

IRRIGATION SERIES

Subak

Irrigation System in Bali:

*An Ancient Heritage of Participatory
Irrigation Management in Modern
Indonesia*

A. Hafied A. Gany



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RESEARCH AND DEVELOPMENT AGENCY
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The Research Institute of Water Resources, Research and Development
Agency, Ministry of Settlement and Regional Infrastructures

*“Subak Irrigation System in Bali: An Ancient Heritage of Participatory Irrigation
Management in Modern Indonesia”*

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“When the wells dry,
we know the worth of water”

Benjamin Franklin (1706-1790)
Poor Richard Almanac 1746

“If there is magic on this planet,
it is contained in water”

Loran Easley, The Immense Journey 1957,

Source: World Water Vision – Making Water Everybody’s Business,
The Second World Water Forum, The Hague March 2000.



People's Participation

People's participation is becoming the central issue of our time. The democratic transition in many developing countries, the collapse of many socialist regimes, and the worldwide emergence of people's organization – they are all part of a historic change, not just isolated events.

Source: Human Development Report 1993
(After: The 2nd WWF, World Water Vision, The Hague, 2000)



PREFACE

Since the beginning of 1970s there has been an increased attention in many parts of the developing world on the improvement of irrigation water management practices through the encouragement of participatory approach. Like many other developing countries, Indonesia since early 1980s has also been giving emphasis on the improvement of participatory irrigation management (PIM) having three major endeavors. **First**, turnover of small-scale irrigation schemes, less than 500 ha to the water users' association (WUAs). **The second** endeavor was the introduction of irrigation service fee (ISF) to the WUA for irrigation schemes larger than 500 ha. **The third** effort was the development of irrigated agriculture by involving the farmers through WUAs for the on-farm level water management.

Learning from experiences on the implementation of PIM approach, the most important challenges has been the sustaining participation of the farmers in irrigation water management, especially under the situation where formal bureaucratically organized WUA, which in fact increasingly become inactive or fading away after some enthusiastic attempt instead of becoming sustainable. There had been an obvious tendency to make the participatory irrigation management approach exceedingly complicated. In fact, a number of experiences in traditional irrigated farming in Indonesia -- among others, *Subak* in Bali, *Keujreun Blang* in Aceh Special Province, *Tuo Banda* in West Sumatra, *Raja Bondar* in Northern Sumatra, *Mitra Cai* in West Java, *Dharma Tirto* in Central Java, *Tudang Sipulung* in South Sulawesi, *Mantri Siring* in South Sumatra, *Ili-ili* in Lampung -- concluded that the simpler the approach the easier the farmer to participate and adopt the

appropriate technicalities and the more sustainable would be the irrigated agricultural practices. The *Subak* irrigated agricultural practices in Bali, for instance, has been in existence and practiced from generation to generation for hundreds of years, and amazingly still continuously practiced today in modern Indonesia.

Beginning with an extensive experience to interact with the Balinese transmigrant farmers in Southern Sumatra together with a number of technical visits to observe the *Subak* practices in Bali Island, the author has been inspired to prepare a brief note, facts and figures about *Subak*. The initial preparation of this booklet was in the form of a working paper presented in the Regional Workshop on Adaptation of Agricultural Production Technologies for Sustainable Agriculture in the ASEAN Region, ASEAN-ADPC in Bangkok Thailand, 10-14 January 1994. In the preparation of this booklet into the present format, the author is fully aware that the *Subak* practices are not necessarily replicable to other irrigated farming circumstances without adjustment with the underlying conditions locally. At least, however, it will give a comparative example about this undoubtedly successful and sustainable irrigated agricultural practices. The outline contents of this booklet include the basic principle of Subak approach, organizational patterns, water distribution and management, the Subak Assembly, financial source of operation and management of the system and other detailed example on technical as well as non technical aspects associated with the organizational implementation.

The author is highly indebted to a number of individuals as well as institutions in preparing the manuscript, but at least to mention the Government of Bali Province particularly to the Provincial Irrigation Services and to a number of Subak organizations -- that the author cannot mention one by one -- for the generous preparation of data, information and direct interview with local *Subak* members during several field visits to Bali.

A special gratitude addresses to Dr. Ir. Suyono Sosrodarsono (the former Director General of Water Resources, and later as the

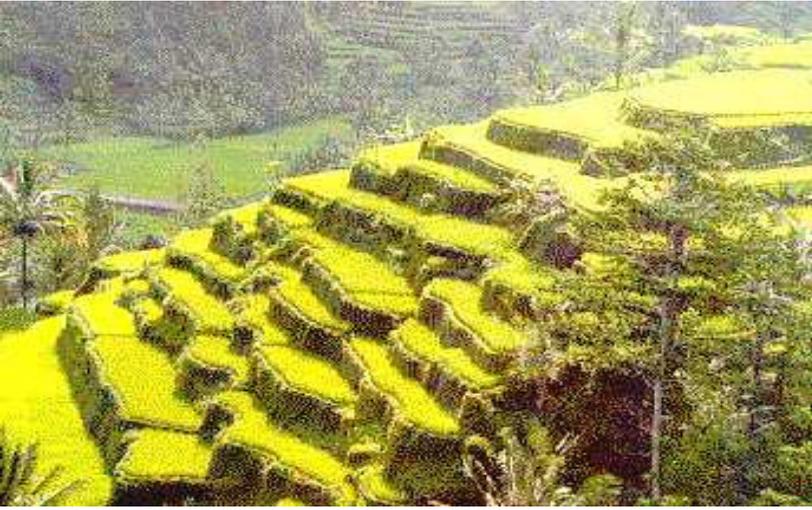
Minister of Public Works of the Republic of Indonesia) for his endless encouragement, inspiration and guidance to the author for writing every aspect of water resources development and management that could be documented for enriching the literature on irrigation in particular and in water resources in general.

Thanks are also addressed to all colleagues and resource persons that I could not mention one by one, for every help, assistance, and encouragement during the preparation of the manuscript of this booklet. The last but not least, the author also appreciate the assistance of the staff of the Research Institute for Water Resources in helping to prepare this book. Without which, this work has never been materialized.

A. Hafied A Gany

Bandung, West Java, Indonesia, July 21, 2001





- Rice terrace in Bali, an evidence of ancient irrigated agricultural practices with lowland paddy, are still perpetuated today in modern Indonesia



- Maintaining the harmonious balance between water ecosystem, human and nature is one of the key principles of perseverance of *Subak* practice till today

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- The front gate of *Subak* Museum in Bali, where a number of historical evidences of *Subak* are kept.



- The interior of the museum -- foreign visitors are frequently come to observe the evidences that describe the *Subak* practices in the old days

ABSTRACT

The *Subak* system is an ancient irrigated-agricultural practices of the Bali Island, Indonesia. This system serves small-scale land holders where lowland paddy are mainly practiced. The exact date of *Subak* was not known, however, a most recent evidence suggested that the *Subak* system was believed to have been existed in 800 of Saka Calendar or in 882 AD.

Learning from agricultural practices of the *Subak* system, it is apparent that the system has been established to meet the farmers' demands through a togetherness approach among it members. The main principle built into this system is based on the ability to maintain proper balance, and harmonious relationship between human and nature on reciprocal basis. The basic techniques are incorporated with the simplicity principles, so that every member of the community can adopt the technique without involving sophisticated learning process.

Although the *Subak* system and its practices were invented long time ago, much of their techniques are still convertible to the modern practices that the people understand today. In fact, there is a reason to believe that the traditional agricultural practices adopted by the *Subak* organization were based on systematic observations.

Today, despite the underlying irrigation development and management practices in modern Indonesia, there remains a lot more phenomenon of ancient agricultural practices -- demonstrated as an example by the *Subak System* -- that need to be uncovered in an attempt to contribute practical technicalities for implementing sustainable irrigated agricultural development under the small-farming circumstances.



