FARMER-MANAGED IRRIGATION SYSTEMS AND THE IMPACT OF GOVERNMENT ASSISTANCE: A NOTE FROM BALI, INDONESIA

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INTRODUCTION

For over nine centuries, wet-rice producers in Bali have been organizing themselves into socio-religious communal irrigation associations known as *subaks*. Throughout this period, subaks have remained autonomous and operated as self-contained water users' organizations. Construction, repairs, and maintenance of irrigation facilities were all carried out by the members of the association as self-help projects. Today, subaks number more than 12,000 and cover about 100,000 hectares (ha) of *sawah* (irrigated rice field).

The government became actively involved in irrigation development only around 1925. Before 1969, government assistance was limited to constructing and rehabilitating headworks and primary canals, leaving the rest of the irrigation networks as before. After 1970, headworks, primary canals, and secondary canals were all built by the government.

Beginning in 1979, the government initiated a development project to upgrade the tertiary irrigation network of subaks which had received main system development assistance. By 1983, about 60 percent of the total sawah area in Bali was already irrigated by government-built dams and the remainder by upgraded tertiary networks (Dinas Pekerjaan Umum Propinsi Bali 1982).

The responsibility of operation and maintenance (O&M) of the main system, which contains the permanent government-built dam, has been taken over by the bureaucracy. The management of tertiary systems, however, remains in the hands of subak members. Thus, an irrigation system in which the dam was government-built is jointly-managed. (i.e., the main system is managed by an irrigation agency and the terminal system is farmer-managed.) At present, about 60 percent of the total sawah area in Bali receives water from jointly-managed irrigation systems. In other words, almost 40 percent of the total sawah area falls under farmer-managed irrigation systems.

There is concern that government intervention in subak affairs, particularly in taking over the responsibility for main system O&M, may have adverse effects on subak organization. This paper first introduces the structures and functions of the subak to provide the necessary background information about irrigation systems in Bali. The paper then discusses the socio-institutional implications of government assistance extended to subaks. Parts of this paper were derived from a current research report by a research team from Udayana University (Sutawan et al. 1984a, and Sutawan et al. 1986), while the rest was based on the author's personal observations and interviews with several subak leaders.

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STRUCTURES AND FUNCTIONS OF SUBAKS

Subak Structures

The subak water users' organization is characterized by: 1) a common source of irrigation water; 2) availability of one or more rice field temples (*bedugul*); and 3) autonomy in handling its own affairs -- such as managing its own budget, with its own written or unwritten rules and regulations (*awig-awig*) -- and in making contact with other institutions. Subaks having a weir (*empelan*) as their source of water usually have a common weir temple (*ulun empelan*) near the dam.

A large subak is usually sub-divided into smaller units called *tempeks* (or in some places *banjaran*, *munduk*, *lanyahan*, or *pamunduk*). A tempek has no external autonomy, though in many cases it has internal autonomy as signified by a common bedugul shared by the members of the tempek or its own budget or both, which is managed without intervention by the subak. In some cases, several subaks for coordination purposes unite into a single body called a *subakgede*.

Recently, some traditional weirs have been replaced by a single permanent dam built by the government to become a single unit irrigation system with a larger service area. The government encouraged the former independent subaks to unite themselves into a subakgede. In that case, a new water temple was erected near the new dam and the previous water temple of each subak was abandoned.

Due to the lack of historical data and the varying terminologies used by local farmers, it is difficult to identify without careful investigation whether an irrigation system which has been long in existence is really a subakgede or only a subak. Although it is not yet precisely known in what ways subakgedes were originally formed, and data on the number of subakgedes are not available, the following possibilities (Sutawan et al. 1986) can be considered:

1. The union of several subaks each of which formerly had its own water temple and its own common source of water but which finally agreed to share a new common water source and water temple, signifying a single unit irrigation system from the viewpoint of a physical and social system;

2. the union of several subaks into a single coordinating body, but with each maintaining its own water source and its own water temple without sharing a new water temple; and

3. a single subak which developed into a larger subak due to the expansion of irrigated rice fields and an increasing number of subak members so that the former tempek gained full autonomy in handling its own affairs, and thus, in this sense, each tempek changed into a subak.

Note that each subak does not necessarily have its own water temple as it can share with other subaks within a subakgede. Similarly, each subakgede does not necessarily

have a common water temple shared by member subaks (in case each subak still maintains its own weir). Also, a subak does not necessarily have to be divided into several tempeks.

Lack of historical information makes it hard to ascertain whether the many existing subakgedes with only one dam originated from a single subak or from a union of several subaks each of which had its own weir.

In a few cases, farmers within a subakgede were grouped into a number of coordinating units. The local farmers improperly called such units "subaks." To avoid confusion, such groups shall be called here *pekasehan*. The manner of grouping has nothing to do with water allocation and distribution, but was mainly to improve coordination of ritual performances and system maintenance. The pekasehan was formed by grouping subaks or by grouping farmers based on their domiciles irrespective of the subak to which they belonged.

The administrative personnel or administrator (*prajuru*) of an irrigation association varies from subak to subak. In general, the prajuru comprise the head of a subak (*pekaseh* or *kelihan subak*), a deputy (*wakil pekaseh*), a secretary (*penyarikan*), a treasurer (*juru raksa* or *bendahara*), and several messengers (*juru arah*, *saya*, or *kasinoman*). In a small irrigation association or subak having no subdivision into tempeks, its prajuru usually comprises a subak head and a messenger. The latter changes every 35 days or every crop season. For subaks having tempek subdivisions, the subak head delegates part of his daily duty to the tempek heads (*kelihan tempek*) within their respective jurisdictions. In semi-autonomous tempeks, a tempek head is usually assisted by a deputy, a secretary, a treasurer, and a number of messengers -- similar to the prajuru at the subak level. In many cases, however, the tempek heads all are given the position of prajuru at the subak level which means that, in practice, the former functions as a messenger of the subak for his own tempek. However, since he has a messenger at his own tempek, the task of extending information to the tempek members is performed by the messenger at the tempek level.

