TRI HITA KARANA AND *SUBAK*
- In Search for Alternative Concept of Sustainable Irrigated Rice Culture-

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INTRODUCTION

Subak as an irrigators' association in Bali has been in existence for almost a millennium. It was created on hydrological basis rather than administrative one with clear defined boundaries with respect to its command area (irrigated paddy-fields) and membership. It's main function is managing water for staple food production especially rice. The operation and maintenance of the irrigation infrastructures have been carried out on mutual help basis with limited or almost without external support, mostly with the use of indigenous knowledge. Religious rituals which are closely linked to the stage of rice growth seem to dominate the activities of subak members. That is why subak has been labeled as a socio-religious irrigation institution that distinguishes it with most of the irrigation systems in other parts of the world. In Bali, Subak is almost identical with rice culture or rice cultivation. The word "subak" is usually interpreted as the irrigation network or irrigation system, the paddy farmers as members of the irrigation association (irrigators' association), and rice fields within the command area of the irrigation system. In this paper the term subak is being used interchangeably with other terms like irrigated rice culture, subak system, subak irrigation system, subak organization or subak institution.

The daily activities of subak organization is guided by the basic philosophy of life adhered by Hindu Balinese known as *Tri Hita Karana* (THK). Essentially, THK emphasizes the importance of maintaining harmony in this world. Horizontally, man should live in harmony with one another as well as with other living creatures and natural environment. Vertically man should live in harmony with God, The Creator, in the sense that man must be a constant worshipper of God and pray for His blessing. Only in this way, human happiness and welfare both materially as well as spiritually would be achieved. Since man is part of nature, he is responsible for its sustainability. Thus, natural resources should not be exploited greedily just for the sake of present generation but should be preserved to support the livelihood of future generations as well. This noble principle has universal values and is clearly quite relevant with the modern concept of sustainable development and sustainable agriculture.

Many foreign scholars have admitted that subak is a long-endured and "sophisticated" self-governed irrigation system. Could it be that the implementation of THK principle by Balinese paddy farmers has been responsible for this? Quite ironic, that the viability of the subak is now under serious threat, due to various changes brought about by the rapid development of tourism in Bali. New values have penetrated many aspects of life of the Balinese which may be detrimental to Balinese culture and have started spoiling the noble value of THK principle.

This paper has the following objectives: (1) to briefly describe the application of THK principle in irrigation water management by subak organization; (2) to propose a concept of sustainable irrigated rice culture; (3) to raise arguments for preserving irrigated rice culture; and (4) to recommend relevant policy measures to preserve irrigated rice culture.

APPLICATION OF THK PRINCIPLE IN IRRIGATION WATER MANAGEMENT BY SUBAK ORGANIZATIOIN

THK principle has been mostly applied by Balinese paddy farmers in managing irrigation water for rice cultivation. THK literally means "three causes of peacefulness / happiness / prosperity", and consists of three elements namely: *parhyangan* (supernatural realm or belief in God); *palemahan* (environmental realm); and *pawongan (*social realm). It dictates that to achieve prosperity, man should keep harmonious relationship with God, with his environment and with other man or his social environment. Men are required to live in harmony with one another avoiding physical conflict as could as possible. As regard to the natural environment, the Hindu Balinese believe that it is a gift for mankind from God. It is believed that the relationship between man and nature is just like a fetus in the womb. Any damage to the womb will certainly endanger the fetus itself. This implies that mankind should take care of natural environment in such a way so that it can sustain their livelihood from generation to generation. As adoration and gratitude to God for His Blessing in providing nature for their sustenance, the Balinese farmers have obligation to make offering through religious rituals associated with irrigation and rice cultivation activities. In the context of subak systems, subak temples hierarchy with their various kinds of rituals signify the element of *parhyangan;* the irrigation network and paddy fields including the fauna and flora represent the *palemahan* ; and the subak organization together with its members and rules and regulation symbolize the *pawongan.*

The manifestation of THK principle in the subak system can be seen in the various activities of paddy farmers and in other aspects of irrigation system. For example, in relation to keep harmony with God, rice farmers have created temples of various kinds as sacred places to worship God through offerings and certain forms of sacrifices. There is hierarchy of subak temples started form the lowest until the highest level i.e., *sanngah catu* (an altar for individual farmer located at nearby his own water inlet) ; *ulun carik (*rice-field temple for the *tempek* i.e., sub division of a subak); *bedugul* (rice-field temple for the whole farmers of a particular subak*)*; *ulun empelan/ulun suwi* (water temple for the subak members located nearby the dam/weir); *masceti* (rice field temple for a group of different subak); and *ulun danu* (water temple for almost the whole subaks in Bali).

