“I am just borrowing water, but I will return it in an hour”. The interdependence of informal and formal institutions in Balinese irrigation management.

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Abstract:

Rice cultivation in Bali cannot be separated from the irrigation societies called subak. Subak are socio-religious organisations responsible for irrigation management and religious activities within a defined geographical area. Every subak has rules that have developed over a long time. They have been codified in a set of laws called “awig-awig”. These laws regulate rights and duties among the members of the subak. Such rights and duties include public obligations, regulations concerning land and water use, legal transactions of land transfer, and collective religious ceremonies.

However, the farmers’ every day decisions rely strongly on informal regulations and unwritten rules. The author explores how irrigation water is negotiated by the heads of the subak who themselves are farmers. It is argued that the formal arrangements are reluctantly implemented by subak heads. It is the strength of the “informal” which gives them the freedom to adjust to constantly changing situations.

This paper uses a case study to show the complexity of local irrigation management. The *first* section discusses the common view of the subak as being a thoroughly structured, well organised irrigation society. The *second* section highlights recent changes to the subak system due to government intervention. The author analyses the impact of a recently established government-assisted federation (subak-gede) of five subak which share a common weir. The introduction of the new management level has brought changes to the way water is distributed amongst the subak which ignites unexpected resistance within the farming community. The *third* section questions the common view that a shift from “weak” informal institutions to “strong” formal institutions really improves irrigation management.

Prologue

In 1996 the pilot project IPAIR (*Iuran Pemakai Air*, transl. water service fee) was launched in the regency Badung, Bali. The goal of the IPAIR project was to reduce administration costs and handing over operation and maintenance (O&M) responsibilities to a new, government motivated federation (subak-gede) of several irrigation societies called subak. The subak-gede consists of six subak which share a dam and some irrigation infrastructure (Proyek APBD, 1995:1-8).[1] Further, the subak-gede was to represent another organisational level in the irrigation management with the purpose of distributing water optimally amongst the six subak in collaboration with the government. Due to the turbulent years following the end of Suharto's regime the project was implemented with some delay.

In 2001 the subak-gede was formed. By 2005, the subak heads of the six subak put together a set of laws for the subak-gede.[2] Formal meetings[3] are regularly held between the subak heads and the sedahan Yeh - a government official who is responsible for subak matters as well as for collecting land taxes of a particular region - and attempts to formalise irrigation water allocation were made.

The emphasis on formal interactions amongst the subak led to unforseen complications. Especially, the newly implemented water negotiations amongst the subak heads left some subak in an undesirable position because their autonomy in making decisions decreased with the subak federation. This resulted in social tensions at the farmers' level. In one subak some farmers abandoned the synchronised cultivation which is a major element of the subak system and thus angered other farmers. Also, water negotiations between farmers didn't run as smoothly as before. The tensions peaked when several farmers asked the subak head to step down. His inability to make the right decisions on the inter-subak level was seen as a direct cause for their loss in yields.

What happened? The formalisation of the informal interactions between the subak heads was supposed to strengthen the system rather than creating turmoil.

[1] Service fees should be implemented in return to the O&M services of the government. To my knowledge these fees have never been introduced. However, the focus in this paper is not on the service fees, but on the creation of the subak-gede and its impact on local water management strategies.

[2] The set of laws called "awig-awig" is not yet signed off by the necessary government officials. The incentive to create an awig-awig originates from the fact that all subak in Bali have a set of customary laws, written or unwritten, which regulate certain subak activities (see next section).

[3] These meetings take place as part of another larger meeting of all subak which are within the boundaries of the local tax region (pasedahan). Even though the Sedahan is not officially a member of the subak-gede, he automatically takes part in such meetings and has a certain influence, especially because conflict mediation between subak fall under his responsibility.

Introduction

In the recent past, constructing, maintaining and operating irrigation infrastructure, as well as managing irrigation water was seen as the responsibility of a centralised body, mostly exemplified by the state. Community managed commons were seen as open to overuse - ending in a tragedy (Harding, 1968).

Nowadays we can observe the reverse. Current policies to sustain common property resources stress the role of community-based management approaches (Mosse, 1997). However, although newly implemented irrigation management strategies are supposed to build on existing local organisations, there is still a belief in the superiority of standard models of management institutions which often lack an adjustment to local circumstances (Bruns et al., 1996). It is assumed, that improved irrigation management is a unilateral move from "weak" to "robust" institutional settings (Ostrom, 1990). Informal arrangements, although recognised as important, are mostly seen as the weak link. As a consequence there is an emphasis on the formal arrangements in decision making focussing on representation, regularisation and formalisation (Cleaver, 2000). This implies that informal institutions should be gradually replaced by "modern" arrangements to reduce the deficiencies of the "traditional" (Seabright, 1993).

Underlying these theoretical approaches are assumptions that better institutions can be crafted by resource users and policy makers (Ostrom, 1992). In irrigation management such crafted institutions are clear boundaries of the resource area and usage rights, clear authority structures, rigorous application of graduated sanctions to reduce free-riding, and transparent decision making backed up by formal regulations (Ostrom, 1990). Such a view seems to contrast with the practices of Balinese farmers who manage water by "borrowing" it from or "lending" it to other farmers. This applies also to the higher levels of the subak. The manipulation of the irrigation infrastructure, ad hoc water negotiations, and the occasional "night operations", although not allowed by subak law, are socially accepted by farmers and the subak heads. Water use rights, resource boundaries, and subak law are less rigid than often described. But still the subak manages water sustainably because the fluidity of the formal and informal subak framework created a subtle combination of structure and flexibility.

Bureaucratic models of irrigation management assume that by crafting institutions there is a movement from primitive forms of interactions which are intertwined with social relations to

autonomous and economically rational forms (Granovetter, 1992). This paper illustrates how an informal institutional frame between several subak has been changed to improve irrigation management of these subak. This, contrary to expectations, resulted in the loss of autonomy of the single subak and in forcing subak heads to make economically inconvenient decisions. The subak heads tried to assimilate new organisational structures into already existing water management strategies which evoked disturbances at different levels of the subak. I argue that unintended consequences evolved because the implementation of the new organisational structure could not grasp the complex interconnectedness of already existing rules in use. In this case, informal agreements between the subak heads have to be seen as "strong" because they regulate relationships which are hard to negotiate in a more formal and "rational" manner.

