal of the Commons, 2*, 288-312.

12) JETRO. (2016). *現地事情の把握：水事情*. Retrieved 1-5-2019, from the Japan External Trade Organization (JETRO) homepage: https://www.jetro.go.jp/theme/bop/precedents/#waterworks

13) JICA. (2015). *事業事前評価表：バゴー地域西部灌漑農業収益向上プロジェクト*. Retrieved 12-19-2018, from the Japan International Cooperation Agency (JICA) homepage: https://www2.jica.go.jp/ja/evaluation/pdf/2015_1400822_1_s.pdf

14) JICA; OPMAC. (2014). *テーマ別評価「評価結果の横断分析 灌漑排水・水管理分野における実践的なナレッジ教訓の抽出」*. Retrieved 12-21-2017, from the Japan International Cooperation Agency (JICA) homepage: https://www.jica.go.jp/activities/evaluation/tech_ga/after/theme.html

15) Meinzen-Dick, R. (2007). Beyond panaceas in water institutions. *Proceedings of the National Academy of Sciences, 104* (39), 15200-15205.

16) Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press.

17) Ostrom, E. (2005). *Understanding Institutional Diversity.* Princeton: Princeton University Press.

18) Ostrom, E. (2008). *How Do Institutions For Collective Action Evolve?* Retrieved 5-9-2017, from https://kelembagaandas.wordpress.com/aksi-kolektif-collective-action/elinor-ostrom/

19) Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science, 325* (5939), 419-422.

20) Soe, A., & Kyi, T. (2016). *Overview of Irrigation Development and Government Policy in Myanmar.* Retrieved 12-15-2018, from the FFTC Agricultural Policy Platform (FFTC-AP) homepage: http://ap.fftc.agnet.org/ap_db.php?id=593

21) Takahashi, A. (2012). *ミャンマーの国と民ー日緬比較村落社会論の試み*. Chiyoda: 明石書店.

22) Takahashi, A. (2015). 比較の中のミャンマー村落社会ー日本、タイ、そしてミャンマーー. *東南アジアー歴史と文化ー*, *44*, 4-26.

23) von der Osten, F., Kirley, M., & Miller, T. (2017). Sustainability is possible despite greed: Exploring the nexus between profitability and sustainability in common pool resource systems. *Scientific Reports, 7* (2307), 1-12. Retrieved 6-10-2018, from https://www.nature.com/articles/s41598-017-02151-y

24) Wade, R. (1988). *Village Republics: Economic Conditions for Collective Action in South India*. Oakland: ICS Press.