The prajuru at the subakgede level also varies. A subakgede is headed by a so-called *pekaseh gede*. Like the subak head, the pekaseh gede also has his own staff comprising a deputy, a secretary, a treasurer, and one or more general assistants who are responsible for extending information and instructions to the subak heads. In some cases, such as observed in Tabanan District, all of the subak heads are assigned as prajuru at subakgede level, in the same way that the tempek heads of a subak are appointed as prajuru at subak level. In other cases, such as found in Karangasem District, the pekaseh gede has no staff because his function is merely to extend information and government instructions to subak heads and to process the subaks' requests for assistance to the government.[1]

The highest authority of the irrigation organization is the *sedahan agung*. He is a government official responsible for collecting land taxes; for approving new subak formation or sawah expansion; for handling water disputes; for supervising and coordinating subaks and subakgedes within a district (*kabupaten*); and supervising water management throughout the kabupaten in consultation with the Department of Public Works, Agri-

culture, and Local Government. The sedahan agung is assisted by a number of government officials (*sedahan*), whose area of jurisdiction is called *kasedahan* or *pasedahan*, and which covers several subaks within a watershed area. It does not necessarily overlap with the *kecamatan* or subdistrict (administrative unit below a kabupaten).[2]

The status of subak members can be distinguished into: 1) the members (*pengayah* or *sekehe yeh*) who are actively involved in the routine activities of the subak; 2) the passive members (*pengoot* or *pengampel*) who do not participate in daily activities of the subak but who must contribute a certain amount either in cash or in-kind; and 3) the members (*leluputan*) who are exempted from daily activities and other subak contributions due to their position in the community, such as the priest (*pemangku*) and the head (*bendesa*) of a village community (*desa adat*). In most of the cases, the size of holdings is used as the criterion to determine whether a member is allowed to be a passive member or not. In a few cases the decision is made according to the supply and demand of the amount of pengoot (Sutawan 1985).

Some subaks in Bangli District distinguish the role and status of their members on whether or not they have *sawah catu*. Those having sawah catu are responsible for maintaining the main system and the tertiary system, in addition to preparing and executing rituals at Bukitjati Temple. The sawah catu owners are called *krama pekaseh*. The members who have non-catu rice fields are responsible only for maintaining the tertiary system. All the members, the catu owners, as well as non-catu owners, are called *krama subak*. Unlike the non-catu owners, the catu owners are not allowed to be passive members. Their tasks are heavier. Catu owners from several subaks, obtaining water from a common weir, but living at the same desa adat, come under a pekasehan, headed by a so-called *kelihan pekasehan*.

Functions of a Subak

A subak as a social system has five main functions: 1) water allocation and distribution, 2) conflict management, 3) operation and maintenance of the irrigation system, 4) religious rituals, and 5) fund raising. A brief description of each follows.

Water allocation and distribution. Within a jointly-managed irrigation system with many subaks, water allocation and distribution among subaks is based on the size of the subak to be irrigated. Allocation and distribution within a farmer-managed irrigation system and also among tempeks (subsubaks), as well as among farmers within a jointly-managed irrigation system is, however, based on the water share received by each member of the subak (*tektek*). If, for instance, farmer "A" has 1.0 tektek and "B" has 2.5 tektek, the water should be distributed through a division structure in such a way that the proportion between the width of water inlet for A and B are in a ratio of 1.0 to 2.5. Whether the debit of water is large or small, the volume of water flowing through the inlet for A would be 1.0 tektek and that for B, 2.5 tektek.

The size of a sawah receiving one tektek of water varies from place to place. For example, in Subak Celuk, Gianyar District, rice fields of about 0.20-0.70 ha were allocated one

tektek (Sutawan et al. 1984). In Subak Kerobokan, Tabanan District, rice fields of about 0.30-0.80 ha received one tektek; below 0.30 ha received only 0.5 tektek; and above 0.80 ha received 2.0 tektek (Sutawan 1985). At present many farmers consider this method unjust, because, in practice, larger rice fields have been taxed higher than smaller ones, whereas the water share has not been exactly proportional to their sizes. In response, for example, the farmers of Subak Umabali in Tabanan District recently changed the water allocation system based on tektek to one based on the size of the rice field being irrigated.

The farmers having two tektek of water share should contribute twice as much labor and other services, whereas those having half a tektek should contribute only half as much.[3]

Water distribution among subaks as well as among tempeks within a subak is generally done by a continuous flow method. An individual farmer who does not need water could close the water inlet by putting mud and rubbish in it.

In some cases, the *nyorog* system of water distribution is employed. This is done by dividing the subakgede or subak, for instance, into two or three groups such as head, middle, and tail. The group receiving water first is called *ngulu*, the second, *maongin*; and the last, *ngasep*. For example, in one case, upstream subaks are ngulu, and the middle subaks get their turn (maongin) after the head finishes land preparation, and finally the tail has its turn (ngasep) after the middle finishes land preparation. In Buleleng District, the sequence is reversed: here the subaks located at the tail are ngulu and get water first, followed by those upstream (ngasep).

