# Performance Indicators: A Case of a Newly Developed FMIS in Bali, Indonesia

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## ABSTRACT

WATER USERS' ASSOCIATIONS in Bali, normally called *subak*, have been in existence for centuries. However, there are also subak of more recent origin. To analyze performance indicators of Farmer-Managed Irrigation Systems (FMIS), one newly built FMIS, Subak Gunung Mekar Mertasari, was selected.

This FMIS is located in Bunutin Village, Kintamani District, a hilly region around 940 meters (m) above sea level. It is located some 80 kilometers (km) northeast of Denpasar. The physical facilities of this FMIS which were constructed in 1977, consist of a dam, a 1.646-km tunnel, a 1.5-km canal and a number of division structures. In the development of these facilities, this FMIS has invested US$49,356.60, with equal contributions from its 70 members. The first irrigation facilities were constructed in response to the regular drought experienced by the village.

To expand the present 25-hectare (ha) command area, this FMIS is now constructing a new 3-km tunnel, to utilize a new water source. The new water source will expand the cultivated rice land area by about 75 ha.

From its historical background and the current practices adopted by Subak Gunung Mekar Mertasari, a set of performance indicators can be proposed, namely: 1) equity in water distribution; 2) equity in members' contribution for FMIS development (investment as well as operation and maintenance); 3) social functions of irrigation water; 4) relationship between FMIS and the broader society in which the FMIS exists (the village, in this case); 5) economic productivity; 6) social productivity; and 7) the irrigated area ratio.

## INTRODUCTION

Old inscriptions and artifacts suggest that subak in Bali were in existence as far back as 1071, or more than nine centuries ago (Purwita 1986; Pitana 1988). The number of subak increased over time, along with the expansion of rice fields and population growth. The latest data indicate that there are now 1,733 subak in Bali (Pitana 1991).

Aside from the old subak, there are also subak of more recent origin. The newly developed subak are generally small in size and are located in the hilly regions. One of these is Subak Gunung Mekar Mertasari.

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This paper attempts to explore Subak Gunung Mekar Mertasari as a case study in order to analyze performance indicators of FMIS. Most of the data for this article are drawn from researches conducted by Rendari (1990) and Jemet (1991), as well as from the author's investigations.

## HISTORY AND DEVELOPMENT OF THE SYSTEM

This subak (as mentioned in the Abstract) is situated in Bunutin Village, Kintamani District, Bangli Region, in the hilly region. It is about 940 m above sea level, located some 80 km northeast of Denpasar.

The idea of developing this subak emerged in June 1977. However, the first intention of diverting water was not for irrigation, but for domestic uses. By then, water was already a scarce resource in Bunutin. The villagers had to walk some 6 km along a steep path to fetch drinking water. Around January 1977, Bunutin experienced a serious drought and famine. Aside from plants and animals, the drought also took the lives of nine villagers.