- The *Subak* meeting where the principle of togetherness is practiced in democratic principle (usually taken place every 35 days)



- Commitments on the "togetherness principle" are manifested in the consistent implementation of "mutual aid" for every kind of work needed for the community, including development and management of irrigation infrastructures

SUBAK IRRIGATION SYSTEM IN BALI:

An Ancient Heritage of Participatory Irrigation Management in
Modern Indonesia¹

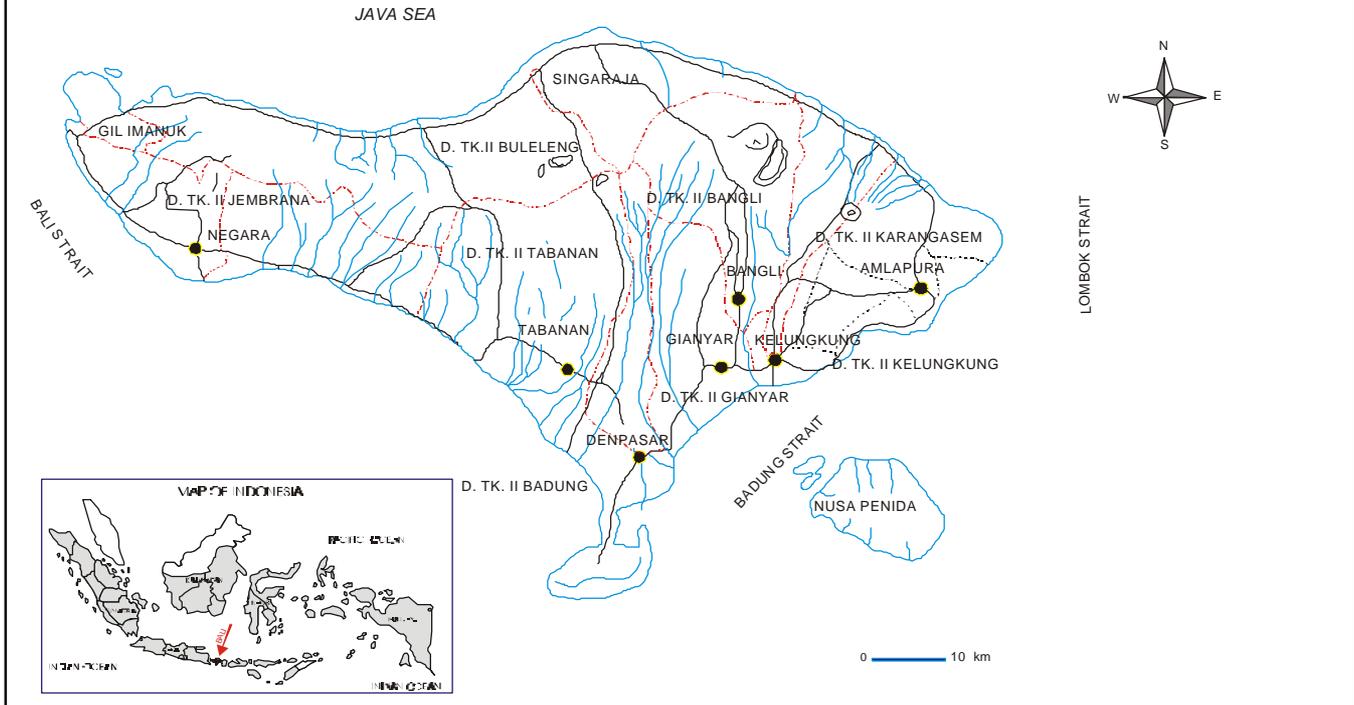
I. INTRODUCTION

The *Subak* system is an ancient irrigated-agricultural practice of the Bali Island, Indonesia (See the General Map of Bali Island overleaf). Like most irrigation schemes in Indonesia, the *Subak* system also serves small land holders where lowland paddy mono-culture are practiced in majority. The exact date of *Subak* was not known, however, some stone inscription indicated that the *Subak* system was known to be part of the Balinese life since hundreds of years ago. Some scholars estimated that the *Subak* system was established during the life of Markandeya, a yogist from Java in the first century of the Saka Calendar (*DPU Pengairan Propinsi Bali, 1972*).

According to *R.Gory (in Gany, 1975)*, paddy irrigation has been practiced in Bali for more than one thousand years. The early monograph of R. Gory, stated that there are some evidences suggested that irrigation in Bali has been existed since 600 AD. Since that era, the farmers in Bali were very skillful in excavating and constructing irrigation tunnel across the high ridges or high lands. The more recent evidence suggested that the *Subak* system was believed to have been existed in 800 of Saka Calendar or in 882 AD.

-
1. The main substance of this booklet was prepared -- with some modification -- based on a water management paper entitled: "Indonesia's Experience on Subak Irrigation System in Bali" which was presented by the author in the Regional Workshop on Adaptation of Agricultural Production Technologies for Sustainable Agriculture in ASEAN Region, jointly organized by The ASEAN Agricultural Development Planning Center (ADPC) and the ASEAN-CANADA Fund in Bangkok, Thailand, 10 - 14 January 1994.

GENERAL MAP OF BALI ISLAND, INDONESIA



At that time, the term *huma* (or upland or rain-fed paddy field in Indonesian term known today) was also known in Bali to be similar to low-land paddy field. Another stone inscription which was found in Prinyan or Trunyan, dated back to 813 of the Saka Calendar or 891 AD, indicated that the *makar aser* which is known today as the *pekaseh* or water master, was in fact already known by the farmer during that ancient period (*IPB, 1974:3*). Another scholar, Dr. Wertheim, indicated that the *Subak* was believed to had been widely practiced since between 896 and 1022 AD. Another stone inscription also indicated that the *Subak* had already been established during the time of the King Marakata Panghodja Stanuttunggadewa in 994 Saka Calendar or 1022 AD (*IPB, 1974:3*). The most recent stone inscription indicated that the *Subak* was widely practiced in 1072 AD for organizing the farmers activities in conducting irrigation for paddy cultivation (*Goris, in Dinas PU, 1972*). According to *Fukuda and Park (1976:24)*, one of the most obvious historical evidence of the *Subak*, in the form of ancient stone inscription, is still kept and preserved today at the Banjar Sengguan Pemejan Temple in the Klungkung District.

Despite that the above evidences do not provide an exact date of the establishment of *Subak*, however, they did indicate that the system had been known and practiced in Bali since the ancient Hindu era. The word *Subak* itself according to the Purana inscription, dated back to 994 Saka Calendar or 1072 was believed to be originated from the term *kesuwakan* which is similar to the term *kesubakan* or presently referred to as the *Subak*. In the district of Tabanan, however, the *Subak* term was believed by the local people to be originated from the word *seuwak* which is literally meant as "a better water distribution system".²

Apparently, no clear information what so far about the inventor, nor the initiator of the *Subak*. Some people believed that the initiative was instructed by the kings as they believed that the *Subak* system hold an

-
2. The name of each individual *Subak* system usually given according to several criteria: (1) after the name of the nearest village; (2) after the water sources, such as *Basangkara, Luwus, Joanyar*; (3) after the nearest religious temple, such as *Andeldewa*; (4) according to the land development system such as *Babakan Anyar* and so on.

important role in the economy of the kingdoms. Another scholars argued that the first initiative of the establishment of Subak came from the initiative of the farming community themselves by initially clearing the forests for providing their immediate agricultural purposes on mutual aid basis. The resulted agricultural lands were then gradually supported by the king by providing irrigation systems. This indicates that the kings and the people had been involved actively in the activities of the *Subak* since the ancient era of the Balinese kingdoms.

II. BASIC PRINCIPLE OF THE SUBAK APPROACH

2.1 Autonomous and Religious Ties of the *Subak* Practice

The *Subak* employs a principle of independence and religiously-tied practices in managing irrigation systems under the circumstances irrigation based agricultural endeavors. The general philosophy of the Balinese aderers to the “*Trihitakarana*” principle which believes that happiness can only be fulfilled when the “Creator” the “people” and the “nature” are confined in harmony. The *Subak* members, thus, establish and maintain irrigation infrastructures based on this philosophy through mutual cooperation without disregarding the judicious and fair dispersion of obligation, rights, and responsibilities amongst their members. These activities are implemented through the mutually agreed regulatory instruments which is referred to as the *Awig-Awig*.³ This regulatory instrument is not only addressing the irrigation circumstances, but in fact, giving also more comprehensive concerns with all agricultural aspects, including crop production, farmers' organization or institution, financial circumstances, facility maintenance and other similar rural development activities. The law or regulatory instrument of the *Subak* is therefore established to accommodate or to deal with every aspect of life and/or development which are prescribed by the organization on consensus basis.

3. The *Awig-Awig* is a Balinese term, which is generally meant as the formal regulatory instrument or law of an organization or group of community members. This law is often referred to, in some other places, as *Sime* or *Pasura*.

