UNIVERSITY OF AGDER

A Traditional Irrigation System in Bali; a Study of its Transferability to Flores

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This Master's Thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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Master's Thesis 2011

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Abstract:

This thesis explores the autonomous community driven irrigation system in Bali, Indonesia; called *subak*, and is evaluated in terms of transferability to Flores, Indonesia.
Information from this project may be important in the sense of contributing to an increase of crop production which further can contribute to amplified wealth, achieving sustainable utilization of resources, and development of human resources, if the subak system is successfully transferred and adopted. This illustrates the importance of the project in a developmental perspective.

In order to obtain my results, I used a qualitative method with a comparative project design. I underwent a fieldwork in two different project locations in Flores; Moni and Lembor, were I executed 25 interviews, while using a secondary data analysis method in order to investigate the subak system. Then I analysed and compared both the empiric and the secondary data. As a result of completing the data collection and analysis, I revealed the subak and Florenese irrigation system have common values which might increase the success rate of a cross-cultural system transfer. The shared values are; cooperation, participation, democracy, and faith, and which the thesis advocates are fundamental for optimum and sustainable resource management.

This thesis focuses on how farmers organize the work in their agricultural fields in terms of water user associations (WUAs) and farmer's organizations and report of a cultural tradition for cooperation. It also exposes the declining relevance of traditional agricultural ceremonies and adat (tradition), due to external and internal influences.

Further, the thesis reveals deficiencies in the Florenese irrigation system, how the subak system may inspire a greater efficiency and sustainable utilization of resources, and how the system in terms of cultural knowledge can be transferred to Flores if the process is inclusive and takes into account the recipient's culture and norms.

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Abbreviations and Acronyms:

ADB- Asian Development Bank

BSDP- Bali Sustainable Development Project

CBD- Community-Based Development

CBNRM- Community-Based Natural Resource Management

DANIDA - Danish International Development Agency

IKS- Indigenous Knowledge System

IMT- Irrigation Management Transfer

ISF- Irrigation Service Fee

ITK- Indigenous Technical Knowledge

MFAD- Ministry of Foreign Affairs of Denmark

O&M- Operation and Maintenance

PNPM- National Community Empowerment Program (Pember Dayam)

PIM-Participatory Irrigation Management

R&D- Research and Development

RPJM- Medium-Term Development Program/ Rencana Pembangunan Jangka Menengah

SES-Social-Ecological System

SRI-System of Rice Intensification

TU-Tertiary Unit

UNEP- United Nations Environment Program

USGS- United States Geological Survey

WEPA- Water Environment Partnership in Asia

WUAs- Water User Associations

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1.0 Introduction:

Presentation of the research topic:

This undertaking represents my master's thesis in Development Management, executed spring/fall 2011.

This paper explores the autonomous community driven irrigation system in Bali, Indonesia; called *subak*, and is evaluated in terms of transferability to Flores, Indonesia.
The rationale behind this is that Flores can increase its agricultural productivity through improved organization of irrigation systems, qualities that the subak system seemingly holds. Further, this also implies better, more sustainable management of local natural resources and a subsequent enhancement of rural livelihood. Although the study of the subak system only takes place through literature, I argue that the information selected and presented has good enough quality, relevance, and validity to pose as basis for my arguments.

When evaluating socio-technical systems' transferability into another context, one must look into the diversity of the societal structures of both the "donor" and "recipient", in this case; Bali and Flores (Moni and Lembor). This thesis presents a review of the subak system in terms of the cultural, technical, and religious aspect, and also a presentation of Flores's agricultural traditions with focus on irrigation.

This thesis argues that the subak system is founded on religion and hence will be impossible to transfer in its *entirety* to another cultural context.
Further, the thesis examines the Florenese current irrigation practices and reveals the system's deficiencies. It debates how the subak system can be an inspiration. It considers the technical construction and the social organization of both the subak and Florenese system and looks into the similarities and differences in order to illuminate what the system lacks for sustainable resource utilization. The thesis discusses if the fundamental values and technological construction can be detached from the holism of the subak organization and function in the structures of another setting. In this respect, it is examines the interaction between people and technology, and how the technology can be transferred between different cultures. This requires that one has a nuanced picture of what technology really is, therefore, the thesis looks at the culturally aspect of technology transfer, and discusses the social context of technology.