In areas where water is scarce, water distribution is done by rotation (*giliran*). In this case, the subak area is also divided into two or three groups. During the rainy season, all groups are allowed to grow rice at the same time (*kertamasa*). After the harvest of the kertamasa crops, the first group must grow rice while the other must grow non-rice crops such as peanuts or beans (*palawija*). For the next crop season, the first group must grow palawija while the other, rice. Water is given to the group whose turn it is to grow rice.

In case the nyorog and giliran systems cannot be adopted at the subak level, water scarcity may be overcome by employing such arrangements at the tempek or even at a special group level called *kanca* or *penasan* (an informal group consisting of 4-10 farmers whose sawah are located close to one another).

To avoid water stealing, the subak receiving water distribution usually appoints a special team of water guards (*petelik* or *pecelang*) to safeguard the water at important and strategic division structures.

Water borrowing among subaks within an irrigation system and among irrigation systems along a river course varies: in some cases it is allowed, in others it is not. A permit issued by the sedahan agung should be secured in case of water borrowing among different irrigation systems along a river course. For water borrowing among subaks within a subakgede or irrigation system and among tempeks within a subak, the decision is made by the head of the subakgede or subak concerned without the need for approval from the sedahan agung.

Conflict management. Water disputes usually occur where water is scarce. But it seldom develops into fights and generally can be settled at the subak level. Only in a few cases is the issue brought to higher authority.[4]

Recent conflicts that required the involvement of the provincial government for resolution have been observed in Subakgede Pama-Palean, located in the neighboring districts of Badung and Tabanan, and were due to the unification of several subaks in 1977. A dam, which had previously served only three subaks, was required to serve nine (Tim Fakultas Pertanian Universitas Udayana 1981).

In general, water disputes occurred mainly because of the incidence of water stealing from the downstream farmers by upstream farmers within an irrigation system, or from the downstream irrigation system by the system upstream.[5] Because the dam and the structures of main systems have been made permanent by the government, the incidence of water stealing has been drastically reduced. One probable reason is the difficulty of manipulating the permanent structures.

Water stealing is strictly forbidden and is liable to a fine. The amount depends on the location of the theft and varies from subak to subak. The nearer the subak is to the dam, the higher the fine. All matters dealing with subak organization, including sanctions for infractions against rules such as water stealing, are set up in the subak's by-laws. Each subak has its own written or unwritten by-laws.

Operation and maintenance of the irrigation system. For jointly-managed irrigation systems, the main system O&M has become the responsibility of the government whereas that of the tertiary system remains in the hands of the subak. For farmer-managed irrigation systems, the main system and the tertiary system O&M are completely in the hands of farmers on a self-help basis.

In jointly-managed irrigation systems, the government usually assigns and pays a dam keeper and his assistants. The dam keeper is given a house near the dam.[6]

Before a permanent dam was built by the government, each active member had to go down to the river 30-70 times a year to repair the weir which was often damaged by floods. Subak Kesiut in the District of Tabanan, for example, had to mobilize about 25,000 man-hours per year to repair the weir on a self-help basis. However, after the dam was built, the burden of the farmers of the jointly-managed irrigation system had been reduced to a minimum because O&M had been taken over by the government. Only on particular occasions, such as when the main canal was closed by landslides, were the farmers requested to help the government clean the canal without any payment.

Little difficulty has been encountered so far in mobilizing the farmers to participate in such communal work. Some explanations may be offered: a) the water opening ceremony (*magpag toya*), which must be performed by all the farmers at the ulun empelan near the

dam, and the inauguration ceremony of the water temple apparently bring the farmers together, reaffirming their solidarity and attachment to the irrigation system as a whole; b) the authority for water allocation and distribution is still with the head of the irrigation association; c) the old canals of subaks are almost fully utilized; d) there is flexibility in implementing system lay-out; e) there is farmer involvement through labor, either paid or unpaid, and of local materials during the construction stage; and f) irrigation water has a social function.

In mobilizing communal labor for system maintenance, the head of the subakgede or subak may assign the work among the member subaks or tempeks on either a concurrent or rotational basis, depending on the work.

Religious rituals. Religious rituals carried out by the subak are closely related to stages of rice cultivation. Religious rituals seem to be a strong unifying element for the life of the subak. More than 60 percent of the annual expenditure of the irrigation association has been for rituals (Sutawan et al. 1984b, Sutawan et al. 1986).[7] In subaks where irrigation networks are permanent structures, almost all annual expenses are for rituals.

The main objective of the rituals is to pray to God for His blessing. The ritual may be performed by the subak as a whole in the subak temple or individually by the farmer at his own altar in the rice field.

The preparation and execution of rituals at the subak or subakgede level is coordinated by the pekaseh or pekaseh gede. For labor efficiency, the pekaseh or pekaseh gede may rotate the work assignments among tempeks or subaks. The rituals at the tempek level are supervised by the head of the tempek whereas those at the subak level, within a subakgede, are supervised by the head of the subak concerned.

The description of religious rituals by the irrigation association may go into many pages and is not of interest here. Suffice it to say that the kind of ritual performed individually by the farmer as well as by the tempek, subak, or subakgede as a whole varies from place to place. However, some important rituals usually performed by all subak members together are: a) *magpag toya*, a water opening ceremony held at the beginning of the wet season at the ulun empelan or at the water temple built near the dam (*ulun suwi*); b) *ngusaba*, a kind of thanksgiving ceremony held prior to harvest at a bedugul; c) *nangluk merana*, a ritual to avoid widespread attack of pests and diseases; d) *piodalan*, a ceremony for inauguration of a subak temple, such as the *ulun danu* (temple of the lake).