2.2 The *Awig-Awig* Principle of Internal Regulation Enforcement

Despite the fact that the general approach of the *Subak* is based on sensible personal consensus or "togetherness principle" amongst the members, however, the *Awig-Awig* regulation is still required by the *Subak* members for enforcing the regulation agreed upon by the members of the organization. Basically, the *Awig-awig* is developed by means of bottom-up approach,⁴ to promote democratic, flexible, sensible, fair and organization-bound regulation toward secure farming undertakings in the entire administrative area of each *Subak* organization. Each *Subak* system owns an independent *Awig-Awig* regulation that applies to the members within a distinct physical boundary of the *Subak* irrigation system.

In general, the written or the unwritten (memorized) regulation prescribed by the *Awig-Awig* are concerned with: (1) duty of the members to cultivate paddy in accordance with the agreed schedule; (2) obligation of the members to perform mutual aid for maintaining irrigation facilities; (3) means of settling disputes or conflicts among the members; (4) obligation to participate in the ritual or religious offering ceremonies in the temples.

In most cases, about 90% of the members are happy with the regulations and submissively obeyed them (*Gany and Faisol, 1975*). There are few cases, however, where the disobedient members were punished or fined in accordance with the kinds of violations they committed.

III. ORGANIZATIONAL PATTERNS OF THE SUBAK

From the point of view of land plot, the term *Subak* refers to as a group of paddy field blocks which are obtaining irrigation from the same water source. These farm blocks are organized together into one management unit which is called *Subak* organization. The *Subak* has a full

-
4. Most of the *Awig-Awig* clauses are established on the basis of consensus among the members themselves from the grass-root level in each *Subak* administrative authority. The Local Government gives the farmers freedom to decide whatever they think appropriate. The *Awig-Awig* Regulations were previously administered by means of local consensus. But recently, they prescribe the regulation in the form of written text or some kind of guide book.

autonomy to manage its activities through the establishment of its board of organization, by law, financial mechanism, regulatory instruments, and enforcement of sanction to the members without allowing involvement or interference of other external organizations. The main principle of organizational responsibility of the *Subak* is to manage irrigation implementation among the members themselves such that each of the individual member has equal, transparent and fair treatment for the sake of their goal toward mutual prosperity. The *Subak* organization also has the responsibility to preserve the watershed environment, to conduct proper maintenance of irrigation infrastructures, farm roads, determination of cropping patterns, land preparation and crop scheduling. Beside, *Subak* also has a responsibility to manage the harmonious relationship with external organizations such as local government agencies concerned. This includes the responsibility of conveying the members' opinion, suggestions and/or comments to the related authorities.

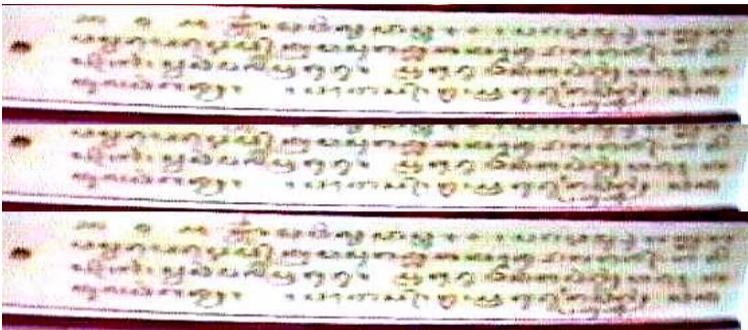
Geographically, the average area covered by one *Subak* organization is about 100 ha, depending upon the magnitude of the area covered by the irrigation command area of the *Subak* system. However, due to individual characteristic of the topographical condition, one *Subak* organization may covers an area in the range of 10 to 800 ha. Under the very special condition, one independent *Subak* area, however, may cover an area even smaller than 10 ha, for instance, *Subak Belimbing* only covers an area of 3.545ha while *Subak Aseman* covers an area of 799.175ha (*Gany and Faisol, 1975:10*). For allowing effective organizational control, the large *Subak* system usually, but not necessarily, sub-divided into two or more blocks. These blocks are referred to as *Tempekan* in the district of Bangli, Gianyar and Klungkung, while in the District of Buleleng they are referred to as *Banjaran* or *Layanan*, *Munduk* in the district of Badung and *Arahan* in the district of Jembrana. The boundary area of each individual *Subak* is usually formed by natural creeks, small valleys, small rivers or village roads.

In the entire Bali Island, there are 1,410 independent *Subak* systems. Each of the *Subak* scheme is equipped with distinct irrigation infrastructures, farmers organization and *awig-awig* regulation (*see Table-1 for further details*). From this table, one could see that there were

very little changes of physical features of the *Subak* through time -- comparing the data of 1971 and 1979. This explains that the *Subak* practice has already been so sustainable in terms of organizational, social, cultural as well as infra-structural management from generation to generation.



- The famous "*Barong*" as one of the cultural identities of Bali



- An example of the "*awig-awig*" regulatory instrument of *Subak* -- it may be written on palm leaves, bamboo or wooden stick

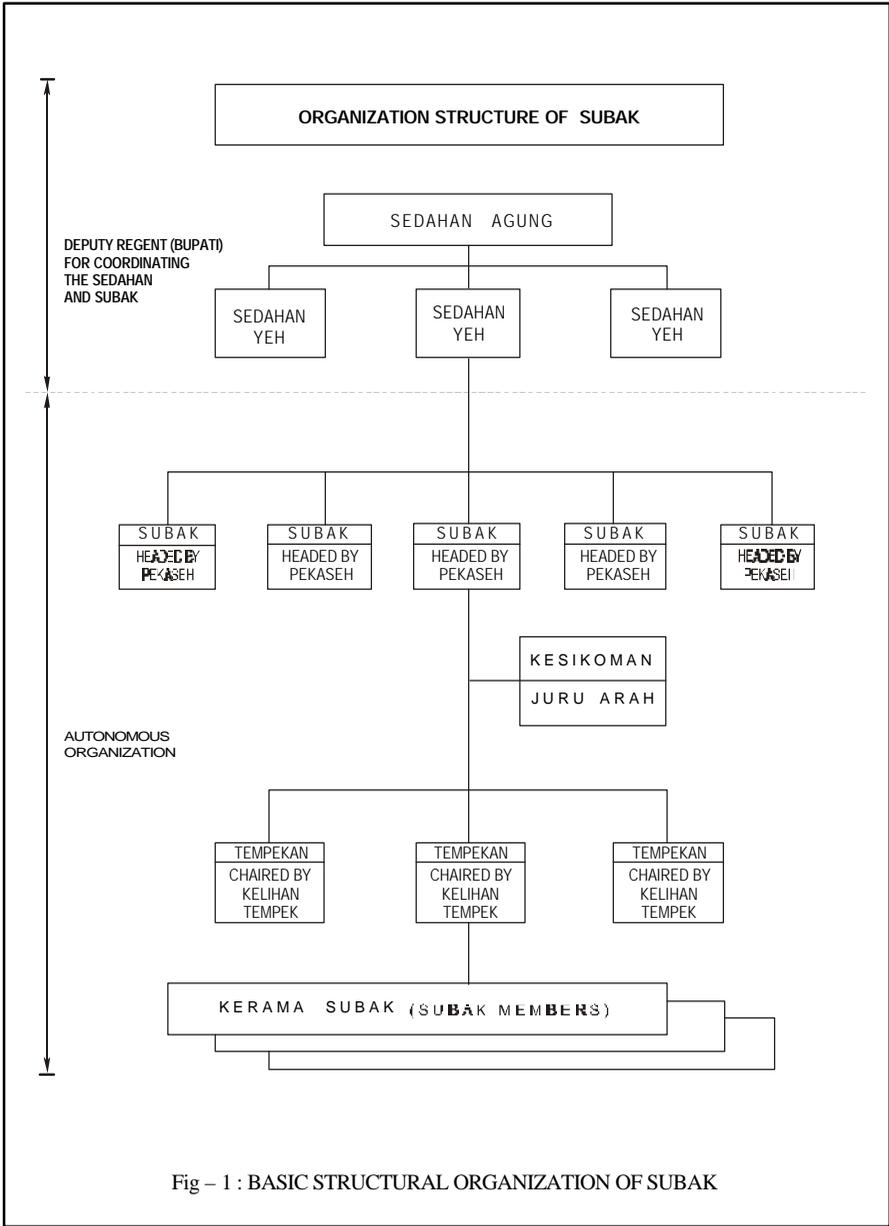


Fig – 1 : BASIC STRUCTURAL ORGANIZATION OF SUBAK

The *Subak* members which are referred to as the *Krama Subak*, are mostly elect their own representative by means of democratic principle in terms of majority rule. The elected president of the *Subak* is called *Kelihan Subak*⁵, who is responsible for organizing the implementation of the day-to-day activities of the *Subak* organization. In performing their responsibilities, the *Kelihan Subak*, in general, are assisted by one or more assistant(s) called *Kesinom* -- particularly for carrying out the water distribution and routine inspection of irrigation networks. The *Subak* member who is responsible for disseminating or delivering information to each *Subak* member is called *Juru Arah* or *Saya*. The *Juru Arah* or *Saya* also works to assist the *Subak* (the basic structural organization of the *Subak* presented in **Figure-1**).