The aim of this paper is to discuss the difficulties the subak heads were facing in negotiating irrigation water. A strong focus is put on the existing subak dependencies on climate, water, and ceremonial obligations. In the first section, the Balinese irrigation societies called subak are introduced, followed by the history of the creation of government implemented subak federations of several subak. In a next section problems which were created with the formation of the subak-gede are examined and analysed. The concluding remarks question the common perception in irrigation development that the move from informal to formal arrangements, supported by new organisations such as the subak-gede, means that "weak" institutions are replaced by "strong" ones.

What is a subak

Balinese rice cultivation is famed all over the world for their efficient use of irrigation water. The farmer managed irrigation societies called subak play a major role in managing water.[4] They are one of the three public corporations of a traditional Balinese village (desa adat) along with the hamlet (banjar) and the temple congregation (pemaksan). Whereas the hamlet orders the public aspects of community life, the temple congregation organises popular ritual, the subak deals with the cultivation and irrigation of rice (Geertz, 1980 and Warren, 1993).[5]

[4] Archaeological evidence indicates that the subak system has been in place for more than one thousand years.
[5] The *banjar* is responsible for regulating community life. The *pemaksan* organises and coordinates the vast religious rituals related to a *desa adat*, which comprises several *banjar*.

The subak is commonly recognised as a socio-religious agricultural association (Sutawan, 2000) and it is considered to be one of the most effective hydraulic organisations in the world (Ostrom, 1992).

The subak is a mixture of different units:

a. It is a ***technological*** unit including a main water inlet and a complex system of collectively owned irrigation canals which secure equal access to irrigation water to all the subak members. The water shares are determined by a combination of area sizes and mutual agreements, and technically implemented with fixed proportional flow division structures (Horst, 1996).

b. It is a ***physical*** unit. The boundaries of a subak are defined by all the rice fields which receive water from the subak irrigation infrastructure. Although the rice fields are within the boundaries of a customary village, the subak does not correspond to the social unit of the village (Bray, 1986; Geertz, 1972).

c. It is a ***social*** unit comprising all farmers who cultivate land within the subak boundaries and receive water from the subak irrigation infrastructure.

   Every farmer owning or sharecropping land within the subak boundaries is automatically a member. Duties for subak communal work such as the maintenance of the canals are equally distributed regardless of social status (Dinas PU, 1997). Next to the reduction of labour and time for the individual farmer the subak structure also allows for a coordinated planting cycle with all its members planting rice at the same time. The synchronisation of rice planting over large areas minimises growth and dispersal of pests and makes pest control more effective (Lansing and Kremer, 1993; Aryawan et al. 1993).

d. It is a **legal** unit given the status of customary law societies with clearly defined rules and regulations written down in a law book called “awig-awig” (Dinas PU, 1997).[6] This set of laws regulates rights and duties among the members. It includes regulations concerning land and water use, legal transactions of land, collective religious ceremonies, and sanctions when breaking the subak laws. The awig-awig of subak has been passed down orally over generations. Nowadays, many subak

[6] The subak are formally recognised by the Bali Provincial regulation No. 02/PD/DPRD/1972: “Subak are customary law societies with socio-agrarian-religious nature which were established a long time ago and evolved continuously as landholding organisations which distribute water in a defined irrigation area.”

have a written version at their disposal.

e. It is a **religious** unit including ceremonies on the individual level, the subak level, and the inter-subak level. The ceremonies vary in scale, involvement and duration. The ceremonies ask for protection against pests and diseases and a successful harvest, and honour god for letting human beings work the land. The most elaborated ceremonies involve all subak who receive water from the same crater lake. (Lansing, 1991; Pitana, 1993; ADB, 1997; Sutawan, 2001).

   The Balinese philosophy guiding the subak system adheres to the principle of Tri Hita Karana which emphasises that happiness can only be achieved if the Creator (God), the people (the farmers) and nature (the rice fields) live in harmony with each other. The ceremonies are based on this principle and represent a substantial element of the rice cultivation cycle. They are carried out at the various temples which are associated with the subak. The temples are organised hierarchically from the simple shrine at the individual water inlet to the Bali-wide inter-subak temple at the crater lake Batur, the most sacred lake in Bali (Lansing, 1991; Pitana, 2005).

Subak internal matters are handled by the subak head (pekaseh) who is democratically elected by all members of the subak. He is responsible for overlooking irrigation matters, to scheduling cultivation cycles and to organising subak ceremonies. He is supported by several assistants, such as the secretary, the treasurer, the messenger and the heads of the sub-subak groups[7].

This is how the subak is described mostly in the literature and leaves us with an image of a well organised irrigation society which is fairly formalised and thoroughly structured (Geertz, 1972; Grader, 1960 [1939]; Liefrinck, 1969 [1934]; Pitana, 1993; Sutawan, 2000).

However, after living in Bali, working on the rice fields, and being an active member of an irrigation society myself, I feel that such a description does not grasp the complexity of a subak. It tends to imply a picture of a passive Balinese farming community which is surrounded by clear rules and regulations. Further, it portrays the subak as similar all over Bali which leads to an underestimation of regional difference.

[7] Larger subak are divided into sub-groups called munduk. In the case study area these groups often have a separate inlet from the subak main canal. They comprise usually of an average of 20 to 40 farmers.

Conversely, I observed that there are considerable differences between the six subak of this case study. Water is negotiated on a daily basis at several levels of the subak. Farmers negotiate water with adjacent farmers in face-to-face interactions and sometimes across subak boundaries. Sub-subak heads negotiate water between each other at certain cultivation periods, and so do subak heads on the inter-subak level. These negotiations are not necessarily following subak regulations. In fact, in many cases, the informal arrangements break subak law. But the formalised subak sanctions are hardly ever enforced and, more important enforced differently in each subak. The subak law is just seen as the final arbiter, a sort of behavioural guideline. This gives the farmers and the subak heads the necessary flexibility to deal with problems related to irrigation water on a day-to-day basis.

Attempts to standardise subak irrigation management are difficult because the ongoing water negotiations on the different levels of the subak system create a complex dynamic of formal and informal rights and duties in which the local social and natural environment plays a crucial role. The informal arrangements are especially hard to grasp because they are not necessarily visible at first sight and their importance hard to measure. Thus, when irrigation improvement projects are launched, there is a tendency to concentrate on the formalised, more visible rules and regulations. A standardisation of local management strategies is still underlying many improvement strategies.

The following case study addresses these issues by analysing a newly created subak-gede.