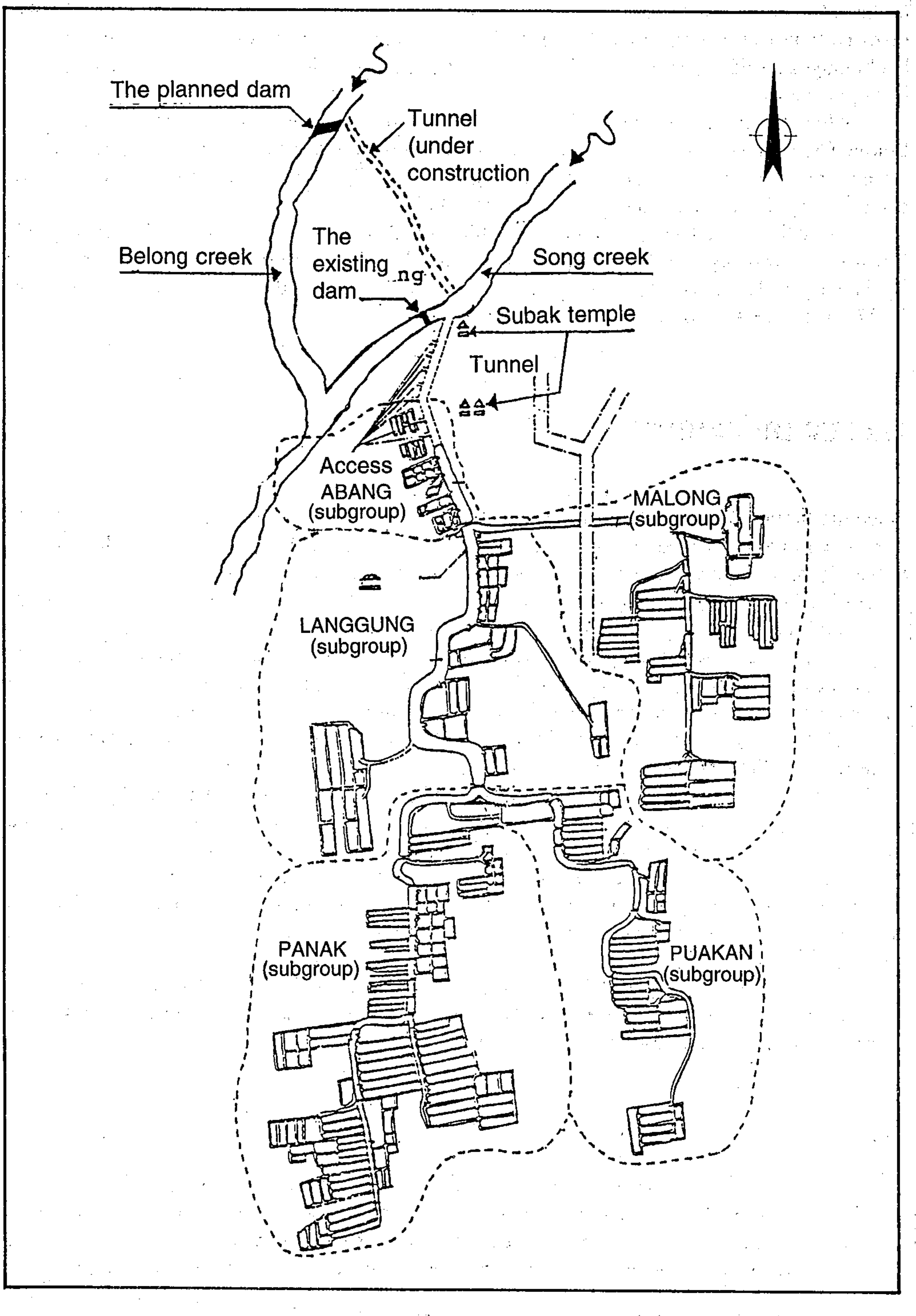
Faced by this difficult situation, a group of villagers, consisting of 50 persons headed by Nang Daging, tried to locate a water source. This group failed in its attempt, however. In July 1977, a second group, this time consisting of 70 persons were organized and coordinated by Nang Pelung. Nang Pelung was a member of the village advisory body, *adat* (customary law society) leader, and a traditional healer. He is also a veteran of the Indonesian War of Independence (1945–1959). After conducting intensive surveys and investigations, the group finally located a water source in Song Creek, in Ulian Village some 2.5 km from Bunutin. The flow of this water source was estimated at about 67 liters per second in volume.

Using traditional methods, the group concluded that the water source was at a higher level than Bunutin and, therefore, could be used as a source for the village. In order to convey this water, a dam, a tunnel 1.646 km long and a canal of about 1.5 km length had to be constructed. To construct these facilities, the (emerging subak) group itself designed everything, carrying out its own measurements, designing and laying out the dam, tunnel, and the canal. The office of Public Works of Bangli regency was consulted only when necessary. Construction began in September 1977. The dam and canal construction were done by the group members themselves, while for tunnel digging, the group used hired labor. To pay for hired labor, each group member contributed US$21.00 per month.

Construction of the above facilities was completed in November 1978. The total sum expended was US$6,823.16 for hired labor, US$29,024.68 for dam construction, and US$13,508.76 for constructing the canal (calculating the value of mobilized labor according to the wage rate prevailing at that time), or US$49,356.60 altogether, excluding the value of local materials used (bamboos, wood trunks, earth, stones, etc.). It should be noted that in the construction of the dam and canal the group was helped by other villagers whose labor was free of charge. The villagers voluntarily assisted the group because the water would be used not only by group members, but by all villagers who would have access to it for domestic purposes.