From the point of view of organizational coordination and mechanism, the highest coordinating authority in the *Subak* organization is called the *Sedahan Agung*. The *Sedahan Agung* (which is also elected by the *Subak* representatives) is responsible for supervising the entire *Subak* organization in one District (Regency) or *Kabupaten* of the local government administration.

In some cases, for instance in Buleleng District, the *Sedahan Agung* is elected from civil servant who is actually responsible to the *Bupati* (Regent) on the routine coordinative basis. This has been applied since 1968 (*IPB, 1974:7*). For coordinating the *Subak* groups (*Subak* federation), the *Sedahan Agung* has the following responsibilities:

1. To manage and to arrange the general water allocation for the entire district administration.
2. To solve the problems pertaining to the *Subak* circumstances that cannot be solved by the *Subak* members themselves.

5. The *Kelihan Subak* in Some parts of Bali are also known as *Penyarikan*, *Pemekel* or *Klian Gede*. They are nominated for election based upon a number of selection criteria among others are: (1) to be a member of the *Subak* Community, (2) to be literate, (3) to be willing to have the position, (4) not to be engaged in any other occupation, (5) having previous experience in the *Subak* irrigated agriculture, and (6) to be capable of organizing the *Subak* organization and its related circumstances.

3. To collect land taxes.
4. To maintain proper coordination among the *Subak* organizations within the *Kabupaten* (Regency) and/or between the *Subak* organizations and the local government agencies or other external organizations.
5. To organize traditional ceremonies related to the *Subak* activities in the entire district government administration.

The administrative area of the *Sedahan Agung*⁶ varies from District to District in Bali, depending upon several aspects such as topographical condition, administrative boundary, watershed boundary, locally specific condition and so on. See the general illustration of administrative area of the *Sedahan Agung* portrayed in **Table-1**.



- The “tek-tek” proportional water measurement device made of coconut log

-
6. The *Sedahan Agung* is elected based upon a general criteria that the candidate must be capable and have previous experience of administering and conducting *Subak* organization. In addition, the candidates must have leadership capability and must be willing to accept the position.

Table 1.

**IRRIGATION AREA COVERED BY SUBAK ORGANIZATION
IN BALI, (1971, 1979 AND 1993)**

DISTRICT	AREA (Sq.Km)	NO. OF SEDAHAN			NO. OF SUBAK			IRRIGATED PADDY (Ha)			REMARK
		1971	1979	1993	1971	1979	1993	1971	1979	1993	
Buleleng	1,357	10	10	10	255	279	269	14,192	14,537	14,377	
Jembrana	830	5	5	5	73	93	108	7,995	8,284	8,860	
Tabanan	844	27	27	27	310	351	373	25,381	25,643	25,275	
Badung	509	10	10	10	146	131	147	19,215	19,218	16,166	
Gianjar	367	10	10	10	181	198	299	15,754	16,427	17,894	
Bangli	312	3	3	3	46	48	50	3,226	3,200	3,510	
Klungkung	530	5	15	5	44	45	45	4,858	4,425	4,476	
Karangasem	857	10	10	10	138	138	119	8,068	7,804	8,565	
Total	5,606	80	90	80	1,193	1,283	1,410	98,689	99,538	99,123	

Source : 1. *Laporan Penelitian Tentang Strategi pembangunan daerah propinsi Bali 1972, Koordinator Perguruan Tinggi VI, Surabaya*
 2. Provincial Irrigation Services of Bali, 1979
 3. Provincial Irrigation Services of Bali, 1993

3.1 General Principle of the Subak Membership

Basically, the *Subak* membership is categorized into two kinds according to the land ownership status: (1) land owner; and (2) land tenure -- i.e. the farmer who cultivate the land on behalf of the land owner. Formerly, the *Subak* membership does not specify rigidly, because most of the farmers within the administrative area were cultivating the land for themselves. Today, therefore, the ones who directly cultivate the land are deserved the privilege of the *Subak* membership.⁷

From the point of view of membership obligation, the *Subak* consists of three categories:

1. The members who are directly involved in irrigation activities of the *Subak*. These members are usually organized themselves in the so called *sekeha yeh* (water user association), also referred to as the *krama pekaseh*.
2. The members who are not directly involved in the farming activities. Instead, these type of members -- usually referred to as *pengampel* -- are obliged to finance the farming expenses in accordance with the mutually agreed *Subak* regulation.
3. The *Subak* members who are not required to work directly on the irrigated farming activities. This type of member refers to as *leluputan*, usually consists of religious priests⁸ who are responsible for performing the religious ceremonies of the *Subak* organization.

7. For the case the land owner who resides in the remote town and does not involve directly with the activities of the *Subak*, all of the farming obligations of the *Subak* membership are shared with the land owner on mutual consensus or agreement. The mutual obligations are varied from place to place. In general, however, the land owners are responsible of paying for all of the expenses related to the provision of irrigation infrastructures and facility maintenance, while the labor requirements are contributed by the land tenurer.

8. Despite the fact that the majority of the people in Bali are Hinduism, the *Subak* members who are belonged to other religions such as, Moslem, Christian etc. are in fact not constrained by any difficulties in conducting the *Subak* activities. The non-Hindu members are mostly supporting the ritual or religious ceremonies, though they are not participated directly in person.

The *Subak* membership terminates when that particular member is no longer cultivating the land for one reason or another. In case of death, the membership will be transferred to the children or descendants. If the land is sold, the membership will be transferred to the new owner -- so long as the new owner cultivates the land on his own.

3.2 Obligation, Right and Responsibility of the *Subak* Members

In general, the obligations, rights and responsibilities of the *Subak* members are consisted of three main aspects:

3.2.1 *Subak* Infrastructures and Rural Facilities

1. Construction and maintenance as well as rehabilitation of irrigation infrastructures such as weirs, irrigation structures, canals, water measurement devices and so on.
2. Construction and maintenance as well as reconstruction of *Subak* and rural facilities such as farm roads, temples, *subak* assembly facilities and other facilities for ritual and religious ceremonies.

3.2.2 Socio-Economic Concerns

1. To obey the *subak* regulation, both the written *Awig-awig* and non documented norms.
2. To implement the consensus resulted by the *Subak* assembly (meeting).
3. To implement the executive order of the board of organization.
4. To undertake general election for determining the members of Board of Organization.
5. To attend the *Subak* Assembly (both periodical and incidental ones).
6. To maintain an appropriate water utilization.
7. To pay for the membership fees and or other fees related to the *Subak* activities, fines etc. in terms of money or in kind.
8. To pay the land taxes or other fees stipulated by the local government authority.

9. To take precautionary action for preventing irrigation water from theft or illegal off-takes, and
10. To undertake mutual aid for pest control.

3.2.3 Concerns with the Religious and Ritual Ceremonies

For the *Subak* organization, the religious as well as the ritual practices are considered to be the very significant determinant factors affecting of the irrigated agricultural implementation. Some of the religious and ritual practices are conducted individually, others are conducted together. Among the religious and ritual ceremonies that are currently practiced are:

1. Welcoming ceremony for the initial commencement of irrigation distribution or *mapag toya* which is conducted together every year at the beginning of the planting season.
2. Individual ceremony at the beginning of land preparation or *ngedagin*. The commencement of this ceremony is determined and conducted by each individual member in accordance with his preferable time allocation.
3. The *Pangwiwit* ceremony, which is conducted by the *pekaseh* and the religious priests as well as the local leaders at the first commencement of seed-bed preparation.
4. The *Nandur* ceremony which is conducted individually at the time the transplanting is to be started.

The ceremony for preventing the attack of plant diseases or *neduh*. This ceremony is conducted by involving all of the *Subak* members, especially when a general indication of pest attacked has become apparent significantly. In this kind of ceremony, each *Subak* member will obtain the so called *air-suci* or the holy water, which is utilized by each of them for conducting individual ceremony on his own farm.

6. The *Pecaruan* ceremony which is conducted to prevent the plant disease from happening. This ceremony is conducted together at the period of about one month growth of the planted paddy.
7. The *Nyambutin* ceremony conducted by each individual member at about one and a half month growth the paddy.