The history of subak-gede in Bali

On 17 September 1981 the Asian Development Bank approved a 33.6 million US$ irrigation project known as the Bali Irrigation Project (BIP).[8] The Project planned to increase food production, provide employment, reduce poverty and strengthen institutional capability (ADB, 1997). To reach these goals many independent smaller irrigation systems with their previously own intake were physically integrated into larger irrigation networks sharing new common permanent weirs (Sutawan, 2000). Three years into the implementation of the BIP the project implementers realised that the new irrigation system did not function according to plan. Although technical improvements increased the amount of available irrigation water the subak which were merged remained passive in creating inter-subak institutions. Quarrels over

[8] Asian Development Bank, Bali Irrigation Sector Project (Loan No. 522-INO).

joint water management rights and duties within the new federation emerged. Sometimes the quarrels went so far that some subak abandoned the new irrigation infrastructure by reviving the old canals. It became obvious that the project focused too heavily on improving the physical infrastructure, neglecting the social framework of the different subak (Sutawan, 2000).

A re-evaluation by the ADB in 1997 agrees that the BIP did not suit the long established informal institutional frame. It failed to understand Balinese irrigation as a complex system intimately woven into Balinese social structure. Irrigation and crop management was seen as a purely technological matter ignoring the complexity of long-standing water rights negotiated among subak along a river (ABD, 1997). The top-down management models introduced with the intensification and irrigation programs conflicted with the former subak organisation. The subak were not involved in the planning process which resulted in a weak understanding of how these merged subak negotiated water before the improvements took place.

The ADB re-evaluation summarises the consequences aptly: "The designers' limited understanding of farmer-managed hill irrigation and key physical and socio-cultural traits resulted in shortcomings of the project. Subak capabilities for operation and maintenance were weakened due to the Project…" (ADB, 1997:3).

By 1987 the quarrels between the subak were still ongoing (Sutawan, 2000). In response to the communication and coordination difficulties the Udayana University in Bali together with the Bali provincial office of public works developed a participatory approach. This approach was used to assist subak in forming federations. They were called either subak-gede or subak-agung depending on size and structure. A Subak-gede is a subak federation of all subak that have been integrated into a system with a common permanent weir. A subak agung is a federation of subak along one or more river courses.[9]

The new federations provided the organisational structure necessary for the subak to maintain their independence within subak activities. At the same time it allowed them to act jointly on decisions and activities that affected the larger group. It also provided a mechanism for

[9] I am using Sutawan's terminology. "Gede" means big in Balinese. "Agung" means great, large. For further information see Sutawan (2001).

conflict resolution (Sutawan, 2000). The strengthening of the inter-subak relationships by including the subak heads was seen as the major element in strengthening subak institutions.

The creation of subak-gede had certainly helped the subak solving the problems around the new irrigation infrastructures. Nevertheless, questions remain how effective the merging of subak really is. I argue that the focus of such projects still prioritises the physical infrastructure and formal organisation over the social embeddedness of irrigation. I show in this paper that the restructuring of irrigation management institutions by implementing a subak federation uncovered inter-subak dependencies based on natural and historical preconditions. These were previously hidden and had to be actively negotiated to adhere to the new organisational structure.

One aim of the subak-gede was to formalise the negotiation process among the six subak to better allocate and distribute the shared irrigation water. The general solution was seen in staggering the cultivation cycles for an optimal water supply to each subak in the crucial periods. However, as I will show, water allocation is by far more complicated. Water off-flow dependencies, climate, subak autonomy, ceremonial links, and rice market prices are all taken into account in the negotiations amongst the subak heads. The creation of the subak-gede left some of the six subak in an unfavourable situation. As a consequence water was not readily available at the crucial time and farmers started revolting.

Problems of water allocation amongst subak

As mentioned at the beginning, the subak-gede was formed in the research area as a pilot project in the regency of Badung within the government project IPAIR (“Irrigation Premium Service”) in 1996. The subak-gede consists of six subak which irrigate 738 ha of rice fields. There are approximately 2000 farmers within the subak-gede area who live in one of the 26 hamlets of the six surrounding villages.

In 2005, the subak heads decided to stagger cultivation during the dry season. The aim was that every subak should receive an additional amount of water from the other subak during their peak time in terms of water needs. This is during the ploughing and transplanting when the fields have to be flooded constantly.

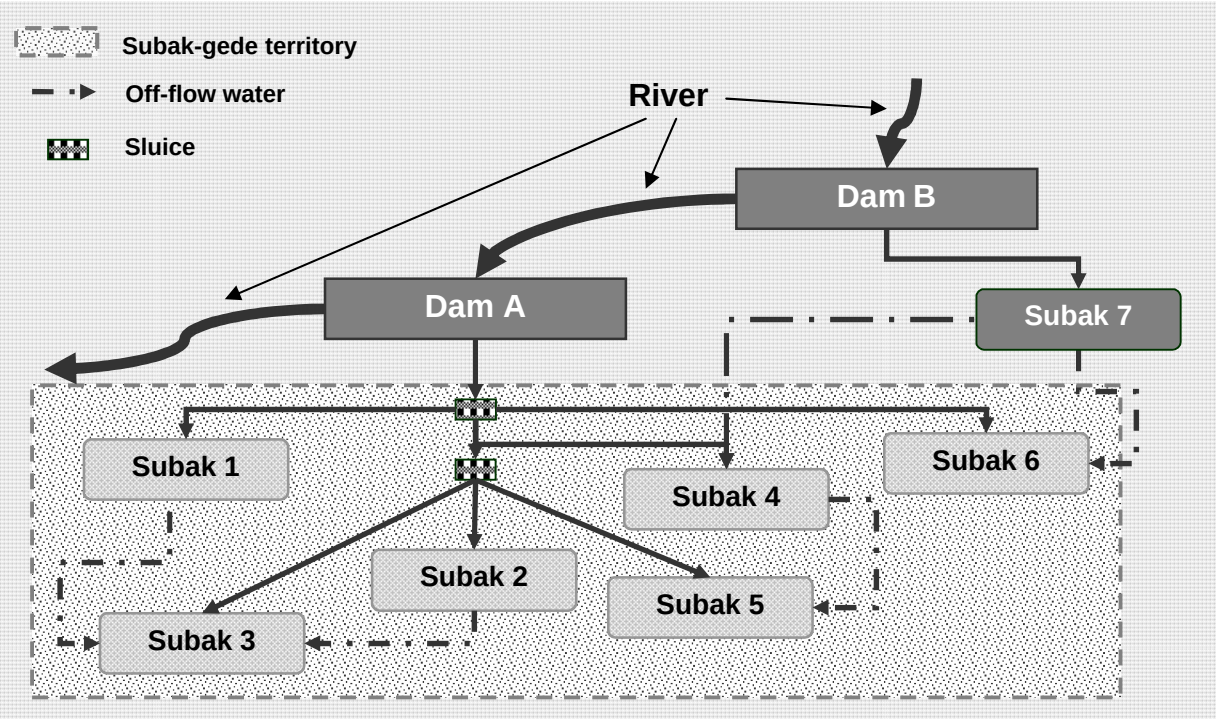
The agreement amongst the subak heads to stagger cultivation opened the debate on which subak starts first in the dry season. This process brought the water dependencies among the subak to the surface. It further became apparent that not only the irrigation water which flows through the subak-gede infrastructure has to be taken into consideration, but also irrigation water from other subak outside the subak-gede boundaries. This shows a simple but crucial characteristic of water – it flows across boundaries. Part of the water which flows into a rice field eventually is returned into off-flow canals. These canals feed subak further downstream which do not necessarily belong to the same water catchment area. What we find is an intricate system of subak which depend on other subak further upstream.