The subak rituals are carried out regularly following the stages of rice growth and the sequences of rice farming activities (which are quite similar with the rite of passage) starting from land preparation which is presided by "water opening ceremony"; seeding; transplanting; blooming of rice plant; milking; harvesting until the harvest being stocked at granary. The rituals may be performed individually by each farmer at his own altar as well as in a joint cooperation with other members of the same subak or even different subaks at relevant temples according to the kind of ceremony to be performed. Subak rituals play important role in providing a continuing basis for farmers' solidarity and developing awareness among farmers that water as a gift from God should be used fairly for the benefits of all. In addition, religious rituals performed by subak have brought harmony and social stability in rural areas of Bali. Rural social stability can help continue economic activities to proceed normally.

In effort to keep harmonious relationship with other living creatures such as pests and insects, rice farmers in former times used not to kill them, but rather they performed ritual known as *nangluk merana* ("avoid pest attack ceremony"). This ritual is still practiced until today by Balinese farmers. The philosophical meaning of this ritual is that not to kill any creature as could as possible but just to protect the crops from pest attack. In some places, many subaks still used to perform "rat cremation ceremony" as a form of *nangluk merana* ritual, by praying for God's blessing so that no pest would attack their crops. Other important rituals that need to be

mentioned here are the so called tumpek *uduh ("flora day ceremony")* and *tumpek kandang ("fauna day ceremony").* Each of these rituals is performed every 210 days on Saturday based on Balinese calendar. These rituals symbolizing *the* biodiversity preservation efforts of Balinese rice farmers. At present however, due to the excessive utilization of pesticides and insecticides, the biodiversity of paddy land ecosystem are under severe threat. The spirit of Tri Hita Karana needs revitalization by practicing it in daily life, not only in form of symbols through religious rituals but at the same time by putting it into real actions.

With regard to keeping harmonious relationship among members of the same subak, the farmers in managing water for paddy cultivation, have developed a set of operational rules called *awi-awig* (soak's bylaw). It specifies various matters such as organizational structure, membership, rights and duties of each member, cropping pattern, planting schedule, methods of water allocation and distribution, subak meetings, kinds and forms of prohibition, and many other matters including the sanctions against rules violation. Every member must obey the *awig-awig*; otherwise he could be fined since it is strictly imposed against any rules violator. The bylaw must be approved or agreed upon by all members through consensus before it is put into effect. The rules may be adjusted or modified according to the changing conditions. Any member has right to control and monitor rule violations such as water stealing and other relevant matters. Any member who by chance could identify the offender of subak's bylaw should report it to the subak head who will then announce it during plenary subak meeting held every 35 days. The subak will impose appropriate sanction against the rule violators. The sanction may be in form of fine or temporary withdrawal of his water allocation.

The subak also has conflict resolution mechanism to avoid prolonged conflict in order to maintain group harmony. Subak's head has to tackle any internal conflict among members; in case he is unable to solve it, the case is to be forwarded to a local official within relevant watershed /river basin jurisdiction *(sedahan);* and if the *sedahan* too cannot handle it, he can take it to the *sedahan-agung* (a government official at regency level as the highest authority of subak organizations within a regency). To resolve conflict by bringing the case to the court should be avoided as could as possible and this has never occurred and mostly could be solved by the subak leaders concerned.

Mutual trust, harmonious interaction, mutual help, and mutual benefit relationship among members are salient features of subak organization which can keep harmony and solidarity and strengthen the incentive for cooperation. More over, these may create "social capital" that can facilitate productive activity. Such intangible form of capital has a significant role for the sustainability of a self-governing irrigation system that entirely relied upon internal funding for its early establishment and for its further operation and maintenance.