Each of these rituals is also conducted by the individual member at his own rice field altar called *sanggah catu* or *ulun carik*. Each member of the association also usually conducts individual rituals based on the stage of rice growth, such as a) *ngawit nambah*, before starting land preparation; b) *ngurit* or *pangewiwit*, an offering before spraying the seed bed; c) *nandur*, an offering made just before transplanting; d) *miseh*, an offering when the rice starts blooming; e) *biukukung*, an offering when the plant is in the milk stage; f) *dewa nini*, a ritual held immediately before harvest; g) *manyi*, a thanksgiving ceremony at harvest; and h) *mantenin*, a ceremony performed after stocking the rice

bundles or threshed rice at the granary.

Fund raising. Each subak has its own ways of raising funds necessary for rituals, and for repairing irrigation structures and subak temples. The sources of subak revenues are, among others: payment by passive members as substitute for labor (pengoot or pengampel); contribution in-kind paid by all the subak members (*suwinih* or *sarih tahun*); fines collected from offenders of by-laws; cash contribution collected whenever needed from all subak members (*peturunan*); rent from the subak's rice fields used for duck raising, and interest on loans (if any) to an individual member. The contribution by individual members depends on the size of landholding or the tektek received by the member.

IMPACT OF GOVERNMENT ASSISTANCE

Study of the impact of government assistance to farmer-managed irrigation systems in Bali is limited. The available research documents on irrigation development projects in Bali focus only on the production and economic impact of the project. Moreover, no effort has been made to probe the socio-institutional implications of irrigation development projects. Windia (1985), for example, in his study on the impact of tertiary development projects, concluded that projects apparently did not bring about any significant increase in cropping intensity, production per hectare, or family income of sample farmers.[8]

On the other hand, the University of Udayana (1985, 1986) reported that, in some cases, the main system development projects have brought about considerable increases in cropping intensity, rice yield, and farm income.

This chapter raises issues related to government assistance to subaks. The discussion is based on observations and in-depth interviews with the heads of several irrigation associations which had obtained irrigation development assistance from the government. Although these are not the only cases, they may provide valuable lessons to irrigation policy makers enabling future government assistance to become more effective and efficient.

Cases Illustrating Less-successful Projects

The following irrigation development projects could be regarded as less successful in that the respective subaks were dissatisfied with project implementation which resulted in inequitable water distribution, a decline in water supply, and a need for coordination among formerly independent irrigation systems.

Betiting Irrigation Project. This project, located at Betiting River in Bangli District, was completed around the end of November 1985. It combined two traditional weirs, which belonged to Subak Umadesa (upper stream) and Subak Denan (lower stream), respectively, into a single permanent dam called Betiting Dam. The dam was built on the former upper stream weir. The Denan system then received its water supply from a new division structure located at the main canal of the Umadesa system through a new canal connected to

the old main canal of Denan. However, where the two canals met, the level of Denan's canal toward the upper stream was lower than that toward the lower stream so that the water flowed to the Denan weir instead of to the Denan rice fields.

The Denan farmers complained of the reduced water supply compared to conditions before the project, and charged the Umadesa farmers with frequent water stealing at the diversion structure located at Umadesa's main canal. The Denan leaders complained that they did not know of the project before its implementation. They only heard that the government would give assistance and were instructed not to grow rice during construction.

The Denan farmers still regard the water supply as reduced in spite of the fact that the irrigation agency has built a special structure functioning as a "buffer" to avoid water flowing back toward the Denan weir. The head of Subak Denan wants its own traditional weir upgraded and a direct water supply from the new dam through the stream and not from the newly built division structure located at the main canal of Umadesa.

Pau-Manduang Irrigation Project. Pau-Manduang Irrigation Project combined two irrigation systems, each of which previously had its own weir located on the Jinah River, Klungkung District. Pau irrigation system (72.8 ha) was upstream, whereas Manduang irrigation system (116.45 ha) was downstream. The newly built government dam combining the two weirs is about one kilometer downstream from Pau weir and located between the two former weirs. The new primary canal is joined to the former primary canal of the Manduang system.

The Pau and Manduang farmers were not adequately informed about the project, or involved in its planning and implementation. Learning that Subak Pau was to receive water from a new division structure, the subak head requested that his weir should be upgraded and kept separate from the Manduang irrigation system. The request was not accepted because the service area was less than 150 ha (a minimum requirement for irrigation development projects). Therefore, the two systems were combined into a single system covering a total area of more than 150 ha, and the project was completed in March 1986. The Pau farmers are now drawing water from a new division structure located at the former main canal of Manduang system and channelled through a flume that crosses over the road separating the two subaks.

The interviews with the head of Subak Pau were conducted in the first week of May 1986. Although the new system had been in operation for less than three months, the Pau farmers felt that without the additional water supply from their former weir, the available water supply was less than preproject levels due to the small size of the flume (the head of Subak Manduang agreed). The head of Subak Pau felt disadvantaged by the project. He therefore suggested the following alternatives: a) his subak's former weir be kept functioning in addition to the present flume; b) the farmers be allowed to take water directly from the dam instead of using the present flume; c) his subak's weir be upgraded and completely separated from the Manduang irrigation system; and d) the present flume be replaced with a bigger one.

Either socio-institutional problems remain as a consequence of the unification of the two irrigation systems, such as how the two subaks are to be organized and coordinated, whether or not a new water temple is to be built near the new dam, and who will be responsible for allocating and distributing water between the two subaks.

