

# Traditional water management in Bali

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The Indonesian island of Bali is famous for its unique system of irrigation. Guided and informed by religious values, it combines impressive feats of engineering with complex and elaborate social structures.

Most of the 162 large streams and rivers that flow from Bali's mountainous interior have cut deep channels into its soft volcanic rock. This has made it impossible for farmers to dam and channel water for irrigation in the usual way. Instead, they have taken to cutting tunnels through the rock, and constructing elaborate aqueducts and bamboo piping systems to carry water to the top of a series of terraced rice fields. From here it can flow, with gravity, from *sawah* (field) to *sawah*.

Community organisations called *Subak* control the water irrigation system to ensure reliable, fair and equitable distribution. Besides its technical functions, the *Subak* also provides social benefits including strengthening the possibilities of its members to maintain social contacts. This is reflected in the various communal activities undertaken in the form of task-oriented self-help groups (*seka*).

Community groups and group activities are traditionally very important in Balinese society. They reflect the significance attached in Hindu philosophy to the relationships an individual has with others members of society. This is a highly valued principal particularly in rural society.

Bali's famous *Subak* system is one of the most vital components of Balinese society. Built over the course of several centuries, it remains an integral part of Balinese life and is a product of the island's history and culture.

## Subak

Irrigation is essential to Balinese agriculture because of the long dry season that extends from April to October. The elaborate system of channelling water from lakes, rivers and springs across countless *sawahs* is controlled by fully autonomous *Subaks*. Their engineering knowledge is sophisticated and the tunnels they build and maintain through the hills can be up to 3km long and 40m deep.



The Subak system makes water available for irrigation in the hills.

Photo: Rik Thijssen

The distribution of irrigation water among *Subak* members is based on the principle of *ayahan*. This is the right of the *Subak* members to make use of available water resources in exchange for *ngayah* or free communal work on *Subak* activities. All *Subak* members have the same right to irrigation water. The amount of water is computed by dividing the total amount of water available by the number of *Subak* members.

A *Subak* consists of all the landowners – or their representatives – in a particular rice production area. The *Subak* is not only responsible for the construction and maintenance of canals, tunnels, aqueducts and dams, and for the distribution of water, but also coordinates the planting and organisation of ritual offerings and festivals.

Registered *Subak* members are mostly men because they are regarded as the representatives of their family. However, women are also involved in meetings as they play a major role in the various religious ceremonies.

There are about 1500 *Subaks* on Bali (1999) each with about 200 members and they cover a total irrigated area of more than 90 000 ha. The organisation of the *Subak* includes the *Paruman Subak* (General Assembly), the *Prajuru Subak* (Board), and the *Kerama Subak* (Members). The general assembly is the highest forum, and allows for open and democratic discussion among the *Subak* members, in order to create consensus on issues of general interest. The *Subak* Board is elected through the General Assembly.

Participatory management is typical in *Subak* organisations. A *Subak* head can call for meetings to discuss and decide upon issues such as maintenance work, cropping plans and the



Collective burning of rice straw to control pests. Photo: Rik Thijssen

allotment of water to members. Responsibilities and duties for *Subak* activities are equally distributed among the members, regardless of family status or social position. Obligations are in direct proportion to the amount of water *Subak* members receive for irrigating their rice fields. For example, farmers who receive one *tektek* - the amount of water necessary for one-season irrigation of rice fields with an area up to about 1 ha - are asked either to take full part in manual activities, or to provide financial compensation as specified in *Subak* regulations.

### Subak organisation

- **Sedahan Agung:** the highest *Subak* institution, located at the office of regional income at district level. A *Sedahan Agung* is a regional government position with a regular government salary.
- **Sedahan Yeh:** similar to *Sedahan Agung*, but located at a lower hierarchy of a watershed of a river (*yeh*) in a district.
- **Subak Gede:** *Subak* organisation at a watershed ecosystem, socially organised, led by a *sedahan* or *pekaseh gede*, at sub-district level.
- **Subak:** water user organisation at a part of a watershed area, headed by a *pekaseh* and socially organised.
- **Tempek:** the lowest hierarchy of water user organisation at a planting area, led by a *kelian*. A *tempek* is usually an area with natural boundaries such as a creek, tall trees, rock outcrops, etc.
- **Kerama:** individual member of a *Subak*

### Participation

*Subaks* are not societies for Balinese Hindu's alone. Farmers of other religious beliefs living in the *Subak* areas may also participate in the system and those farming other people's land are also included in the *Subak* system. Their 'share-cropping' contracts state who is responsible for paying *Subak* fees and this is usually the landowner.

It is possible to distinguish three types of *Subak* members. Apart from the special members, such as Hindu priests, there are 'active' members, who carry out the essential work of maintaining the irrigation systems and 'passive' members who prefer to pay for maintenance. There are also two types of meetings: the more regular, short meetings where work is divided between the 'active' members and, only if necessary, general meetings to discuss more serious issues. All members are expected to attend these.

### Why cooperation?

What is the basis for this widespread cooperation? It might be thought that upstream participants in this cooperative network would be less inclined to cooperate because cooperation means they would have to leave some water for the farmers downstream and therefore would not be able to use it all themselves. However, in the particular ecology of Balinese rice paddies the flow of irrigation water affects the population dynamics of rice pests. If fields are planted randomly, rice pests can easily move from one field to the next after harvest, allowing pest populations to escalate. By coordinating planting over a wide enough area, farmers can create large fallow spaces that prevent pests from migrating between food patches. In this way pest populations are kept small. The rather low incidence of pests and diseases in the rice might, however, also be attributed to other specific agricultural practises, such as the collective burning of rice straw, maintaining water layers on fields after harvest and herding ducks in harvested fields. Even ceremonial offerings have been identified as possible reasons for pests being lured or scared away.

In short, both upstream and downstream participants gain advantages from cooperating with each other. Pest damage is reduced upstream, while downstream farmers experience less water stress.

### Collaboration

Officially there is no link between the *Subaks* and government institutions and the autonomy of *Subaks* is guaranteed by their legal status defined in local Balinese regulations. However, government agencies have sometimes tried to 'use' the existing *Subak* cooperatives for their own purposes. These have included agricultural extension, introduction of new rice varieties, as well as the provision of credit for chemical fertilisers. At one stage taxes were also collected through the *Subak* heads. Most of these government 'intrusions' have back-fired and the *Subaks* have proved their resilience by surviving these attempts to hijack the community groups for reasons other than their main objective: fair and equal provision of irrigation water to farmers.

Farmers see the *Subak* as their one and only agricultural organisation. Such aspects of their agriculture as planning the time when a new crop should be planted or the use of fertiliser, for example - can be dealt with through the *Subak* if there is a clear relation with the provision or use of irrigation water. A *Subak*, for instance, decides on the type of rice to be grown, depending on the amount of water that is expected to be available. In some cases, when there are signs of water shortages, a *Subak* can also decide, as a group, not to grow rice but to plant alternative crops (*palawija*) that are less water demanding.

### Resilience

Irrigation water management by community organisations on Bali has proven to be effective, efficient and durable. The *Subak* system has adapted itself time and again over the last 1000 years. Any minor conflicts that have arisen have generally been effectively solved. This capacity to resolve problems is only one of the strengths of this system that is deeply rooted in Balinese traditions.

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Women play an important role in *Subak* ceremonies. Photo: Rik Thijssen