Figure 1 illustrates the dependencies of the six subak within the subak-gede boundaries as well as outside. All subak of the subak-gede receive water from dam A. When only taking the irrigation water from the shared irrigation infrastructure into account all subak would have the same starting point for water negotiations. However, when considering the off-flow water the picture changes drastically. Let me describe the water realities of the different subak in detail (please refer to Figure 1).

- Subak 7, a subak which is not member of the subak-gede receives its water from a different dam, dam B, 1.4 kilometres further upstream. Indirectly all subak of the subak-gede are dependent on subak 7 because there is less water for their dam A if subak 7 starts cultivating.
- Subak 6 has to follow the cultivation cycle of subak 7 because 50 percent of their water derives from surplus water of subak 7. It normally starts cultivation two to three weeks after subak 7. This has been so before the creation of the subak-gede and will be so in future, so the subak head said. In fact, he mentioned that his subak should rather be joining a subak-gede with subak 7.
- The same is the case for subak 4 and 5. These two subak have merged and share one subak head. They also receive surplus water from subak 7. Although the amount is not as large as for subak 6 they still rely on this water because they constantly suffer from water shortage during the dry season.
- Subak 3 receives surplus water from subak 1 and 2. Consequently the subak head of subak 3 hopes to cultivate shortly after subak 1 and 2.

- Subak 1 and 2 are not dependent on surplus water of other subak, but have ceremonial connections. Both these subak lie within the boundaries of the same customary village. Thus, they have a history of joint ceremonies in relation to rice cultivation.[10] As these ceremonies are related to the growing stages of the rice plant, it is important that the two subak start cultivation closely after each other.

Figure 1: Water Dependencies



- The same is the case for subak 4 and 5. They lie within the boundary of another customary village. Thus, they also coordinate certain ceremonies with each other.

The following table summarises the inter-dependencies amongst the subak of the case study area:

Table 1: Subak Inter-dependencies

Subak	Dependencies with	Nature of Dependency
1	**2**	Ceremonial (joint ceremonies); spatial (rice fields within the boundaries of the same customary village).

[10] It is not possible to go into detail about the importance of ceremonies in rice cultivation in this paper. Note that several ceremonies have to be done to mark certain growing stages of the rice. Larger, very costly ceremonies are held several times a year. Thus, there is an economic incentive for the subak to merge ceremonies if they already have established links with the same temples.

1	**7**	A coordination with subak 7 increases water availability for the subak 1 which often suffers from water shortage.
2	**1**	Ceremonial (Joint ceremonies); spatial (rice fields within the boundaries of the same customary village).
3	**2**	Off-flow dependency
3	**1**	Off-flow dependency
4	**7**	Water problems, so coordination with subak 7 increases water availability.
4	**5**	Administrative (two subak share one subak head); ceremonial (joint ceremonies); spatial (rice fields within the boundaries of the same customary village).
5	**4**	Off-flow dependency; administrative (two subak share one subak head); ceremonial (joint ceremonies); spatial (rice fields within the boundaries of the same customary village).
6	**7**	Off-flow dependency (50% of water from off-flow of subak 7).

In summary, the water dependencies narrow the ground of negotiations for each subak. After taking ceremonial, administrative and water dependencies into account, there is not much space left for negotiations. In fact, the dependencies basically determine the order for the staggering of the cultivation cycles.

Prior to the creation of the subak-gede every subak determined their cultivation cycle on its own. Naturally, the dependencies already existed. But because every subak had a greater autonomy in their decision making, the individual dependencies were differently weighed adjusting to specific situations. As mentioned above, some subak prioritised the reduction of ceremonial costs; other subak merged and thus have to be seen as one unit. Again other subak coordinate with subak outside the subak-gede area due to water dependencies. All these informal arrangements have evolved over a long period of time. Therefore, they are embedded in the history of every subak and create a complexity which is hard to grasp "rationally" – and even harder to predict the implications of their re-negotiations.

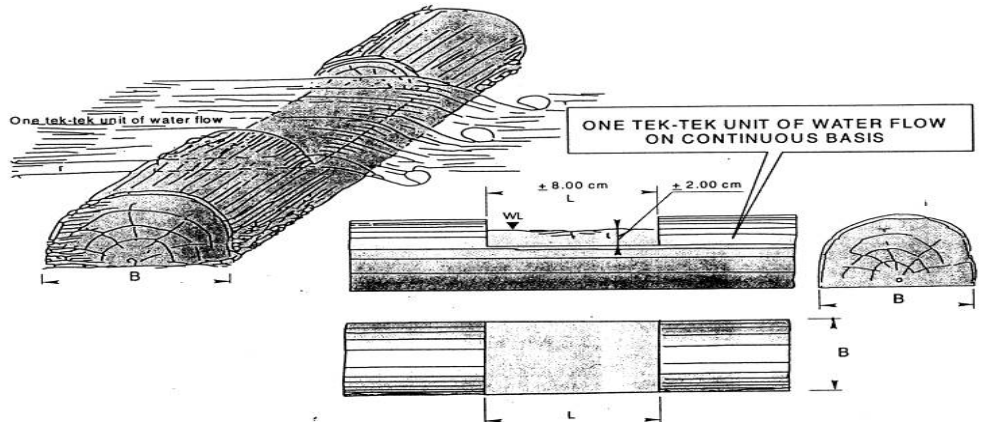
With the water negotiations in full swing more problems emerged. As the next section shows, general principles of how irrigation should work were discussed when an old conflict surfaced.