Government assistance to Subak Bedugul and Subak Bumbung. The weir of Subak Bedugul is on the upper stream and that of Subak Bumbung is on the lower stream of a small river in Karangasem District. The distance between the two weirs is about one Klometer.

In 1985, the government assisted both subaks to rehabilitate their main canals. The total length of the main canals of the two subaks is about 2,500 meters (about 1,000 meters belonging to Subak Bedugul and 1,500 meters to Subak Bumbung). Additionally, Subak Bedugul had its intake upgraded.

Lining the main canals and upgrading the intake of the Bedugul weir were, in fact, only a kind of expansion of a bigger project called the Ababi Irrigation Scheme which covered a command area of more than 1,600 ha under the Bali Irrigation Sector Project. The farmers of both subaks were not informed beforehand about the project, except during the construction phase when they were instructed not to grow rice.

It is unfortunate that such an expensive project was poorly accepted by the farmers. Many of the new permanently built structures were left idle because division structures along the canal were not properly located. During the construction stage, the head of Subak Bumbung had protested about the improper location of division structures but the contractor had to follow the project blueprint. After completion, many farmers could not obtain water because their previously operated canals and division structures were closed. As a result, they had to make holes along the newly built canal, otherwise no water would flow to their rice fields.

The farmers in Subak Bumbung wanted government assistance to upgrade their temporary weir and its intake into a more permanent structure. Their weir had been frequently destroyed by flood and its intake covered with sand, requiring about 350-600 hours of communal labor annually for repairs and maintenance. Surprisingly, they received government assistance for the canal lining, which was not as urgently needed as improvements to their weir and its intake (Sutawan et al. 1986).

Tertiary development projects. Tertiary development projects were extended to the jointly-managed irrigation systems. Government assistance for improving tertiary networks was given therefore only to irrigation systems having already received main system development assistance.

Under the tertiary development projects, the government introduced a new perpendicular branching type of division structure, known as a *ngerirun* system, which replaced the subak-built straight line type structure, known as a *numbak* system. Compared to the numbak system, the inflow sections for the ngerirun were much narrower. In addition,

between the inflow sections, a stilling pool was made with a depth of 15-20 centimeters (cm). The stilling pool was designed to enable the water to circulate prior to entering each inflow section so as to permit more equitable distribution of water. However, for the proper functioning of this new structure, constant cleaning was necessary due to the fact that the narrow openings were easily clogged by debris and the stilling pool easily filled with sand and mud.

The case study of Subak Celuk in Gianyar District (Sutawan et al. 1984a) reveals some interesting findings. The farmers in Subak Celuk were not informed by the head of the subak about the government assistance for tertiary development. They only came to know about it after the contractor had dismantled the old permanent structures which had been built by the subak on a self-help basis. Although the subak members expressed their objections, the contractor insisted on following the design provided by the irrigation agency and replaced the old structures with the ngerirun type. The farmers seemed dissatisfied with the ngerirun system because: a) it failed to provide equitable water distribution to farmers getting water from the left or right of the boxes because the narrow openings were easily clogged with grass and leaves and the stilling pool filled easily with sand and mud; b) rotational water distribution, used in cases of water scarcity, could not be practiced anymore because the water overtopped the canal; and c) the quality of the new structures was inferior to those previously built by the subak.

Similar findings were noted in other irrigation systems receiving tertiary development assistance. In Subakgede Tamanbali, for instance, although the irrigation agency provided information, subak leaders had difficulty in comprehending detailed blueprints and remained unaware of the real form of the new structures. After a number of new structures were completed, they realized that the ngerirun structures were different from the earlier ones built on a self-help basis and tried to stop further dismantling of the remaining old structures. However, the contractor continued to work according to the blueprint provided by the irrigation agency. After completion of the project in 1983, the subak could not use one of the newly built structures because, when plentiful, water overtopped the canal and damaged the embankment. The farmers were compelled to replace this structure by the numbak system. Furthermore, some of the ngerirun boxes were of inferior quality and were damaged by frequent overflowing of the water. The subak-built structures which were not replaced by the new boxes are still functioning well (Sutawan et al. 1986).

Similar complaints were also expressed by farmers of Subak Sidayu in Buleleng District about the replacement of their numbak structures, which had been permanently built on a self-help basis, by ngerirun boxes.

In other cases, however, particularly in subaks where the previous division structures had not yet been permanently built, as at Subak Mandi and at Subak Aya in Bangli District, no complaints were made by farmers with regard to government assistance for tertiary network improvement. Farmers were satisfied with the new structures. And yet, the leader of Subak Aya himself seemed to prefer the numbak structure. This was evident from his proposal (mentioned during the interviews) that the remaining numbak structures should be upgraded into permanent ones without changing the old design.

Cases Illustrating Rather Successful Projects

The government has carried out an increasing number of main system development projects in which several traditional weirs were combined into a single permanent dam serving water to all the former irrigation systems. Because the subak as an irrigation system is not merely a physical system but a social system as well, it is likely that irrigation projects combining several subaks would create problems such as those illustrated in the previous section. Although main system construction has long been completed for some irrigation projects that combined previously independent systems (as observed along the Ho River in Tabanan District), the problem of coordination among these systems is not being considered and the problem of how to manage the new system has not yet been formulated. This indicates that the socio-institutional aspects of such projects frequently seem to be neglected.

Irrigation development projects dealing with only one subak or irrigation system seem to be more acceptable to farmers than projects combining several irrigation systems into one because, with a single subak or irrigation system, the problem of coordination does not arise.