8. The *Biyakukung* ceremony conducted by individual *Subak* at the maturity stage of the planted paddy.
9. The *Miseh* ceremony is conducted at the maturity stage of the paddy, just before harvest.
10. The *Ngusaha* ceremony which is conducted at about 10 days before harvest, particularly for the main crop season. This ritual ceremony is conducted by the whole *Subak* members, which is meant to express gratitude to the Almighty God the Creator for having endowment with good crop. Prior to the commencement of this ceremony, no one allowed to start the harvest.
11. The *Mantenin* ceremony, conducted by individual in respecting the generosity of the Almighty God the Creator, few days after the crop has been kept in the household storage.

3.2.4 Membership Rights

Beside obligations and responsibilities, the *Subak* members also have privileges for being involved in the organization. The membership rights include among others:

1. To have an appropriate irrigation allocation proportional to the size of agricultural land he has.
2. To elect and to be elected as the member of board of *Subak*.
3. To convey his opinion, suggestion and proposal in the general assembly.
4. To be represented by other person in conducting the activities related to his membership.
5. To provide information concerning violation of the *Subak* regulation to the Board of *Subak* and therefore, to be deserved of having part of the fine money -- in accordance with the provision stipulated by the *Subak* regulation -- that must be paid by the violator.
6. To be deserved of having part of the *Subak* property -- in accordance with the underlying regulation.
7. To have judicious and fair treatment from the *Subak* Board of Organization.

IV. WATER DISTRIBUTION AND MANAGEMENT

4.1 General Water Distribution Principle

The majority of irrigation areas operated by the *Subak* organization consist of simple irrigation with simple structures and appurtenance facilities. However, the Central Government in the last decade has provided some technical assistance for improving the infrastructures of irrigation system operated under the *Subak* organization. This technical assistance is particularly provided for the large scale irrigation schemes.

Under the *Subak* system, the water distribution system is conducted by the farmers themselves through the elected representatives. The water distribution pattern is based on a certain water requirement consideration as the following: (1) the water delivery is assigned to the farm land on plot-by-plot basis; (2) each individual plot with a seed requirement of one *tenah* of paddy seed⁹ per plot, is called *tek-tek* unit area¹⁰; each area covers by a farm plot of one *tek-tek* unit is measured by a traditional standard of water measurement device.

4.2 Subak Irrigation Structures

To provide a complete series of water management practices, The *Subak* system in general is equipped with every irrigation facilities required to serve for the farm plot. The irrigation structures are mostly of the simple ones -- temporary construction using the locally available materials such as timber, bamboo, coconut log etc. -- but most important is that the irrigation facilities are capable of serving each farm plot effectively.

The structural layout of a *Subak* scheme varies from place to place but in general each scheme consists at least a number of irrigation structures as follows:

-
9. The farm plot water requirement is determined by the amount of seeds of paddy that are planted in a certain size of farm plot -- refers to as *sesukat* which is called *Tek-Tek*. The amount of seed requirement for each *te-tek* unit is called *tenah* which is comparable to about 25 to 30 of grain paddy.
 10. *Tek-tek* is the Balinese term which is literally meant as to cut one thing into small pieces.

4.2.1 Empelan or Diversion Weir

Empelan is a kind of temporarily constructed weir -- usually made of log of coconut tree or bamboo, or stone that are put together. Some *empelans* are made of soil embankment so simple that they are strong enough to hold water at a certain elevation so it can be conveyed to the farm-land by means of gravity flow. In some cases, the structures are equipped with spillways that are built at suitable location, for example at the massive rock layer, cliff and so on. This type of irrigation structure is mostly constructed at the river site, otherwise at the site of water source.

4.2.2 *Telabah* (canal) and *Aungan* (tunnel)

Conveyance canal for irrigation is called *telabah*, while irrigation tunnel is known as *aungan*. These facilities are constructed by the *subak* members themselves on the mutual-aid basis. Excavation and construction of tunnels are undertaken by manual labor with very simple equipment and with traditional techniques learned from generation to generation.

The *telabah* is divided into several types according to the function and the scheme layout:

1. *Telabah Gede* or main canal extends from the river.
2. *Telabah Pamaron* or secondary canal, branched from the *telabah gede*.
3. *Telabah* or tertiary canal, branched from secondary canal.
4. *Telabah Cerik* or quarternary canal.
5. *Kekalen* or conveyance canal which serves the farm ditch. This type of small canal is connected with the *tali-kunda* -- which conveys water directly to the farm block or paddy plot.
6. *Tali-kunda* is the smallest canal that deliver irrigation water to each individual paddy field on plot-to-plot basis.

4.2.3 Supplementary Structures

For conveying the water acrossed the existing roads, canals, valleys, creeks or small rivers -- including the necessity to conduct appropriate irrigation operation, a *Subak* irrigation system is equipped with supplementary structures. These structures are among others: (1) *Abangan* or aqueduct; (2) *Jengkung* or large culvert; (3) *Keluwung* or small culvert; (4) *Petaku* or

drop structure; (5) *Pepiyuh* or sipillway; (6) *Telupus* or siphon; and (6) *Titi* or small crossing bridge (*PRIS, Bali, 1983:5-8*).

4.2.4 Pamaron or Diversion Structure

The water distribution is carried out by making use of diversion structures which consist of several types: (1) *Tembuku Aya* or main diversion structure; (2) *Tembuku Pamaron* or secondary diversion structure; (3) *Tembuku Gede* or tertiary diversion structure; and (4) *Tembuku Cerik* or quaternary diversion from which the water flows to the paddy field through the *kekalen*. Like other structures for *Subak* system, these diversion structures are also built with temporary structures, taking the advantage of the locally available materials.

4.2.5 Telabah Pengutangan or Drainage Channel

Since the farm level irrigation distribution practice of the *Subak* organization is conducted by means of plot-to-plot conveyance method, the tail-plots must be equipped with facility to convey the excess water to natural drains. For this purpose a *Subak* irrigation system is facilitated with *telabah pengutangan* or drainage channel which are eventually mounted to the main drains (*pakung*), otherwise, to the natural river streams. For further details some examples of the features of the *Subak* irrigation schemes are presented in *Figure-2* and *Figure-3*.

4.2.6 Buildings for Religious and Ritual Ceremonies

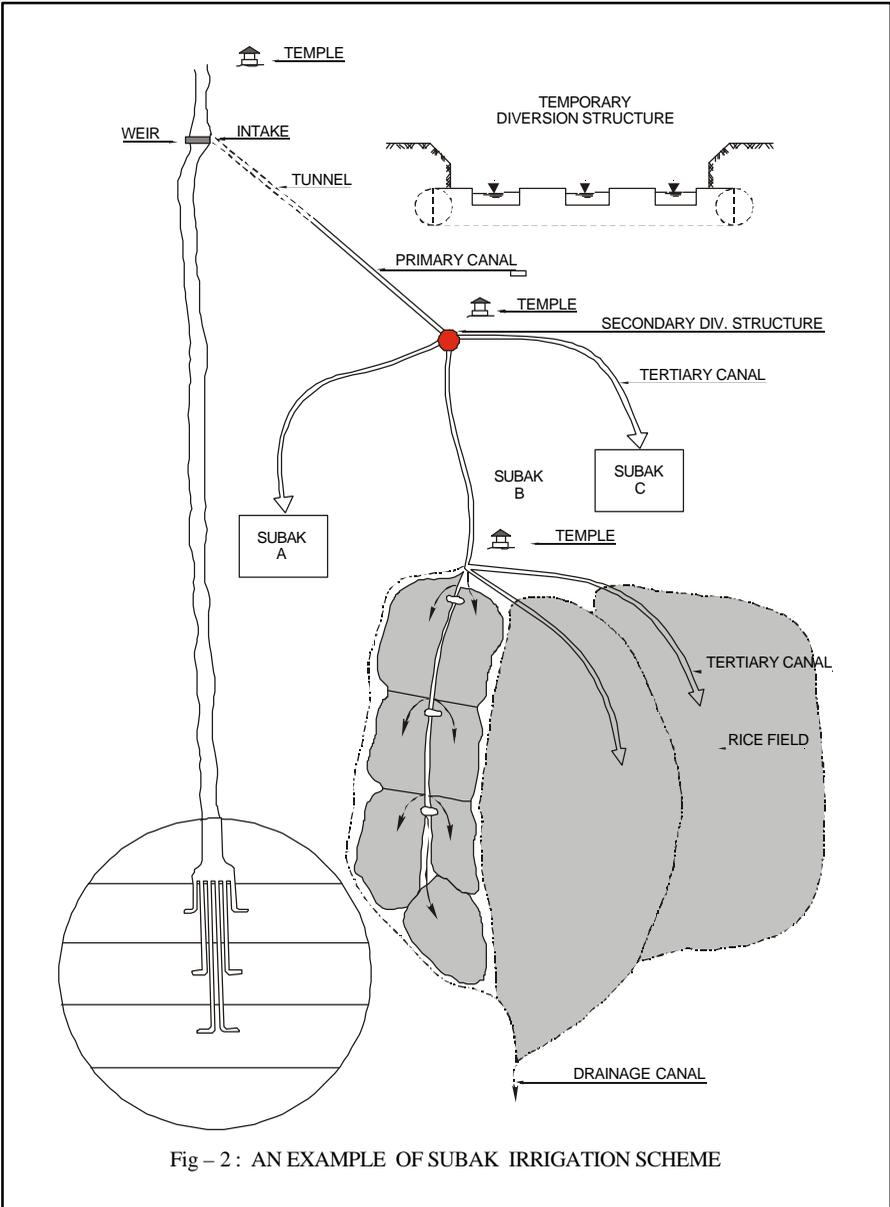
For conducting the religious and ritual ceremonies -- which are among the important practices of the *Subak* organization -- a number of buildings and facilities are provided. These buildings and facilities are: (1) *Pura Bedugul* or small temple which is built for each diversion structure; (2) *Pura Ulun Suwi* or temple for communal use within one or more *Subak* areas receiving water from the same water source; and (3) *Pura Ulun Danu* or temples that are built for each lake or reservoir such as Lake Batur, Lake Beratan, Lake Buyan, Lake Tamblingan, which are considered to be the source of prosperity of the Balinese people.