Internally, every subak generally has several smaller unit organizations called *tempek* (subak's sub division). But in effort to maintain harmonious relationship with other subaks, several subaks sharing a common weir/dam also coordinate themselves into a federation called *subak-gede,* whereas for many subaks / irrigation systems along a part or a whole river course /river basin they organized themselves under a larger federation called *subak-agung.* Through these federations, paddy farmers in Bali could use river water as common goods in more equitable and efficient manner by coordinating cropping pattern and planting schedule.

Balinese paddy farmers have built their irrigation network (weir, water tunnels and canals) by employing local wisdom/indigenous knowledge with only very simple tools. They built irrigation structures in such a way so as to be in harmony with nature or best suited to local environment, using locally available materials. This means that they have been able to create appropriate

technology by which they can operate and manage the system by themselves without difficulty and at the same time easy to monitor and can be cheaply managed. This can be seen for instance in the design of water division structures for allocating and distributing water share to individual farmer as well as to groups of farmers which have ensured fairness and transparency in water allocation and distribution.

The traditional proportional water division structure as measuring devise is based on *tektek* principle. *Tektek* is a measurement of water allocated to each member. The water must flow through an inlet or division device of specified depth and width which varies from subak to subak. The use of *tektek* as water share measurement seems to be the result of a long process of negotiations and renegotiations by trial and error in a democratic manner. The amount of water share was determined by various factors such as size of landholding, initial investment of labor and other contribution by each member during the construction stage; soil condition; distance of the farmer's plot from the intake; and many other considerations all of which have been accepted through consensus. The water share received by each member determines his rights and duties that he should perform and it reflects the equity concept that has been mutually agreed (Sutawan, 2000). The fairness and transparency coupled with accountability in monitoring and autonomy in handling the organization's internal affairs are some of characteristics of good governance. Hydraulic engineers might better understand to what extent the irrigation networks created by the traditional Balinese paddy farmer's long time ago are really compatible with the modern engineering principles.

Such attributes of the three elements of THK conform to the eight design principles of long-endured or sustainable self-managed irrigation systems as conceptualized by Ostrom (1992), namely: clearly defined boundaries with regard to service area and membership; fair proportioning between rights and duties of each member; collective action decision making arrangement; accountable monitoring; graduated sanction against rule violations; conflict resolution mechanism; recognition as formal organization by government; and multilayered organization in managing the system. In this connection it can be said that the application of THK principle has contributed to the sustainability of irrigation system and hence the irrigated rice culture in Bali.

PROPOSED CONCEPT OF SUSTAINABLE IRRIGATED RICE CULTURE

As has been discussed above, THK seems to have significant contribution to the sustainability of irrigated rice culture in Bali. Inspired by the application of THK principle by Balinese farmers in managing the irrigation water for rice cultivation, it seems necessary to develop a concept of *"sustainable irrigation systems for rice cultivation"* which is essentially the same thing as *"sustainable irrigated rice culture*".

There are a lot of definitions about sustainable agriculture. Pakpahan (1995) has cited several definitions of sustainable agriculture such as for example the one offered by the Consultative Group for International Agricultural Research (CGIAR) as " successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources". A more specific definition was cited from Francis and Hildebrand (1988) namely : " a sustainable agricultural system is the result of a management strategy which helps the producer to choose hybrids and varieties, soil fertility packages including rotations, pest management approaches, tillage methods, and crop sequences to reduce costs of purchased inputs, minimized the impact of the system on the immediate and the off-farm environment, and provide a sustained level of production and profit from farming". Meanwhile, Dover and Talbot (1987) proposed nine criteria regarding sustainable agriculture

namely: replenish soil nutrients; maintain physical condition of the soil; enhance the humus level in the soil; no build up of weeds, pests and diseases; no increase in toxic elements; control soil erosion; minimize pollution of environment; maintain adequate habitat for wildlife; and conserve biodiversity.