Interdependencies through fixed proportional water flow and the consequences of manipulation

Balinese irrigation is based on the principle of gravity, continuous flow and fixed proportional water division (Horst, 1998).

Each division structure has the same crest elevation. In earlier days these devises were made of timber. This is still the case for the individual field inlets and smaller division structures. For the larger ones on the sub-subak level and the subak level the timber constructions have been replaced by stronger concrete structures. The width of the fixed proportional flow division structures is determined by the size, quality and topography of the rice fields to be irrigated. The widths of each of the devices are measured in units called tek-tek. One tek-tek is similar to the width of a normal hand without the thumb and the depth of one finger (Gany, 2004). Translated into the metric system it is equal to 8 centimetres width and 2 centimetres depth (see Figure 2). The tek-tek is multiplied according to size of the irrigated area and is measured in 90 degrees to the water flow. This means that every division structure has to be in an exact rectangular position to the flow. Farmers are not allowed to manipulate the flow.

Figure 2: Tek-tek Calculation of Water Allocation



Source: A. Hafied A. Gany (2004:270)

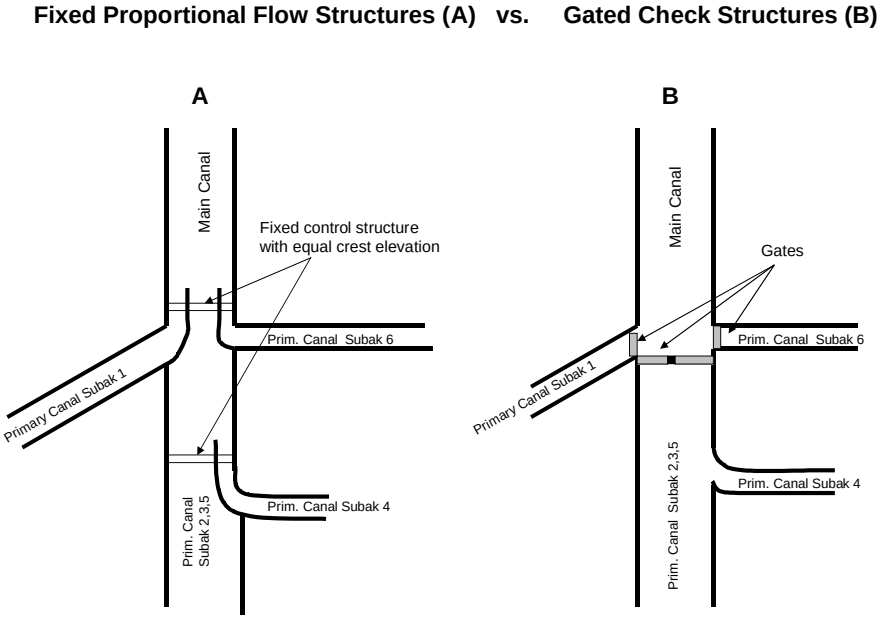
Fixed proportional flow division structures guarantee an equitable share of water amongst all subak and, at the lower level, amongst all the farmers (Horst, 1998). Fluctuations of incoming flows are automatically propagated to lower levels in the irrigation system. Consequently, the water proportions do not change and flow measurements are not necessary. The only variable

is the width of the weirs. Thus, water division is relatively transparent and is socially controllable by farmers (Geertz 1980; Jha 2002; Sutawan 1987).

There is a common perception amongst subak heads and farmers that with fixed proportional flow the burden of water shortage is divided mutually amongst all subak and all farmers.

During the improvement of the irrigation infrastructure in the 1980s the Indonesian Government made major changes to the subak by implementing a 'gated check structure' (see Figure 3[B]).

Figure 3: Division Structures



The new infrastructure focussed on crop water requirements and hydraulic efficiencies. The water allocation and distribution method was based on the "Palawija Relative Factor" (PRF), a method invented by the Dutch for their sugar cane plantations in Java before the Second World War. The method requires the gathering of large amounts of data (meteorological data, river flow data, percolation data etc.). This data is analysed to calculate an irrigation schedule which then defines the operation of the gates. The PRF had to be re-assessed every 10 days and the gates adjusted accordingly (Horst, 1996). It is not hard to understand that this method was predestined to fail. A shortage of staff and an incompatibility of irrigation design with the subak members' perceptions of fixed proportional flow led to unsolvable problems.

However, the gates were built and a return to the old infrastructure was not possible. To more or less restore fixed continuous flow the six subak agreed to operate the gates only upon a subak's request to temporarily increase water flow into specific areas.

The remaining problem is that the major division structure within the subak-gede infrastructure does not support the principle of fixed proportional flow. As seen in division structure B (Figure 3), the gates of the new division structures are not rectangular to the flow and the crest elevations do not match. As a consequence, the water intake to the left (subak 1) and to the right (subak 6) is smaller than originally calculated, and the water inflow to the middle stream is increased. The same mistake was made a couple of hundred meters further down stream at the division structure that diverts water into subak 4.

This issue was the centre of conflict in earlier times and surfaced again during the water negotiations of the newly formed subak-gede. The heads of subak 1, 4 and 6 believe that the gated check structures imposes a deviation from the principle of the mutually shared burden of incoming flow fluctuations. The supposed water interdependency of all subak has become a dependency of one half of the subak towards the other half. As a result, these three subak claim that they repeatedly experience water shortage during the dry season and only are able to manage the cultivation by "borrowing" water from the other three subak.[11] This argument is regularly used to justify the manipulation of the gates without the authorisation of all subak. The following example illustrates the problem nicely:

"Sometimes the pekaseh (subak head) of subak 1 goes directly to the gate keeper and pays him 10,000 rupiah smoking money (uang rokok). The gate keeper then will close a gate to subak 2 over night without informing anybody. I asked the pekaseh if he does not get into trouble for this. He answered that he is responsible that his subak receives enough water and, because they are in constant water shortage, he does not feel like asking the pekaseh of subak 2 for water all the time. Subak 2 has profited from the mal-construction of the division structure and thus should show solidarity towards the others. The pekaseh of subak 2 is not always cooperative and is criticised of not showing enough solidarity towards the other subak. The only way to manage this problem, so the pekaseh says, is by using other avenues to receive additional water.

[11] Subak 6 is not that strongly affected because they receive most of their water from the off-flow of subak 7.