Realizing that the volume of water was more than necessary for domestic use alone, the group decided to distribute the water to its members for irrigation. Each member then converted his dry land to rice land. The group then changed its name and became Subak Gunung Mekar Mertasari.

*Figure 1. Irrigation scheme of Subak Gunung Mekar Mertasari, Bunutin Village, Kintamani District, Bangli Regency, Bali, Indonesia.*



Since the subak members felt that irrigated land would be much more productive than nonirrigated land, rice land became a "status symbol" of the villagers. As a result, Subak Gunung Mekar Mertasari tried to find another water source to expand its rice land. After carrying out investigations over a long period, the subak found a water source in 1980 in Belong Creek, located in Gunungbau Village, about 3 km from the existing dam. The flow of water was estimated at 430 liters per second.

After consulting the authorities, the subak decided to divert this water by damming the Belong Creek and digging a 3 km tunnel. Water from this source was to be conveyed by means of a tunnel to Song Creek just above the existing dam (see Figure 1). It is estimated that the water from Belong Creek can irrigate some 75 ha rice land.

As with the first water source, everything for this source was done by the subak itself. Construction was begun in 1980. At present, the tunnel is still under construction using hired labor. By January 1991, 1.752 km of tunnel had been completed (valued at US$17,302.49) and some 1.247 km still remain to be completed.

## WATER DISTRIBUTION

Since the farmers had invested considerable resources to obtain the irrigation water, it had to be distributed in a manner satisfying the standards of equity of the subak members. In the Balinese Subak System, there are at least two considerations in water distribution. One is the method of water distribution employed by the subak over the course of time; and the second is the subak's method of defining the water rights of its individual members.

In the case of water distribution over time, Subak Gunung Mekar Mertasari employs the continuous flow method, meaning that all subak members in any part of the rice land receive water continuously. This method was adopted because in addition to its use for irrigation, the water is also used for domestic uses and animal watering. Hence, the availability of water at all times is the preferred one, though in very small volumes.

The rights to water of each individual member is equal to his or her contribution in the development of the subak. Since all contributed equally to the development, all farmers enjoy equal rights to water, i.e., "one portion," regardless of their land size.

The water from the dam is divided into 75 portions: 70 portions for 70 members; one portion for the subak head (the head of the group); two portions for the village's communal lands; and one portion for the communal lands of Ulian Village (because the water source is located in that village).

In the efforts to achieve a fair water allocation and distribution, the subak has experimented with three methods of water distribution/allocation in terms of the rights to water of individual farmers. These are *tektek, pelampias* and *nguu.*

### Tektek Method

In this method, irrigation water is divided (in the division structures) based on the number of members. Example: If there is a two-inlet division structure, say, the right inlet is used by seven members and the left one by three members, the width proportion of the inlet will be 7:3. This method probably favors the upper stream farmers, because the loss along the canal (evapotranspiration, percolation, etc.) is not taken into account. Hence, the downstream farmers usually get much less water and plant a smaller area of rice. This method was applied in 1979.

### Pelampias Method

This method is similar to the tektek method, except that, water loss along the canal is considered. To compensate for losses along the canal, the downstream farmers are given "additional water." In the above example, for instance, the width proportion of the canal would not be 7:3, but say 7:4, if the three farmers have a longer canal than the seven. Theoretically, this method was acceptable for all farmers. However, it was very difficult to define who gets how much additional water. Furthermore, the upstream farmers complained, because their rations were reduced. This method was only used for one month, in 1980.

### Nguu Method

This method measures the volume of the actual water entering the individual rice fields, i.e., just below the individual inlet. The subak measured the volume of water in an individual inlet using a two-liter can. The time consumed in filling in this two-liter can was measured. After conducting trials, the subak decided that one portion of water (for one member) was 2 liters in 36 seconds, or 0.06 liter per second. (When measured in November 1990, the volume of water of individual farmers was 1 liter in 12 seconds or 0.083 liter per second). This method has been employed since 1980, and no complaints have arisen yet.

The size of irrigated rice land has increased over time, because of the increase in efficiency of water use. In 1979, only 7 ha of land could be planted. In 1982, the irrigated area rose to 15 ha, and now (1991), it is around 25 ha.