The first definition offered above seems to be quite general while the others seem to emphasize more on the environmental and agro-technological aspects. Since land and irrigation water are indispensable for irrigated agriculture, rice culture in particular, it seems necessary to see sustainability of agriculture especially irrigated rice culture from a rather different point of view. An irrigation system for rice cultivation especially self-managed irrigation system such like subak in Bali which in this paper, is the same thing as irrigated rice culture, can be viewed to possess several inter -related elements. These are: (1) irrigators' or farmers' organization responsible for managing water and irrigation network; (2) irrigation network or irrigation infrastructure; (3) agricultural production ;(4) irrigated land ecosystem ; and (5) socio-cultural values and traditions linked to the rice cultivation. To achieve sustainable irrigated rice culture or irrigation system for rice cultivation, it is necessary to keep all of the above elements sustainable. However, the sustainability of irrigated rice culture also largely depends on the sustainability of upstream watershed and the quality of river water upstream which are external to individual irrigation system but directly have an impact to the system concerned. An individual irrigation system is also an element or sub-system of the entire river basin or watershed. This implies that the performance of individual irrigation system or irrigated paddy culture drawing water from lower stream may also be affected by the system getting water from the upper stream. The sustainability of local environment of the systems along water course /river basin such as lake, water springs and upstream watershed are affected by various factors or external forces like demographic, social, economic, cultural, political, industrial development, tourism , government policy, and so on.

Sustainable irrigated rice culture should there fore be perceived here ***as prolonged existence and functioning of a number of important inter-related aspects of the irrigated rice culture.*** Thus, sustainability of irrigated rice culture should encompass the sustainability of the followings: (1) ***farmers' organization or institution (institutional sustainability);*** (2) ***irrigation networks (technical sustainability); (3) agricultural production (economic sustainability); (4)irrigated land ecosystem (ecological sustainability); (5) social and cultural values and traditions linked to the rice cultivation (socio-cultural sustainability; and (6) local natural environment especially the upstream watersheds(environmental sustainability)***

Institutionally or organizationally weak farmer's organization may not be able to properly manage its irrigation network and thus can be easily deteriorated. The same case may happen if the irrigation network was constructed using low quality materials and its design does not fulfill farmers' need and beyond their managerial, technical and financial capability to operate or manage it . In addition, agricultural productivity and consequently the farmers' income may decline. If the farmers are poor due to low agricultural productivity or due to disadvantageous agricultural policy against farmers, the maintenance of the physical system may be neglected resulting in dysfunctional irrigation system. Degradation of local natural environment of irrigation system such as deforestation of the upstream watersheds would certainly threaten the sustainability of irrigated rice culture itself. Irrigated land particularly paddy land is rich of various kind of small species that become source of protein and side income of many farmers. Degraded agro-ecosystem of the irrigated land may destroy biodiversity and reduce to a certain extent the source of farmer's income in particular areas. Besides that, polluted agro-ecosystem due to heavy used of agro-chemicals such as fertilizers, pesticides, etc. could result polluted water and unsafe foods which may endanger physical health of farm families themselves and of

non farm community as well. Finally, the socio-cultural values common to irrigated agriculture particularly paddy culture in many rice producing countries of Asia, seem to play important role in creating unity and harmony and social stability within farm community especially through regular ritual activities. Disharmonious human relation and social instability would inevitably discourage farmers to work cooperatively in system operation and maintenance.

Sustainable irrigated rice culture should not be perceived that the farmer's organizations responsible for managing irrigation water are static or never changing and completely self-sustaining without any external assistance. Government assistance through various agency support services and farmers' welfare-oriented agricultural policy are still important.

Perceiving the sustainability of irrigated rice culture in this way, would make it possible to better understand the tremendously diverse nature of irrigation systems for rice cultivation in a rather holistic perspective so as to be able to formulate more relevant and effective agriculture and irrigation development policy best suited to the conditions of a particular country.

It is necessary to stress here that such concept of sustainable irrigated rice culture as described above may be applicable only to farmer-managed irrigation systems such like subak system in Bali, but might not so relevant for government-managed irrigation systems.