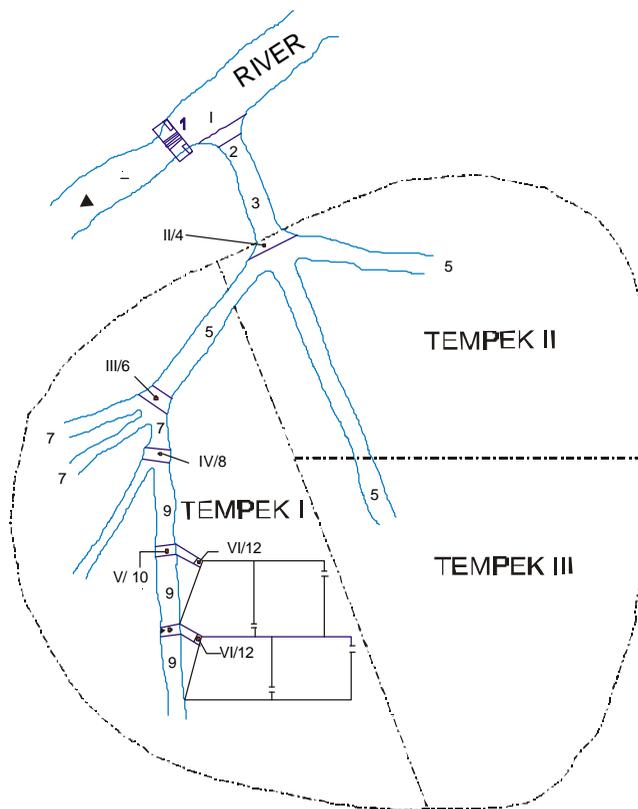


- A Balinese irrigation staff shows the map of an integrated *Subak* system



- An example of prefabricated farm level diversion box -- it may be made of concrete block, masonry wall, timber or bamboo





NOTES

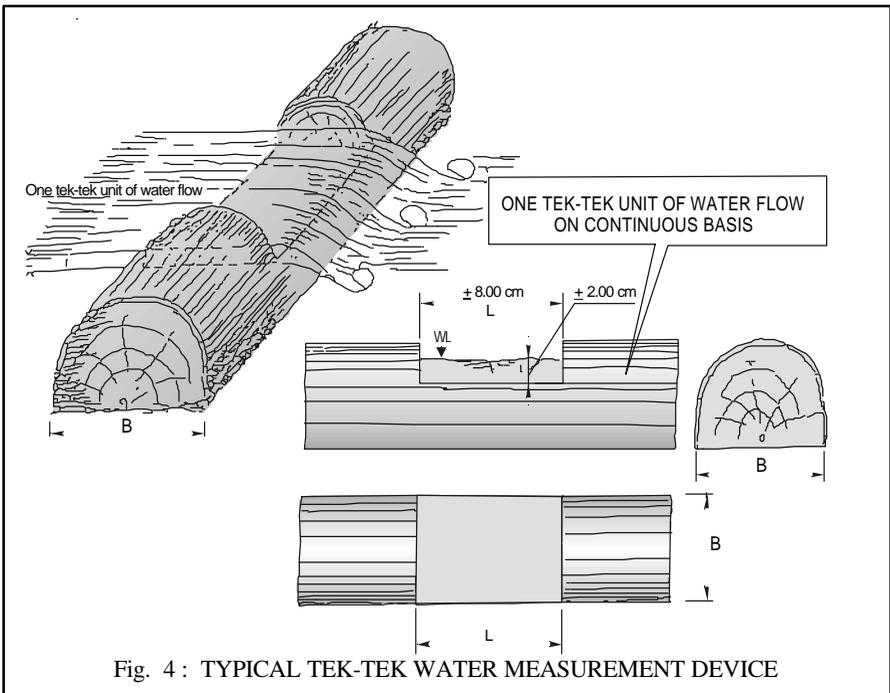
- I/1 = Wear at the River
- 2 = Temuku (Main Intake)
- 3 = Telabah Gede (Main Canal)
- II/4 = Temuku Aya (Primary Diversion)
- 5 = Telabah (Primary Canal)
- III/6 = Temuku Pamaron (Secondary Diversion)
- 7 = Telabah (Secondary Canal)
- IV/8 = Temuku Gede (Tertiary Diversion)
- 9 = Telabah (Farm Ditch/Tertiary Canal)
- V/10 = Temuku Cerik (Quarternary Diversion)
- 11 = Andungan (Silt Trap)
- VI/12 = Pengalapan (Farm Block Intake)

Fig – 3 : TYPICAL IRRIGATION STRUCTURAL NETWORKS OF A SUBAK SCHEME

4.3 Water Measurement Device

To provide reliable water distribution for each farm plot, a standard water measurement device is installed for each individual farm plot in accordance with the size of the plot in terms of *tek-tek* unit. Thus, each of the *tenah* seed unit is translated into *tek-tek* unit of farm area, the unit area is further converted into a certain magnitude of water measurement. This water requirement unit is also called *tek-tek*. The water measurement device is usually made of a piece of timber or log, cut at the desired length with a cut-off groove for measuring the water flow. The size of the cut-off groove of one *tek-tek* unit, for instance, is measured in terms of ordinary human finger thickness, about four fingers width and one finger depth, which is comparable to about 8 cm width and 2 cm depth (see **Figure-4** for illustration).

For larger farm plots, the size of cut-off is determined by multiplying the single *tek-tek* standard illustrated above, proportional to the size of the command area. Thus, one *tenah* of seed or one *tek-tek* unit area



will get one *tek-tek* unit requirement of water. The water requirement for larger area is served in terms of multiplication of the one *tek-tek* water flow standard.

In practice, this simple water measurement procedure is widely implemented by the *Subak* water users' association without ever being tempted to use more water than they are actually deserved. The *Subak* members are bound together in some sort of traditional entity or feeling of togetherness in the society. In addition, they are tied up with social as well as religious norms so intensely that taking an excessive amount of water makes no sense to them.

4.4 Rotational Water Delivery and Cropping Schedule

During the water scarcity in the dry season, the water distribution for *Subak* members is conducted on rotational basis. The rotational water distribution system is conducted on mutual consensus. All water disputes are settled down with judicious arrangement among the *Subak* members themselves.

The cropping schedule is also determined by the *Subak* members themselves by clearly stating the water distribution obligation. In the determination of cropping pattern and water delivery schedule, for instance, they adopt three cropping -- and hence water distribution -- schedules: (1) the *Ngulu*; (2) the *Maongin*; and (3) the *Ngesep*. The *Ngulu* means water distribution from the head, which is referred to as the water delivery for the crop rotation which starts earlier (between November and December). The *Maongin* means water delivery from the neck, which is referred to as the second crop rotation starts two months later (between January and February). The *Ngesep* means late, which is referred to as the third crop rotation which is implemented between March and April. In practice, this crop rotation is very effective for managing the staggered planting date, so that the crops do not consume water simultaneously, and hence the water constraint can be minimized.