## OPERATION AND MAINTENANCE

Operation and maintenance is one of the main tasks of any irrigation system (Coward 1985). To supervise the water distribution method agreed upon, the subak appoints a *patalik* (water master). The water masters also supervise all of the subak facilities, including the dam, tunnel, canals and division structures. In cases of minor damages, they repair them, or they report to the subak head if they cannot manage the repairs themselves. The subak head then mobilizes subak members to repair the damages.

To maintain the irrigation facilities, the subak conducts regular maintenance works (canal cleaning, grass cutting, bank rehabilitation, etc.) eight times a year on the average, generally three days for each period. Every member has to contribute one laborer. Labor consumed in routine maintenance activities is about 5,040 man-hours per year.

When the subak needs materials for rehabilitation, each member has to contribute "one portion" of materials needed. When it is necessary to purchase materials (cement for example), the amount of the expenditure is calculated, and then equally divided among all members.

## DISCUSSIONS AND CONCLUSIONS

Subak Gunung Mekar Mertasari — the FMIS being discussed — cannot be assumed to be representative of all FMIS in Bali. However, some of the principles of this FMIS are not unique to it. They hold true in general for Balinese subak systems.

With regard to performance indicators, some of the principles discussed below are of interest.

### Equity in Water Allocation

As mentioned above, the rules of defining water rights for individual members had changed three times. This implies that equity in water allocation among members is a matter of great concern. The sense of equity, in turn, will determine the frequency and intensity of conflict among farmers.

### Equity in Resource Mobilization

Resources contributed by each member should be in direct relation to the amount of water he receives, as is highlighted by Subak Gunung Mekar Mertasari. Interviews with subak members and subak officials clearly showed that a member is allowed to sell his water right to his fellow, whether a "half portion" or the "entire portion." A member who has rights to only a half portion of water, owes labor and other duties of only a "half portion." Stated differently, the ratio between the rights and the duties in this FMIS is constant.

### Relationship between FMIS and Village

In constructing irrigation facilities, the subak was helped by village members. After the physical system came into operation, the village was given irrigation water (two portions), for village communal land. The village of Ulian, where the water source is located, is also given one portion of water.

This suggests that although the subak, as a water users' association, is entirely separate from the village, as a residence-based association (Geertz 1967; Pitana 1988), coordination between the two is very harmonious. This harmonious relationship is very important for the subak for several reasons: 1) Subak members are also village members. Should the subak and village conduct activities simultaneously, subak members will be freed from village activities, and could concentrate on the subak's activities. 2) Village members, especially those who are not subak members, will not disturb the irrigation facilities; and 3) There will be no problem for "right of way," even though the canal of the FMIS crosses land belonging to the villagers here and villagers elsewhere.

### Social Functions of Irrigation

Before this FMIS was formed, drinking water and water for other domestic uses was very scarce and the villagers had to walk some 6 km to fetch water. This hard and time consuming work is no longer burdensome since the irrigation facilities have started operating. This nonirrigation use of water is a very important factor to bear in mind.

### Yield of the Irrigated Land

Land productivity (indicated by yield per ha) is an important indicator in measuring performance of the irrigation system (FMIS). In Subak Gunung Mekar Mertasari, the irrigated land is significantly more productive than the nonirrigated land. Calculated in economic terms, the Internal Rate of Return (IRR) of the conversion of dry land into irrigated land is over 18 percent (economically "go").

Aside from productivity in economic terms (production), the productivity in social terms has also to be considered. In the FMIS being discussed, the social productivity is quite high: rice land has become a "status symbol" of the wealth of the villagers, and the main staple food of the villagers has changed from sweet potato-maize to rice-rice.

### Irrigated Area Ratio

Theoretically, the irrigated area ratio, i.e., the ratio between the actual irrigated area to the planned irrigated area, is one of the performance indicators. The higher the irrigated area ratio, the better the performance of the FMIS.

In the case of Subak Gunung Mekar Mertasari, the irrigated area ratio must be very high (more than one), because the first intention of diverting water was not for irrigation, but for domestic uses.

## WRAP-UP

To wrap up this article, it is concluded and proposed that in evaluating irrigation performance (especially for small-scale FMIS), the following indicators be taken into consideration:

1. Equity in water distribution;
2. Equity in members' contribution;
3. Social functions of irrigation water;
4. Relationship between irrigators' association with the larger society, in which the system is located;
5. Economic productivity of the irrigated land;
6. Social productivity of irrigation; and
7. Irrigated area ratio.

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