ARGUMENTS FOR PRESERVING IRRIGATED RICE CULTURE

Multi-functionality of Irrigated Agriculture Particularly Irrigated Rice Culture

Irrigated agriculture, irrigated paddy cultivation in particular, possesses multi-functional roles with positive externalities. Irrigated agriculture does not only produce food and fiber but also other intangible "goods" which are quite difficult to quantify or evaluate in economic term. The multi-functional roles of irrigated agriculture are: provision of agricultural production to ensure food security, flood preservation, soil erosion control, groundwater recharge, water purification, air cooling effect, provision of habitat for various tiny living creatures that can create ecological balance or biodiversity preservation, provision of beautiful landscape that can be quite potential for eco-tourism, provision of drinking water for rural people and domesticated animals, provision of additional source of water plant and animal protein, provision of a place for duck raising, provision of a place for religious rituals and rural festivals, usage for water wheel and small-scale hydropower generation (Mizutani, 2002; and Kwun, 2002 and Groendfeldt, 2003).

Suppose the next generation would no longer like to engage in irrigated agriculture particularly rice farming activity, or in other words if they abandon rice culture, what would likely to happen? We can not imagine, how much money we need to combat flood and soil erosion, to purify water, to clean the air and numerous problems that could emerge. Kwun (2002) provide important information on estimates of economic values of several multi-functional benefits of irrigated agriculture in Korea and Japan. For example just for the flood control function of paddy farming it ranges from 16.27 billion to 23.99 billion US dollars in Japan and from 1.11 billion to 1.32 billion US dollars in Korea. Though modern agriculture may also produce negative externalities such like degradation of biodiversity and poisonous foods, it is likely that the economic value of positive externalities might exceed the negative ones. The much lower prices of foods produced by irrigated agriculture particularly the price of rice in many developing countries as compared to non agricultural products clearly does not reflect the multi-functional benefits of rice farming. In the context of multi-functionality, it is not exaggerated to say that the rice farmers deserve to be honored and praised as national heroes in environmental and biodiversity preservation. This is due to the fact that they produce non -market multi-functional benefits but which are reaped and

enjoyed by many other peoples not directly involved in rice farming activities. Accordingly, the water pricing policy may not be fair enough if it is to be applied to water for rice cultivation.

Local Wisdom and Socio-Cultural Values Attached to Irrigated Rice Culture

Another basic reason for preserving irrigated rice culture is due to the fact that local wisdom or indigenous knowledge and socio-cultural values are inherent in rice cultivation. Local wisdom has been employed in irrigated rice cultivation from generation to generation and proven effective and efficient. Rural traditions and various kinds of rituals and festivals associated with rice farming can bring social stability and social harmony. Agronomists and engineers who got training in modern industrialized countries may regard the agricultural and irrigation practices of traditional farmers as primitive and unscientific. However, if studied in depth, it is quite probable that what looks as primitive and unscientific might contain scientific truth. The ancient farmers of Bali for example have cooperatively built rice terraces and irrigation structures like weirs and tunnels of thousands meters long using a very simple tools without any external support. The present generation has inherited those “master pieces” from his ancestor and many of them still functioning well until to day.

Before the advent of Green Revolution, irrigated agriculture in many developing countries were rich in a wide variety of genetic resources. There were numerous local rice varieties. Modern agriculture has replaced local varieties with their associated local wisdom by modern rice variety requiring expensive agro-chemical inputs which in many cases beyond the capacity of the local farmers to purchase them. Moreover, the trade related intellectual property rights recently implemented through international trade arrangement has put the farmers of developing countries into further difficulties. They would not get access to such costly technology crucial to enhance agricultural development in their countries. Modern technology should not completely replace the traditional ones but rather should complement them.

Technical, Managerial and Financial Constraints Faced by Rice Farmers

Many of existing irrigation systems with long history of development is found to be well-managed, though there are ample cases of being poorly- managed. Furthermore, due to natural calamity some of the well-managed systems have become less sustainable. They need external assistance for major repairs in order improve their performance and to remain sustainable (Yoder, 1994). Meanwhile, due to centralized, non participatory and top down approach in irrigation development programs, many of the newly-government built and upgraded irrigation systems have not been so well functioning as intended since they seem to be beyond the technical, managerial, and financial capability of the farmers to operate and maintain them. And as a result, the sustainability of the existing irrigation infrastructures within such government-owned and jointly-managed systems is being threatened (IIMI and WCES, 1987). In addition, many of government-created farmers’ organizations assumed to taking over the operation and maintenance of the systems as implementation of irrigation management transfers were not quite functioning as intended as happened in some countries like Indonesia, Mexico and China (Kloezen and Samad,1994). The reasons of the failure are not clear, but lack of technical, managerial and financial capacity of the farmers may be possible explanation. In case of deep tube well turnover in Indonesia for example, the technology was not quite appropriate since it was too sophisticated for the farmers and required spare parts and specialized tool not available locally. In other words, the systems were far beyond the skill and resources of the farmers to operate and maintain them (Johnson III and Reiss, 1993).