In comparison with the most recent irrigated agricultural techniques -- that the people knows to day, it is quite amazing to observe the fact that the traditional agricultural practices under the *Subak* system are perfectly confirmed with the current (modern) irrigation application for

low-land paddy. For example, the field water requirement which has long been practiced by the traditional *Subak* is perfectly comparable with the most recent calculation on the ultimate field water distribution demand for low-land paddy. In addition, the modern agricultural research has demonstrated that the occasional necessity of 24 hours per day water distribution is recommended for optimum growth of paddy during the early growing stage. As the matter of fact, this sustainable water management practice has long been implemented by the *Subak* farmers in Bali through generations.

V. THE SUBAK ASSEMBLY

5.1 Internal Coordination

Every *Subak* system prescribes a regular meeting among the members (usually conducted every 35 days) to discuss all aspects concerning their farming circumstances such as, operation and maintenance of irrigation infrastructures, maintenance of temple and other rural as well as public facilities, to solve the underlying irrigation distribution problems, to settle disputes and so on. In such a meeting, discussions are mostly focused on the most immediate and urgent issues, such as monthly working schedule for the following month, acceptance of new membership, membership contribution, financial status, ritual ceremonies and so on. Apart from this routine meeting, incidental meeting are also advocated for discussing and overcoming the urgent problems such as emergency works for improvement and repairs of irrigation network facilities, pest or disease attacks, emergency action for food relief and other such matters.

Depending upon the urgency of the problem to solve, the meeting of the *Subak* may be conducted in the form of general assembly or involving the complete team or selective members of the board of *Subak* only.

The incidental meeting of the Board of *Subak* usually conducted at the residence of the *Pekaseh*. This meeting usually conducted one day prior to the general assembly of the *Subak* members, discussing about the programs that are going to be implemented.



- Mutual aid for Installation of "*tek-tek*" water measurement devices
-- center, coconut log *tek-tek* in operation; lower, bamboo *tek-tek* device in operation



- A view of the upstream part of a water tunnel across the hill -- lower view, a short type of tunnel excavated by *Subak* members by means of appropriate technology



The general assembly for the members consists of routine and incidental (on demand) ones. In most cases the routine assembly is conducted every 35 days. This meeting, which is usually conducted at the *pura bedugul*,¹¹ must be attended by all of the members.

In the routine meeting, the discussion usually concerning the internal circumstances such as the following: (1) replacement of *Juru arah*; (2) routine announcement of the violators of the *awig-awig* and execution of fine; (3) financial circumstances; (4) routine maintenance of *Subak* facilities; (5) agricultural circumstances, crop maintenance, credit facility etc.; (6) ritual and religious ceremonies; (7) suggestions, comments, proposals, recommendations of the members; and (8) announcement concerning instructions to the members for implementing the member's obligations and other organizational responsibilities.

5.2 Coordination with External Organization

For discussing the external cooperation or for solving the external problems related to other *subak* or other organizations, the meeting is usually attended or coordinated by the *Sedahan* or the *Sedahan Agung* for the meeting related to the agencies or organization at the Regency, District (*Kabupaten*) level.

Depending upon the context and urgency, the *Subak* assembly may be conducted through coordination of other government agencies such as Regional or District Agricultural Extension Services, Provincial or District Irrigation Services, Local Government Authorities and so on. For further details, see the schematic chart of the interagency coordination of the *Subak* which is presented in *Figure-5*. In this chart, other line organizations and agencies give the necessary technical guidance to *Subak* according to the immediate demands without direct intervention to the *Subak* -- as autonomous organization.

11. *Tek-tek* is Balinese word, which is literally meant as to cut off one thing into small pieces.

VI. FINANCIAL SOURCES AND MANAGEMENT

6.1 Financial Sources

As far as the financial circumstances are concerned, the *Subak* rural agricultural organization relies all of its financial sources from the members. The magnitude of the membership fee is collected proportional to the size of agricultural land owned by the *Subak* members. This membership fee can be paid either in cash or in kind. The *Subak* funds may also come from penalties, fine money, labor contribution for performing operation and maintenance of irrigation infrastructures, temples and other public facilities.

All of the funds collected are kept by the *Subak* chief, while the utilization of that fund -- for instance, for the routine maintenance of irrigation system or for financing traditional or religious ceremonies -- is subject to approval of the members through the *Subak* assembly prior to implementation.



- An example of building facility for *Subak* assembly



- Periodical meeting of *Subak* members to discuss and solve the problems and issues of irrigated agricultural practices



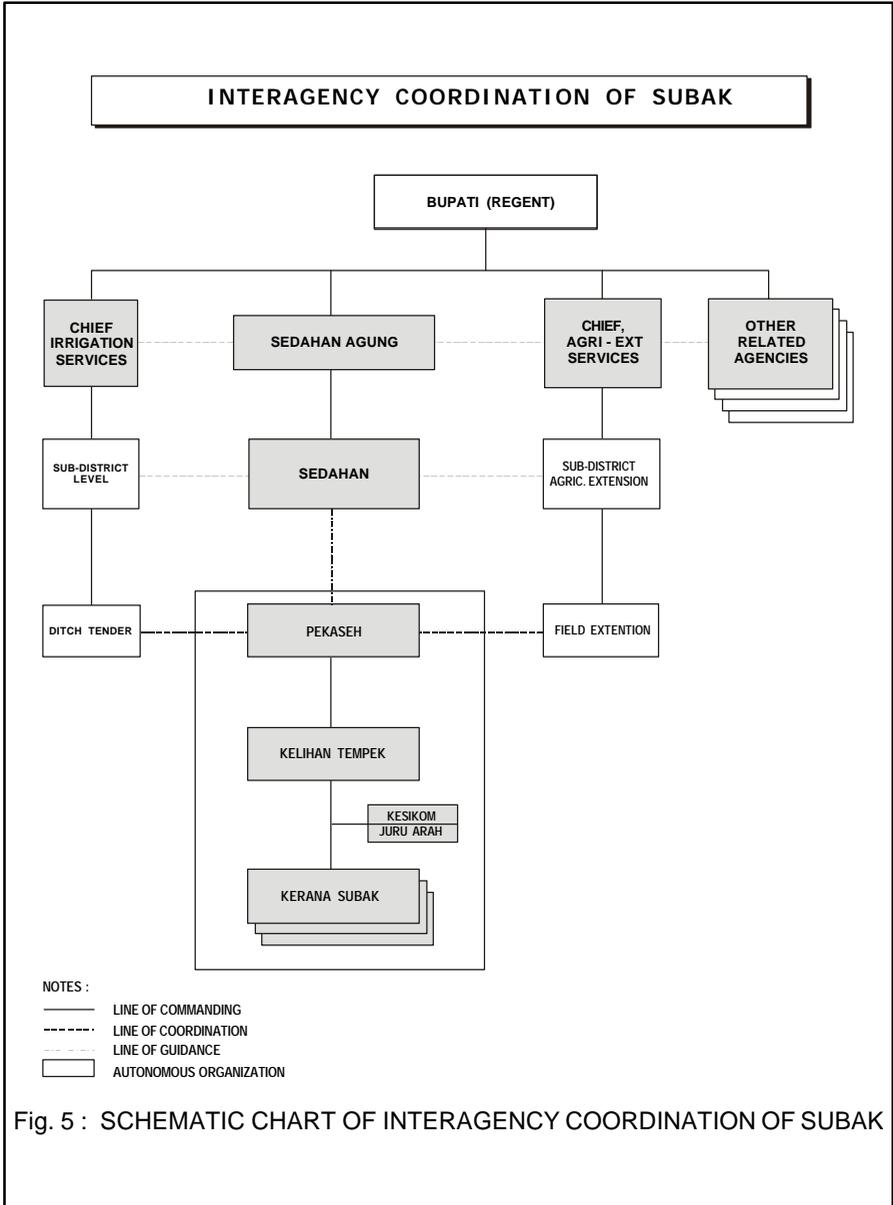
- A man and his wife undertake rice transplanting on their farm plot -- a usual practice



- A women helping her husband to store the paddy at the family barn -- after harvesting



- A women cleaning the threshed grain paddy at the farm -- before sun drying



6.2 Determination of Membership Fee

The magnitude of the membership fee varies from place to place, depending upon several aspects including size of land ownership, location, crop production, accessibility and other location specific. Determination of the membership fee is based upon the general consensus of the *Subak* assembly, both in terms of its kind and its magnitude.