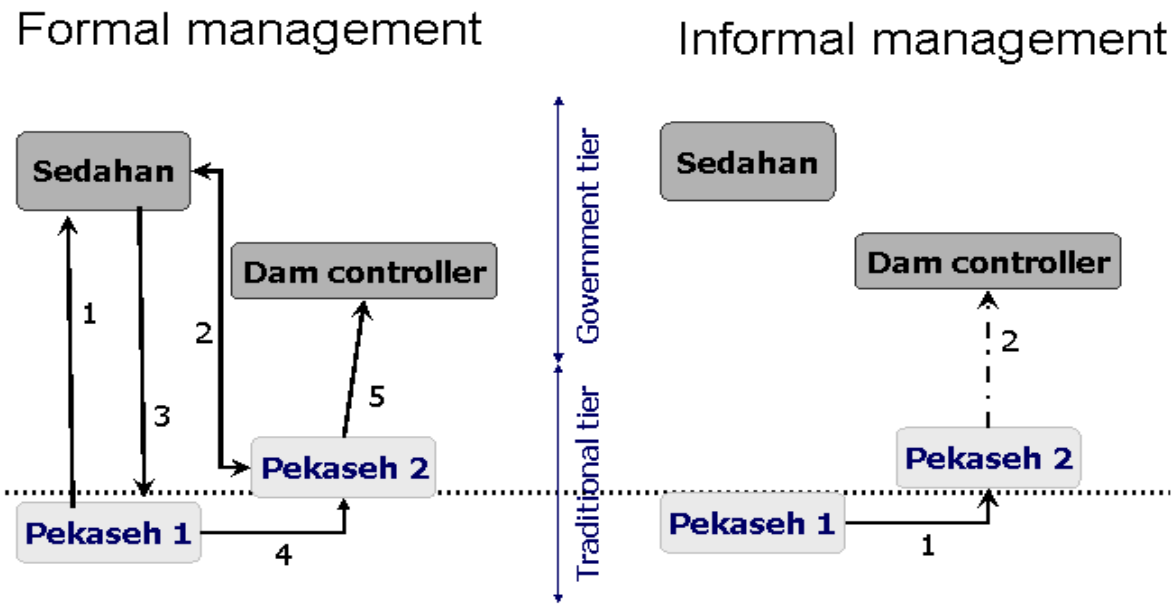
Attempt of formalising water negotiations amongst the subak heads

Formal versus informal arrangements

Given that the above mentioned conflict was voiced regularly, the sedahan Yeh tried to act as an intermediary. He made an effort to create formal avenues for water "borrowing/lending" amongst the subak heads.

The idea was that subak heads who want to borrow water should voice their reasons with the sedahan first. The sedahan then consults with the other subak heads on the water "borrowing" proposal. If the other subak come to an agreement the sedahan issues a formal letter for the gate controller (public servant) who then will operate the gates accordingly (see Figure 4).

Figure 4: Inter-Subak Irrigation Management



Although the subak heads approved this procedure, they hardly ever use the formal avenue. They prefer to negotiate water needs informally amongst each other (see Figure 4) or "borrow" in "night operations". Two reasons were mentioned for this. First, the informal procedure fast tracks the whole process which allows the subak heads to deal with water scarcity straight away. Second, informal face-to-face interaction has always been part of water negotiations between the subak heads. They see water allocation for their subak as their main responsibility and thus do not want to have a third party involved.

In fact, the formal procedure is regarded as highly impolite because it implies a severe conflict amongst the subak heads which would move the problem from a subak level to the personal level. Thus, the subak heads prefer direct negotiations or the occasional rule breaking by bribing the gate keeper. The following example illustrates how water is negotiated informally.

It is the end of May. Two days ago there was a thunderstorm in the mountain area which resulted in an instant rise of water in the canals. Unfortunately, the off-flow gate from the main canal of the subak-gede back to the river was not opened on time[12]*. Much waste which normally is redirected into the off-flow canal ended up in the primary and secondary canals of the subak. Subak 1 was hit the worst. One of their tunnels which feed 15 ha of rice fields was clogged resulting in a small landslide. The pekaseh ordered the pengliman (sub-subak head) to organise the farmers of the affected munduk (sub-subak group) to do the cleaning up. It took two days to bring the water flow back to normal. This led to a water shortage within the 15 ha. The munduk has just finalised transplanting. In this stage it is crucial to have enough water in the rice fields so that the seedlings can establish their rooting system. Even with a constant water flow this munduk had problems to receive enough water. With the tunnel incident the farmers were worried that their seedlings would suffer severely.*

The pekaseh of subak 1 decides to ask the pekaseh of subak 2 if he could borrow water to solve the problem. He normally asks the pekaseh of subak 2 because it is the largest subak which rarely experiences water shortage. Also, they belong to the same customary village. Hence, as the pekaseh of subak 1 argues, the foundation for mutual help is stronger than with the other subak. In an informal visit to the subak 2 pekaseh's home the matter is discussed. The request is to shut one of the two gates to subak 2 for 24 hours to increase the flow to subak 1.

Unfortunately subak 2 is in the process of ploughing their fields. This is the period where the subak needs much water. Actually all they can get. The pekaseh is reluctant to allow the closing of one of the two gates for 24 hours. They agree on 7 hours starting at 11 o'clock at night until 6 in the morning for two nights. The solution is based on the grounds that the tractor workers start ploughing between 6.30-7 am. That is when no water can be spared.

[12] To be able to minimise the risk of flooding, gates have been installed at strategic point in the irrigation infrastructure. These gates are opened when heavy rain leads to a fast increase of the water level in the canals. During the dry season this rarely happens. But in the transitional months April, May and October the gates can play a crucial role to react to unexpectedly strong precipitations.

As the closing of the gate will happen over night time the pekaseh decide not to contact the gate keeper. This will save them money to buy cigarettes for the gatekeeper to assure that he actually does the job. A couple of years earlier subak 1, 2 and 6 invested in a copy of the gate tool so that they can surpass the gate keeper and make fast decisions in manipulating the gates.

The pekaseh 1 is not completely happy with the decision of the subak 2 pekaseh. He expected more cooperation. The pekaseh of subak 2 tells me later that in earlier occasions the subak 1 pekaseh has manipulated the weirs without telling him. So, although he feels he has to share water with subak 1, he is not willing to go further than the minimal cooperation.

I asked both pekaseh why they do not follow the formal procedure by requesting a formal letter from the sedahan. Both tell me that the management of THEIR water should be made without involvement of others. Also, the subak 1 pekaseh said that the matter is urgent and requires immediate action. The involvement of others would have slowed down the process.