Threats to the Sustainability of Irrigated Rice Culture

There are several conditions or factors that may severely threaten the sustainability of irrigated rice culture namely: *(1)* ***declining interest of rural youth to work as farmers particularly as rice farmers ;(2) declining of irrigated land areas due to the conversion for non agricultural uses; (3) increasing conflict in the use of water resources; (4) deforestation and pollution of irrigation water*** Although these kinds of threats are now being observed in Bali island, these conditions might have also been experienced by many of developing countries.

Generally speaking, in many developing countries, farm income quite often lags behind the income from other sectors of the economy. The economic gap between farmers and non farmers seems to be a common phenomenon in many developing countries. This may be primarily due to small size of landholding, low term of trade for many of farm products relative to non farm consumers' goods, and severe competition with foreign agricultural products penetrating the domestic markets of less developed countries. Wide economic gap between rural and urban seems to be one of the main reasons why farming tends to be no longer quite attractive occupation for the younger generation. Young people tend to move to large cities in attempt to find better and more prestigious jobs. In the near future, rural areas may be occupied mainly by aging population. Thus, as farmers age, farm productivity would decline. This condition could threaten the sustainability of the irrigated rice culture.

Another threat is the rapid conversion of irrigated land including rice land for non agricultural usage in many developing countries. This is due to the population explosion and industrial development programs promoted by government in many developing countries. In Indonesia for example, according to World Bank's estimate, about 40,000 ha of paddy land have been converted to non agricultural uses from1990-1995. And by 2020 according to JICA's estimate it would reach more than 800,000 ha. In Bali alone, since the last 10 years about 1000 hectares of paddy fields have been converted annually to other uses such as for housing, roads, hotels, golf courses and other public utilities. Without irrigated agriculture particularly paddy culture, many of the existing socio-cultural values and traditions may extinct.

The demand for water both in quantity and quality tend to increase in the coming decade. The water will become scarcer and scarcer. Experts said that two-thirds of the world population would suffer from water shortage in the next 20 years. This would imply that the competition in the use of water would become very keen. As a result, water conflict among users would be inevitable. Considering the low bargaining position of farmers in many developing countries, there is a great concern that they would become the loser. If social tension would arise due to water conflict, then farming activities may be disrupted and the farmers might have no incentive and motivation to properly manage their irrigation systems. As a result irrigated rice culture would be threatened.

Sustainability of irrigated rice culture is also threatened because of deforestation has become a common problem in many developing countries at present. The threat also could come from industrial plants emitting poisonous by-products which polluting the water at the river and irrigation canals. In addition, agricultural modernization using high dosage of inorganic inputs such as fertilizers, pesticides, herbicides and so on has produced negative externalities by destroying biodiversity within irrigated land especially paddy- fields ecosystem and at the same time producing contaminated food products and polluted the environment . In some cases, it is reported that rice yield per hectare has been declining rather than increasing due to excessive utilization of inorganic fertilizers.

In the context of the subak systems, such conditions which are now threatening the sustainability of irrigated rice culture in Bali may imply that the spirit of THK needs revitalization and its

implementation should be put into real and concrete action not only symbolically through subak rituals.

RECOMMENDED MEASURES FOR MAINTAINING IRIGATED RICE CULTURE SUSTAINABLE

Several strategic measures are required to keep irrigated rice culture sustainable. The following measures are recommended: ***(1)To limit or minimize the irrigated paddy land conversion to non agricultural purposes; (2) to narrow the socio-economic gap between rural and urban community; (3) to strengthen and empower irrigators' associations (IAs) particularly with respect to their technical, managerial and financial capacities; (4) to reduce water conflict among different sector of water users; (5)) to protect the upstream watershed and irrigation water quality from forest resource degradation and water pollution;***

Minimizing irrigated paddy land conversion may be achieved through the following approaches: (1) careful spatial and land use planning taking the water resource availability into consideration; (2) creation of legal framework prohibiting the use of paddy land within the prescribed zone for non farming activities with strict low enforcement in its implementation.