Prior to the Bali Irrigation Sector Project in 1979/80, the government fund was limited. Sushila (1984) notes that the basic policy of the government in providing assistance to the subak has been: 1) to preserve the old canals as much as possible; 2) to request the involvement of farmers in the project, particularly during the construction phase, through contribution of labor and local material such as stones and sand; and 3) to adopt the subak's suggestions in laying-out the irrigation structures.

The adoption of such a policy, which no doubt secured the farmers' sense of belonging and sense of responsibility toward the irrigation system, might explain the willingness of farmers to participate in main system maintenance whenever needed, although main system O&M usually remains in the hands of the government.

Due to the increasing number of projects since the Bali Irrigation Sector Project, and the inadequacy of irrigation agency personnel in handling the increasing scope of projects, the above policy has been practically neglected, although still used as a reference. Thus, in practice, there have been many shortcomings in project implementation with various implications, as shown by the previously discussed cases illustrating less-successful projects.

One development project which combined several irrigation systems that could be regarded as a success is the case of Caguh Irrigation Project located near the Ho River in Tabanan District (Sutawan et al. 1986). The project combined nine subaks. Of these, Sambian, Samsam, Caguh, Kesiut, and Penatih subaks had their own weirs, whereas Anyarkumpi, Dukuhancak, Mumbu, and Batuaji subaks depended on water through seepage. Under the Caguh Irrigation Project, all nine subaks are now served by one permanent dam covering a total area of more than a 1,000 ha.

Before the construction of the dam, the irrigation agency and local government officials, particularly the sedahan agung, held lengthy discussions with leaders of the respective subaks concerning the project and the need for an intersubak coordinating body (subakgede). Two subaks, Sambian (an upper stream subak) and Mumbu (a seepage subak) refused to join the project. However, after discussion at a meeting on 29 December 1978 (which is considered the birth date of Subakgede Caguh), they agreed to join under the following conditions: 1) during construction of the dam, the existing weirs would be kept functioning as much as possible and the water shared with all subaks; 2) a single division box would be built for Subak Sambian and the canal diverting water from this box would only deliver water to its area (i.e., no other subaks would be allowed to draw water from this canal); and 3) Subak Mumbu would join the project and become a member of the subakgede if and only if it really depended on the dam for its irrigation water. If the Mumbu farmers could not grow rice without water from the five subaks with weirs, that would be proof that they really depended on the dam for irrigation.

During dam construction, the subaks were able to grow rice by building a temporary division structure on a self-help basis among the five subaks concerned. This temporary structure was built using coconut trunks at the location where the primary canals of the respective subaks were close to each other. (The project utilized this location later to build the permanent division structure.) Subak Samsam was allowed to draw water from the weir belonging to Subak Sambian by building a temporary canal, whereas the other four subaks obtained water from the temporary division structure. The construction of the common temporary structure could be regarded as a "test case" for the new subakgede. The farmers were convinced that the project could really benefit them.

During construction, the project employed the farmers as hired labor. The subakgede sold stones and sand collected by the farmers under the supervision of the leader of the new association, who was appointed through consensus. The proceeds went into the association's fund.

During construction of main canals and division structures, water was not available for almost two crop seasons and, as a consequence, the farmers in Subak Mumbu and neighboring subaks, were unable to grow rice. This proved the dependency of Subak Mumbu and other seepage subaks on the dam located on the Ho River. Therefore, Subak Mumbu finally agreed to join the subakgede.

At the project's completion in September 1980, the keys of sluice-gates at the division structures (which in a jointly-managed irrigation system are usually kept by the *tukang empelan*) were handed over to the leader of the subakgede, signifying that the authority for water allocation was in the hands of the farmers. Near the dam, a new water temple was erected for use by the member subaks and all the previous water temples were abandoned.

The Caguh project has run smoothly. Farmers have been satisfied with the project and grateful to the government because they no longer had to go down to the river to repair their weirs, which were frequently destroyed by floods. There has been no difficulty in

mobilizing self-help labor among farmers for repair and maintenance of the main canal when requested to do so by the government. In particular, farmers have so far been willing to participate in cleaning an area of the main canal about 1,200 meters from the intake which is filled by landslides almost every year.

CONCLUDING REMARKS

A subak, as an irrigation association, is location-specific in nature. Although subaks have been in existence for more than a thousand years, relatively little is known about their present performance or about the existing irrigation systems in Bali, particularly those receiving government assistance. To enrich the knowledge of irrigation systems in Bali, more in-depth studies are required.

Religious rituals seem to play an important role in the life of the subaks and provide a strong social basis for unifying subak members. This is evident from the high percentage of annual expenditure allocated to rituals by the subaks.

Many small (below 50 ha) traditional irrigation systems greatly need government assistance to upgrade their temporary weirs, but without combining them into a single system. Although combining might be technically and economically efficient, it may not be effective. It seems that, to some extent, efficiency must be sacrificed for effectiveness.

Farmers' active involvement in repair and maintenance of the main system for jointly-managed irrigation systems, despite main system O&M being the responsibility of the government, may be due to the following reasons: 1) the existence of a water temple near the dam no doubt draws the farmers together and reaffirms their membership in the irrigation community; 2) the involvement of the association leader in making decisions about water allocation and distribution; 3) the almost total utilization of the old canals of subaks; 4) the government's flexibility in implementing physical lay-out; 5) the involvement of the farmers during construction; and 6) the continuing use of irrigation water for domestic and household purposes.

However, concern has been raised that management of main systems by the government may reduce the farmers' sense of belonging and their feelings of responsibility toward their irrigation system, particularly when the supply of water for daily household needs can be provided from other sources, such as water pipes or pumps. Therefore, action research to determine proper division of management tasks between the farmers and the irrigation agency in various sizes of irrigation systems is necessary.