This example shows that the subak heads rely strongly on informal interactions as a major form of water negotiations. Attempts to formalise procedures related to water management are seen as inconvenient and impolite. Although inconsistencies continue to exist such as the strong dependencies of subak 1, 4 and 6 on other subak, formal avenues are not regarded as good options to solve the problems.

However, after trying to address the local complexity of irrigation management the subak heads agreed to stagger the cultivation cycle as a step towards a stronger coordination within the subak-gede. The last section of this paper discusses the outcome of this attempt.

The staggering of cultivation cycles within the subak-gede

The newly implemented subak federation was expected to facilitate a better coordination of the water distribution between the six subak, especially during the dry season. During this time there is insufficient water available to be delivered to each of the six subak. The staggering should give each subak a greater share of water during the ploughing period when much water is necessary. The subak heads of the six subak decided to stagger cultivation in a 21 day interval.[13] Two reasons were given for this interval. First, with a 21 day interval all

[13] This means the second *subak* starts planting rice 21 days after the first, the third starts planting 21 days after the second and so on.

subak can cultivate on rice crop during the dry season. Second, the seedlings spend 21 to 25 days in the nursing plot before they are transplanted into the rice fields. During this time the field preparations which need constant flooding such as ploughing and levelling have to be finalised.

Last year's [2005] dry season cultivation[14] and the rotational schedule of the irrigation water were discussed at the meeting of the subak-gede in February 2005. Although, as discussed above, the water and ceremonial dependencies very much determined which subak cultivates when, more concerns were voiced in relation to the effects of climate on rice cultivation.

Seasonal variables play an important role in rice cultivation affecting yield as well as expenditures on fertiliser and pesticides. The best time to start planting in this region of Bali is in June and July. April and May are transitional months with still considerable amounts of rain and higher temperatures. These are good conditions for pest and diseases. Also, farmers prefer to harvest the rice before the beginning of the rainy season which starts in October. In the three weeks before the harvest the rice fields should be not more than moist. They are only watered if the soil starts to crack. Also, the rice plant needs much sunlight in this last stage. The beginning of the rainy season can jeopardise these factors with unpredictable downpours and cloudy conditions reducing sunlight. Consequently, most subak of the subak-gede tried to negotiate the beginning of the cultivation as close to June or July as possible.

As discussed in the previous section, some subak cannot choose the beginning themselves because they rely on the off-flow of other subak upstream. Just to remind the reader:

Subak 6 does not have much freedom in choosing when they want to cultivate. They receive 50 % of their irrigation water from the off-flows of subak 7. Thus they have to plant one month after them which is mid-July. Logically, subak 7 seeks the best cultivation period (June) because they do not have strong dependencies. Subak 4 also gets some off-flow water from subak 7. Not significantly but to take it into consideration. Especially because the water they receive from their main inlet is insufficient they rely on the little water they receive from subak 7.

Others depend on the subak adjacent to them because they can "borrow" water better in a period in which the water is not needed by the "lending" subak.

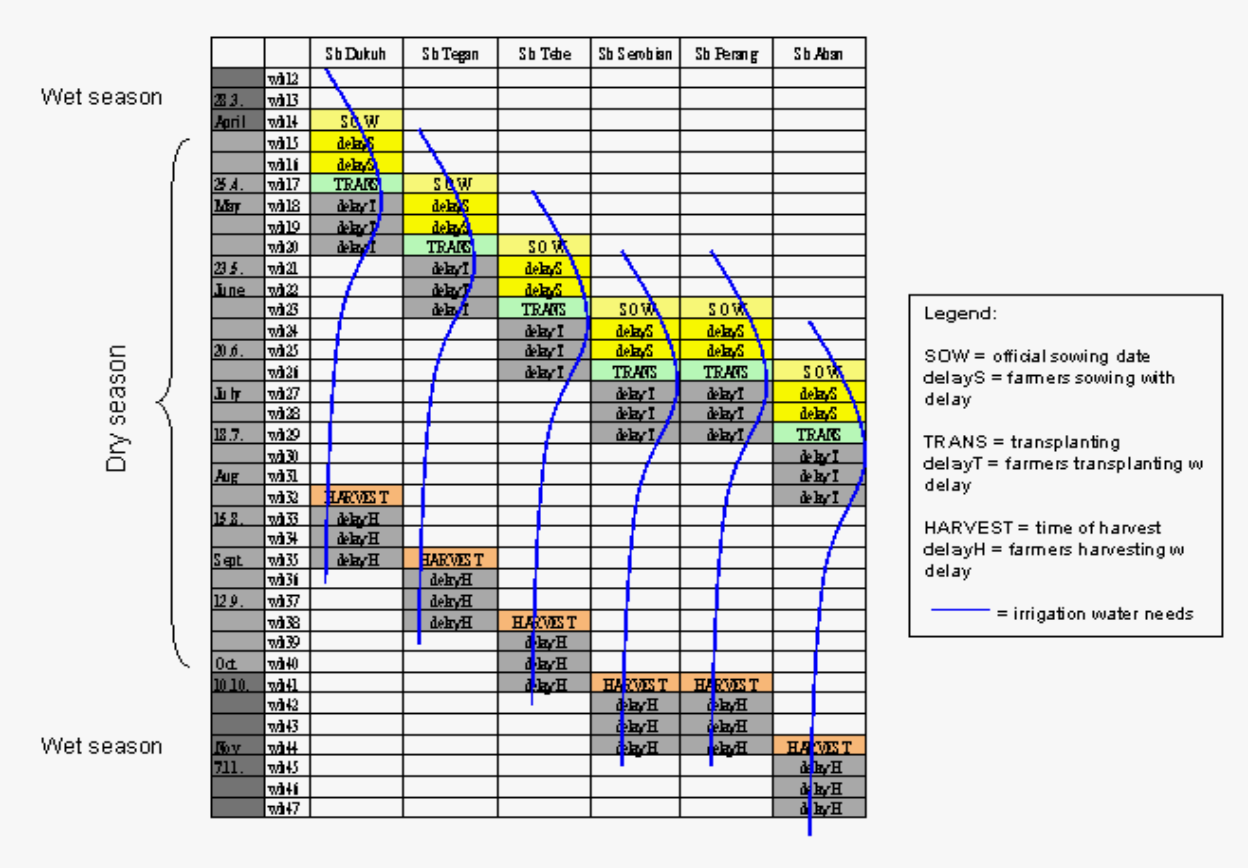
[14] The dry season lasts from April until October. But April, May and October have to be seen as transitional months where rainfall, humidity and temperature can vary strongly (for tropical conditions).