The followings are several kinds of membership fees:

6.2.1 Incidental Membership Fee

This incidental fee usually levied to the member in the form of cash to cover the non-routine financial requirement, for instance, for incidental repairs of irrigation structures, recovery of damages caused by local disaster such as land slides or floods. The magnitude of this fee usually determined by the nature of the required works divided equally or proportionally to the members, based on consensus.

6.2.2 Periodical Membership Fee

This type of membership fee may be paid in cash or in kind, but in most cases, the payments -- especially after harvest -- are paid in kind. There are several types of periodical membership fees:

1. The *Pengoot* or *Pengampel*, which is considered to be the payment in lieu of the annual service charge for the members who could not undertake the mutual works, they are responsible for. In some cases, for instance in the Kabupaten Badung, the active member or *ngoot ngayah* is not levied with this type of fee. For agricultural lands consisted of more than one *tek-teks* the fees are levied to the members who are not active participants (*ngoot ngutang*). Part of this collected fee usually spent for paying the active members or for expenditures related to the ritual or religious ceremonies.
2. The *Sarin Tahun* is a form of periodical membership fee which is paid in kind -- generally in the form of grain paddy -- immediately at each harvest season. Some *Subak* collect this type of fee on annual basis to finance the ritual and religious ceremonies, others prescribe bi-annual collection at the harvest seasons of the main as well as the secondary

crops. The magnitude of this contribution varies from place to place. The *Subak Pengembangan* in Tabanan District, for instance, a paddy field with the unit size of 500 square meters has to contribute a so called *sarin tahun* at about 1 kg of grain paddy per year (about 20kg of grain rice/ha/year).

3. Membership fee in term of compensation or incentive for the member of *Subak* Board of Organization. Some *Subaks* obliged their members to pay for a special form of membership fees on top of the *Pengoot*, *Sarin Tahun* and incidental fees. This, for example applies in the Tamblang and Pangkung Gondang of the District of Jembrana. In this areas such a special contribution is collected in the form of grain rice at an amount of 4 kg for each paddy field with a unit size of less than 0.75ha, which obtains water from a single water off-take gate. For the paddy field with the size of more than 0.75ha and obtains water from a single water source, the paddy contribution is determined by the *Subak* assembly -- proportional to the size of the paddy field in questioned.

6.2.3 Mechanism of Internal Financial Auditing

In most *Subak* organization the responsibility to conduct financial account is entrusted to the *Pekaseh*, helped by one or more financial assistants, for collecting fees, book keeping and so on. This type of financial account is mostly carried out in a very simple book keeping system. The members usually rely the annual or periodical settlement of account to the *Pekaseh* and his assistants (IPB, 1974:22-23).

Annual planning for routine works is usually prepared by each *Subak* authority on the basis of mutual agreement and consensus. However, this type of annual working schedule is rarely prepared in written format. Financial disbursement schedule is rarely prepared by the board of organization. Budgeting system is mostly conducted on the basis of "**balanced budgeting system**". For financing the emergency works, the members are obliged to contribute extra fees on the basis of the amount of money required for the works.

6.2.4 Execution of Sanction for the Violator

For enforcement of the *Subak* regulation or *Awig-awig*, each *Subak* Board of Organization has a prerogative obligation to execute the prescribed sanctions. The sanctions are generally executed in the order of importance as: (1) remainder or warning; (2) penalty or fine; (3) temporary cease of irrigation water allocation; (4) to sell by auction the violator's property; (5) withdrawal of the privilege of the *Subak* membership.

Penalty for violators varies from *Subak* to *Subak*, depending upon the nature of organizational regulation. One *Subak* prescribes the penalty in cash or in kind, others insist the violator to pay in labor in lieu of money.

As far as the violations of the *awig-awig* regulation is concerned, they are mostly associated with the cases as follows: (1) absence or late participating in the meeting; (2) crop damage due to unguided cattle grazing; (3) late land preparation for regular cultivation; (4) water theft; (5) inability to comply with the executed penalty; (6) absence in attending mutual aid obligation; (7) damages of farm ditches, canals levees, irrigation facilities or crop due to carelessness.

VII. CONCLUDING REMARKS

Learning from agricultural practices demonstrated by the *Subak* system in the Island of Bali, it is apparent that the irrigated agricultural practices has been developed to meet the farmers evolutionary demands and circumstances through a long range practice, so that the system could sustain, without major changes, from generation to generation.

The main principle built into this system is based on the ability to regulate the suitable techniques, time, space and environment in order to meet the livelihood of the people through "**harmonious-togetherness**" principle. The underlying approach is based on the ability of maintaining a proper balance, and the ability of acquiring harmonious relationship between human and nature on reciprocal basis. The basic techniques are incorporated with the simplicity principles, so that every members of the community are able to adopt and/or apply the technique without involving sophisticated learning process.

Despite the fact that the *Subak* system and its practices were invented and evolved long time ago, it is quite amazing to know that much

of their techniques are still convertible and/or adaptable to the modern practices that the people understand today. The more we can comprehend the traditional irrigated-agricultural practices the more we learn about their technicalities. In fact, there is a reason to believe that the traditional agricultural practices adopted by the *Subak* organization were based on systematic observations. Today, in modern Indonesia, there remains a lot more phenomenon of the ancient heritage of participatory irrigated agricultural practices, adhered to the *Subak*, that need to be uncovered in terms of scientific explanation.



- Religious and ritual ceremonies are adhered to everyday practices of *Subak* organization -- asking for blessing before, during and after irrigated agricultural implementation, expressing their thankfulness to the beneficent and merciful Creator

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- The basic techniques of *Subak* are associated with the simplicity principles, so that every member of the community -- with the equal rights between man and woman -- can adopt the technique without involving sophisticated learning process



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Mr. A. Hafied A. Gany, was born in a Regency Capital town of Watan Soppeng, South Sulawesi, Indonesia, on November 10, 1944. He started his professional career in the Water Resources Development and Management as a construction supervisor of water resources projects after completing his civil engineering undergraduate in Bandung in 1967. From 1968 to 1981, Mr. Gany had a series of experiences working in the water resources design, construction, Operation and Maintenance, and field research and experimental activities in the Irrigation Based "Transmigration" Settlement in Southern Sumatra.

In 1979, he obtained M.Sc. degree from the University of Southampton, U.K. He was assigned as the project manager of the Construction Guidance Service Center – CGSC – Project, at the same time as chief of the Research Station for Hydraulic Structures of the Ministry of Public Works in Bekasi, West Java from 1985 to 1989.

In 1993 he obtained an interdisciplinary Ph.D. studies majoring Engineering, Economics, Sociology, and Demography at the University of Manitoba, Canada, with commendation. In 1995, he had been assigned as the Director of Water Management and Conservation, Ministry of Public Works till 1999. He has been assigned as Deputy Director General of Water Resources Development -- DGWRD 1999; Assistant Deputy of Water Resources Protection and Conservation, State Ministry of Public Works November 1999, and in 2000 as the Director of the Research Institute for Water Resources, Ministry of Settlement and Regional Infrastructures till now.

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Water Management and Past Experiences:

"We must manage our water resources as effectively as possible, learning from experiences that had been pursued in the past."

(President Megawati, July 28, 2001:
Indonesian Water Bulletin "Air.02/th1")

Rivers and Lovers:

" We must look after rivers like we care our lovers. Make sure rivers are always beautiful"

(Mahatir Muhammad: "Malaysian Love our Rivers Campaign 2000",
The Straight Times: Asia

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Subak Irrigation System in Bali: An Ancient Heritage of Participatory Irrigation Management in Modern Indonesia

The *Subak* system is an ancient irrigated-agricultural practices of the Bali Island, Indonesia. This system serves small-scale land holders where lowland paddy are mainly practiced. The exact date of *Subak* was not known, however, a most recent evidence suggested that the *Subak* system was believed to have been existed in 800 of Saka Calendar or in 882 AD.

The main principle built into this system is based on the ability to maintain proper balance, and harmonious relationship between human and nature on reciprocal basis. The basic techniques are incorporated with the simplicity principles, so that every member of the community can adopt the technique without involving sophisticated learning process. In fact, much of their techniques are still convertible to the modern practices that the people understand today.

Today, despite the underlying irrigation development and management practices in modern Indonesia, there remains a lot more phenomenon of ancient agricultural practices -- demonstrated as practical examples by the *Subak System* -- that need to be uncovered in an attempt to contribute practical technicalities for implementing sustainable irrigated agricultural development under the small-farming circumstances.

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