Tertiary development projects were initiated in 1979 in an effort to upgrade tertiary networks of jointly-managed irrigation systems. In many cases, the subak leaders as well as the farmers did not know about the project but came to know about it only after the contractor had dismantled the old structures. The tertiary development assistance has been criticized and found less acceptable to many farmers because of three major shortcomings: 1) the ngerirun boxes introduced by the government as a substitute for the

numbak division structures failed to secure equitable water distribution; 2) under conditions of plentiful supply, water frequently overtopped the canal and damaged the embankment, especially where the inflow sections were narrower than the subak-made division structures; and 3) the new structures were of inferior quality compared with the old ones built by farmers on a self-help basis.

The cases illustrated earlier regarding the impact of government assistance for irrigation development clearly support the view that the "blueprint approach" has been less successful than the "participatory approach" to irrigation development. Therefore the participatory approach should be employed in future irrigation development strategies.

GLOSSARY

The words below are Balinese except for those indicated by *.

Adat	Customary law, Hindu in character.
Awig-awig	rules and regulations or by-laws of the association.
Banjar	subdivision of *desa adat,* basically an implementing organ of the desa adat and the main organization responsible for activities related to customary law.
Banjaran	subdivision of a *subak* (subsubak); see *tempek* (most popular term), *lanyahan, munduk,* and *pamunduk.*
Bedugul	rice field temple dedicated to *Dewi Sri.*
Bendahara*	Indonesian word for treasurer; see *juru raksa.*
Bendesa	head of *desa adat.*
Biukukung	an offering by a farmer when the rice is in the milk stage.
Desa adat	an autonomous (i.e., completely independent from the hierarchical structure of government administration) self-contained, traditional community based on *adat.* Desa adat usually comprises one or more *desa dinas* (in Bali there are 1,456 desa adat but only 575 desa dinas). Within a desa adat there are a number of *banjar* (3,508 in Bali). The most important characteristic of desa adat is the *kahyangan tiga.*
Desa dinas	an integral part of the hierarchical structure of the government administration unit below the *kecamatan*

Dewa nini	a subak ritual held by farmers immediately before harvest by making a symbol of *Dewi Sri* (i.e., 162 rice panicles are divided into 2 parts consisting of 108 and 54, signifying male and female, respectively).
Dewi Sri	god of fertility.
Empelan	a traditional weir built and maintained by the farmers on a self-help basis.
Giliran*	rotational method of water allocation.
Juru arah	messenger; see *saya* and *kasinoman*.
Juru raksa	treasurer; see *bendahara*.
Kabupaten*	district; administrative unit within a province.
Kahyangan tiga	three important temples found in each *desa adat* namely: *Pura Puseh* (temple of origin) dedicated to Vishnu, the Preserver; *Pura Desa* or *Pura Bale Agung* (village temple) dedicated to Brahma, the Creator; and *Pura Dalem* (Temple of Death) dedicated to Shiva, the Destroyer.
Kanca	an informal group consisting of 4-10 farmers whose *sawah* are located very close to one another; see *penasan*.
Kasedahan	a cluster of *subaks* or *subakgedes* within a watershed; see *pasedahan*.
Kasinoman	messenger; see *juru arah* and *saya*.
Kecamatan	subdistrict; administrative unit under the *Kabupaten*.
Kelihan	elder, head, leader; also *kelihan pekasehan*, head of a *pekasehan*; *kelihan subak*, head of a *subak*; and *kelihan tempek*, head of a *tempek*.
Kertamasa	system where rice is grown on all fields simultaneously.
Krama	member of an organization; also *krama pekaseh*, the owner of *sawah catu*; *krama pekasehan*, member of a *pekasehan*; *krama subak*, member of a *subak*; and *krama tempek*, member of a *tempek*.
Lanyahan	subsubak; see *tempek*.

Leluputan	*subak* members who are exempted from its daily activities and from other contributions.
Magpag toya	a water opening ceremony held by all *subak* members at the beginning of the wet season at the *ulun suwi* or *ulun empelan*.
Mantenin	a ceremony performed after stocking the rice bundles or threshed paddy rice at a farmer's granary.
Manyi	a thanksgiving ceremony performed by a farmer at harvest.
Maongin	part of the *subak*/irrigation system, gets water at the second turn.
Mùnduk	subsubak; see *tempek*.
Miseh	an offering made by a farmer when the rice starts blooming.
Nandur	an offering made by a farmer before transplanting rice.
Nangluk merana	a ritual by the whole *subak* to avoid the attack of pests and diseases.
Ngasep	part of the *subak*/irrigation system, gets water at the last turn.
Ngawit nambah	a ceremony by a farmer before beginning land preparation.
Ngerirun	perpendicular branching type of water division structure.
Ngulu	part of the *subak*/irrigation system, gets water at the first turn.
Ngurit	an offering made by a farmer before spraying the seed bed; see *pangewiwit*.
Ngusaba	a kind of thanksgiving ceremony performed by the *subak* as a whole prior to harvest.
Numbak	straight line type of water division structure.
Nyorog	method of water distribution by dividing the *subak* or irrigation system into 2-3 groups, such as head, middle, and tail. The head gets water at the first turn, followed by the middle and finally the tail.
Palawija	non-rice crops such as corn, bean, and onion.