After considering several options, the subak heads decided on the cultivation intervals. Subak 1 started cultivation in April, followed by subak 2 and 3 in a 21 days interval. Then Subak 4 and 5 followed which have a history of cultivating rice simultaneously. Subak 6 went last. The implementation of the staggering caused a number of unexpected problems on different levels:

- The farmers of subak 1 were to sow at the last day of April. Many farmers of this subak voiced serious concerns when they heard that they have to start cultivating that early. The risk of losing the yield to pests and diseases is still high at this time of the year. Also, the input costs are higher because more pesticide has to be applied. To defend his decision to go first the head of subak 1 argued that most of the subak in the area will harvest in September or October. Since they already harvest in mid-August, the market won't be flooded with rice, thus the farmers can negotiate higher prices. Also, subak 1 can "borrow" water from subak 2 which is the largest subak of the subak-gede. Further, subak 1 and 2 have a history of joint ceremonies. Therefore they have to cultivate closely after each other.
- Ideally, all farmers transplant the seedlings within one week. Or at least within the 21 days, since thereafter, water will be considerably reduced to allow the next subak to start the ploughing. The practice showed that these 21 days are not enough to prepare all the rice fields in one subak for transplanting. This is due to a shortage of hand-tractors.
- The claimed insufficient water intake of subak 1, 4 and 6 was seen as another reason. The ploughing in some of the subak took up to 5 weeks until all the rice fields were ready for the transplanting. As a result the cultivation cycle was not synchronised anymore as planned in each of the subak. Also, the effectiveness of the integrated pest control was weakened.
- Because larger amounts of water were allocated to the individual subak during the 21 days of ploughing and transplanting, the willingness to negotiate water informally after these 21 days decreased. The formal negotiations of the staggering and linked water sharing were seen as enough cooperation amongst the subak. Thus, an instant reaction to water shortage became more difficult. This affected the subak which regularly experience water shortage and thus were more dependent on ad hoc water negotiations in times of shortage.

Figure 5 shows the six subak staggering the cultivation cycle over this year's dry season Delays as described above have been included.

Figure 5: Staggering of the cultivation cycle in a subak-gede



As a matter of fact, subak 1 which cultivated first faced major pest problems with some farmers having to replant seedlings. Subak 2 still had pest problems but not as bad as subak 1. The other three subak did not complain about pest problems.

The uncertainty and fear of loss of harvest triggered different reactions within the farming community. Farmers turned active and creative in trying to deal with the insecurity, often stretching the subak regulations as far as possible. Many decided to cultivate a variety which only has 90 days instead of 115 days to mature. This meant that they could push back the beginning of the cultivation for up to 25 days and bring it closer to June. To avoid being blamed for not following the custom of planting simultaneously[15], they argued that the ploughing of the rice fields was not yet finalised and planting couldn't take place. As the sub-subak group is allowed to make decisions on ploughing on their own, one sub-subak group

[15] Traditionally, the farmers had to transplant the seedlings within one week, beginning with the subak head. However, due to the shortage of tractors and water this is not possible anymore.

decided to push back the ploughing of the whole sub-subak group by 15 days. Other farmers cultivated peanuts on half of their fields and rice on the rest if it. This breaks subak law because during the main rice cultivation season (Kerta Masa), all farmers have to cultivate rice.[16]

The example above shows that decisions on the inter-subak level trigger reactions on the farming level. Subak customs are broken or interpreted in a way that suited the problems the farmers were facing. The rule breaking farmers argued that the decision of having to cultivate in April jeopardises their income. Especially farmer who don't work off-farm saw their household income seriously in danger.

As a consequence many questioned the integrity of the subak head. They did not feel that the subak head was representing the subak's interests. The subak head countered that the staggering of the cultivation cycle increased water supply to the subak. The farmers replied that this was a bad excuse because they were used to deal with water shortage whereas the control of pests and diseases is much harder. The conflict peaked when many farmers were discussing replacing the subak head with somebody who has the well-being of the subak at heart rather than good relations to the other subak heads and the sedahan.

Conclusion

Before the formation of the subak-gede it was the responsibility of the subak head to provide his subak with sufficient water by enforcing subak law and protecting the subak from any outside disturbances. In this case study the cultivation cycles were not coordinated in direct communication amongst the subak, even though they are sharing a common weir. With the creation of the subak-gede, water allocation amongst the subak has been institutionalised.

However, this comes with the cost that not all subak can cultivate rice at the best time of the year. This has certain negative implications for some subak which impact right down to the individual farmer's income. So, rather than strengthening the subak system by implementing stronger coordination, the cohesion within the subak decreases. Farmers' incentives to follow

[16] Exception can be made on small fields with water problems if the pekaseh allows it.

subak customs decline when they see that their income is jeopardised by decisions of the subak head.

The subak heads tried to make good decisions for the members of their subak. However, the dependencies in water, ceremony, and climate make it difficult to "rationalise" all consequences. This leaves us to question if the newly crafted subak-gede institutions really benefit the six subak of this area. The strength of the subak seems to lie in its flexibility and autonomy. Both these features react to processes of formalisation.

Although formal subak regulations exist, the Balinese subak depend strongly on informal arrangements which are constantly re-negotiated. Their informality gives the subak the necessary flexibility to react to an ever changing social and natural environment. Before the creation of the subak-gede, every subak head was responsible for the water allocation of his subak. The formalisation of inter-subak interactions interfered with the autonomy of every individual subak. Water dependencies between the subak, determined by the natural flow of water and the topography, played an active part in the water negotiations, creating some emotional discussions around the equal distribution of water amongst the subak. These dependencies existed before the creation of the subak-gede, but were accepted as a fact of reality. With the stronger formalisation of inter-subak relations the subak heads could justify interfering with long established water rights of every individual subak – an interference which was impossible before the subak-gede because of the subak autonomy.

Inequalities amongst the subak in relation to water allocation existed before the creation of the subak-gede. The subak-gede did not bring along more equality. On the contrary, the underprivileged subak found themselves with fewer options to deal with water shortage. These options were based on informal "water borrowing" which gave the subak a greater flexibility to deal with problems straight away. If the subak-gede can deal with this shift in water negotiations from informal so called "weak" arrangements to more formal "strong" agreements has to be seen in the next few years. At the moment, many farmers experience the creation of the subak-gede as a disturbance into former ways of managing irrigation water.

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