Narrowing the rural- urban gap can be achieved through: (1) pro- paddy farmers agricultural policy such as price policy and international trade policy that ensure the enhancement of farmers' income and term of trade of farm products; (2) agricultural-based rural industrial development efforts for rural employment and income generation; (3) improvement of rural infrastructures such as rural transportation and communication, education facilities, rural hospital, et cetera. Rural-urban balance may discourage rural youth moving to the cities and keep them to work on farms and thus may reduce urbanization. On the other hand, city dwellers especially those who are already retired from private as well as public sector may be encouraged staying in rural areas.

For ***empowering irrigators' associations (IAs)*** the following methods may be relevant: (1) provision of support services such as agricultural credit, market information, agricultural extension service, and agricultural inputs; (2) provision of training and education to increase farmers' skill skills and knowledge in various fields wherever needed and required by the farmers concerned such as for example the operation and maintenance of irrigation system, financial management, leadership, book keeping, and many others based on real need of the farmers; (3) facilitating and motivating the potential IAs to perform income generating activities beyond irrigation management to enhance financial capacity of the organizations; (4) external support for selected IAs which are badly in need for major rehabilitation of infrastructure due to natural calamity through participatory approach ; (5) government recognition for IAs as legal entity wherever possible so that they can make economic transaction and assess credit from financial institution if they are supposed to take additional income generating activities.

Reducing water conflict can be endeavored through: (1) creating legal frame work for clearly defined water rights for different users; (2) promoting good coordination among existing irrigators' associations both within a single "large-scale" irrigation system and inter-system coordination along the watershed /water basin if it is really required and potential for equitable water allocation and distribution ; (3) mobilizing and organizing dialog among stakeholders particularly water users of different sectors to develop mutual understanding on how to use water as common property for the benefit of community as a whole; and (5) promoting more efficient use of the available water for agriculture, domestic and industry.

To protect upstream watershed and irrigation water quality from further degradation it is important to take the following measures: (1) imposing strict punishment for water polluters and illegal woodcutters in the protected watershed; (2) refusing the issuance of permit for any project investment which from environmental impact assessment criteria is not feasible since the project may potentially pollute natural resources; (3) implementing "polluters pay principle"; (5) strengthening the roles of the existing "community-based" forestry if any; (6) exploring the possibility of transferring government- managed forestry to local communities when ever needed; (7)) reducing the excessive use of chemical farm inputs and application of organic farming.; (8) improving and strengthening inter-agencies coordination in handling water problems.

CLOSING NOTES

THK principle dictates that how important it is for man to live in harmony with one another and with his environment and to be a constant worshipper to The Creator or The Almighty God in order to achieve happiness, peacefulness and prosperity. Subaks as irrigation systems in Bali have applied this principle in their activities related to the management of irrigation water for rice cultivation. However, due to dramatic changes in various aspects of life brought about by the rapid tourism development in Bali, the noble values and spirit of THK seems to be degraded. Thus, THK needs revitalization and its implementation should be put into real action not just symbolically through rituals.

Numerous small scale irrigation systems for rice cultivation are found in many parts of the Southeast Asian countries and they extremely diverse in many aspects. Sustainability of irrigated rice culture should encompass: the technical, institutional, economic, ecological, socio-cultural and environmental sustainability. In this way, it would enable us to: (1) better understand the location specific nature of greatly diverse irrigated rice culture in a rather holistic perspective; and (2) formulate irrigation and rice policy best suited to specific conditions of a given country. This concept of sustainability, however, may be applicable mainly to farmer-managed irrigation systems but might not quite relevant for government-managed systems.

One of the greatest threats to the sustainability of irrigated rice culture is rapid conversion of paddy fields to non agricultural uses. Considering that irrigated agriculture, paddy culture in particular, plays multi-functional roles with positive externalities, irrigated paddy culture should be preserved. Effective and appropriate policy options need to be taken to restrict the changing uses of irrigated paddy fields.

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