Pamunduk	subsubak; see *tempek*.
Pangewiwit	an offering; see *ngurit*.
Pasedahan	cluster of *subaks*; see *kasedahan*.
Pecelang	water guards; see *petelik*.
Pekaseh	head of a *subak*.
Pekaseh gede	head of a *subakgede*.
Pekasehan	a number of coordinating units within a *subakgede*.
Pemangku	priest.
Penasan	informal group of farmers; see *kanca*.
Pengampel	passive member (i.e., farmers who do not participate in daily activities of the *subak* but must pay a cash or in-kind contribution. Such contributions are also called *pengampel* or *pengoot*).
Pengayah	active member (i.e., farmers who are actively involved in the daily activities of the *subak*); see *sekehe yeh*.
Pengoot	payment by passive members of a *subak* as a substitute for labor; see *pengampel*.
Penyarikan	secretary.
Petelik	water guards; see *pecelang*.
Peturunan	cash contribution collected whenever needed from all *subak* members.
Piodalan	a ceremony for the inauguration of a subak temple, held every 210 days. Each temple has its own *piodalan*.
Prajuru	*subak* administrators.
Sanggah catu	small altar; see *ulun carik*.
Sarin tahun	in-kind contribution paid by all members of the subak, usually at the end of the harvest; see *suwinih*.

Sawah	irrigated rice field; *sawah catu*, rice field given to the farmers by the king in former days in Bangli District and in exchange the owner has been responsible for the performance of rituals at the Bukitjati Temple.
Saya	messenger; see *juru arah* and *kasinoman*.
Sedahan	government official, assistant to *sedahan agung* (the area of jurisdiction of a *sedahan* is the *kasedahan or pasedahan*).
Sedahan agung	the highest authority of *subak* organization; he is a government official mainly responsible for land tax collection for *subaks* or *subakgedes* within a district.
Sekehe yeh	active members; see *pengayah*.
Subak	water-users' organization in Bali.
Subakgede	intersubak coordinating body.
Suwinih	contribution; see *sarin tahun*.
Tektek	a measure of water share.
Tempek	most popular term for a subsubak.
Tenah	a bundle of unhusked rice around 25-30 kg; since one *tenah* of rice seed is required for a rice field of 0.35-0.50 ha, which also receives one *tektek* of water, then quite often *tenah* is used interchangeably for *tektek*, size of *sawah*, and the amount of rice harvest.
Tukang empelan	dam or weir keeper.
Ulun	temple. *Ulun carik*, a small altar belonging to a farmer erected at the rice field nearest his own water inlet (see *sanggah catu*); also *ulun suwi*, water temple; *ulun danu*, lake temple; and *ulun empelan*, weir temple.
Wakil pekaseh	deputy to head of a subak.

NOTES

[1]In Karangasem District, it was found that several irrigation systems were put under one coordinating authority. It was probably introduced by the government during the Dutch era for tax collection. This coordinating authority had nothing to do with irrigation per se and each member subak remained completely independent of the others.

[2]In Bali there are 8 *sedahan agung* because there are 8 *kabupaten* (districts) and 80 *kesedahan*, but only 51 *kecamatan* (subdistricts). Below the kecamatan there are 575 *desa dinas* (Dinas Pekerjaan Umum Propinsi Bali, 1982).

[3]At the beginning of *subak* formation, it was highly probable that irrigation water was allocated equally to each member based on participation in the construction works of weir and irrigation networks irrespective of the size of *sawah* owned (except for the leader who might be given extra shares as reward for his service to the association). Later on, due to such reasons as inheritance and transactions through buying and selling of water rights, the water share has apparently become unequal among individual farmers. Depending on the consensus, the members having sawah located a long distance from the main canal may be given an extra share of water.

[4]Water conflicts among members of the same subak are tackled by the head of the subak concerned. In case he is unable to solve it, the case is forwarded to the *sedahan*. And if the sedahan cannot overcome the problem, he can take it to the *sedahan agung*.

[5]In former days, serious conflict frequently occurred between subaks located at the border of neighboring kingdoms. The king whose area of jurisdiction was located upstream instructed his people to close his enemy's weir and divert water for the benefit of his own people. As a result, the enemy's sawah dried so that no crop could be grown, or the weir of the enemy was destroyed so that the enemy's territory was flooded (Liefrinck 1969).

[6]Prior to the construction of a permanent dam by the government in place of a temporary structure in some subaks, such as in Subakgede Tamanbali in Bangli District, the *subakgede* had assigned a dam keeper (*tukang empelan*) and a number of water guards (*petelik*). They were paid in-kind by the association and their tasks were in fact more or less similar to the present tasks of the dam keeper and his assistants paid by the government. In Subak Tinjak Kayu in Gianyar District, members, and not the government, pay the dam keeper although the dam was built by the government.

[7]In 1985, for example, the total annual expenditure of Subakgede Caguh (1,057 ha) amounted to almost Rupiah (Rp) 10 million (US$8,991). Of this, almost 80 percent was for rituals and the remainder was for other purposes, such as repairs and maintenance of irrigation facilities. Meanwhile, in Subakgede Tamanbali (351 ha), total annual expenditure was about Rp 6 million (US$5,395), with almost 92 percent for rituals; in Subakgede Saren (84.6 ha) more than 95 percent of a total annual expenditure of about Rp 2 million (US$1,798) was for rituals. The annual expenditures of individual member subaks ranged from Rp 0.2-2.6 million (US$193-2,333) within Subakgede Caugh; Rp 0.05-0.38 million (US$40-340) within Subakgede Tamanbali, and Rp 0.09-0.36 million (US$81-323) within Subakgede Saren (exchange rate used was Rp 1,112 - US$1.00).

[8]The study only compared two neighboring irrigation systems, one with and the other without a tertiary development project.

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