The thesis also discusses the level of cooperation between the beneficiaries, and analyzes the value of this in relation to the production. In my fieldwork, I focused on how farmers organize the work in the agricultural fields, in terms of water users associations (WUAs) and collaboration between farmers. This, as well as *participation*, are what this thesis will argue are the essentials for optimum and sustainable resource management.

This paper begins by presenting the research questions and objectives, then a descriptive presentation of my study area. This section goes into depth of local agricultural practices and traditions as a detailed presentation of these are central in order to understand the social structure of the local society. As well as having an imperative purpose in the analysis part, it is also out of respect for local traditions and value systems that I choose to embrace this. By including the local's traditions and stories, I not only localize my project, but also the *people* this project is all about.

Next, the paper moves on to a descriptive chapter on irrigation; first irrigation in general terms then specific in relation to the research questions. Subsequently, the thesis proceeds on to the subak irrigation system. This chapter has a theoretical approach; discussing the system's religious, cultural and technical aspects. After that, the thesis will continue on a theoretical line, with the emphasis on transferability of technology, knowledge and idea transfer between cultures, and the theory of irrigation management. Next, the paper will give a full report of the methodical approach in the making of this thesis, followed by empirical chapter where my findings will be presented, discussed and analyzed. Finally, the paper will close with a summary of my key findings and concluding remarks.

Research questions and objectives:

My aim for this thesis is to analyse how the Florenese and the Balinese subak irrigation systems are organised and functions. The main objective is to find out how the subak system can be transferred to Flores in order to enhance agricultural efficiency.

This project is initiated on information concerning poor utilization of both natural- and human resources in the Florenese irrigation systems as a result of deficient organization.

This study will have relevancy in a developmental perspective as it may well contribute to improve ineffective irrigation systems and enhance famers' livelihood. To achieve the needed information, the project will examine these research questions and objectives:

- *What are the current irrigation and agricultural practices in Flores?*

I will study and map the current irrigation systems in Moni and Lembor and find out how they function. In that respect, I will examine the agricultural practices. I want to find out why the systems have a poor utilization of resources. In order to do that, I will analyze the empirical finings to reveal the Florenese system's deficiencies.
Since there is limited information to be found of these practices through literature; first hand research is emphasized.

- *How can the technology of the subak system be transferred to enhance agricultural efficiency in Flores?*

To seek the answer to this question, I will analyze the technical, organizational, and cultural aspect of technology in relation to the donor *and* recipient culture to uncover if the subak system's components are transferable to Flores. I will look into the significance of the Florenese agricultural traditions for an adaptation of a new irrigation system.
I will also look into the development value of a transfer of the subak system to Flores.

2.0 Study Context:

Indonesia:

Picture 1: *Map of Indonesia*. Credit: Bought from istockphoto.com

The Republic of Indonesia is a country in Southeast Asia with an estimated population of about 240, 3 million inhabitants and with a growth rate of 1, 136 % per annum (Bureau of East Asian and Pacific Affairs (EAP), 2011). Indonesia consists of more than 17,500 islands which of 6,000 are inhabited and 1,000 of them are permanently settled (EAP, 2011). The climate is tropical but it is cooler in the highlands. Bahasa Indonesia is the national language; however, local languages are important in many areas (EAP, 2011). There are six religions accepted by the Indonesian state: Islam (86.1%), Protestantism (5.7%), Catholicism (3%), Hinduism (1.8%), Buddhism (about 1%), and Confucianism (< 1%), and even animism is still practiced in some secluded areas (EAP, 2011).

Water and land resources in Indonesia:

In Indonesia, paddy rice accounts for about 11 million ha of the total area (Ministry of Public Works, 1998 *cited in* Suprapto, N.A.), which 3.4 million ha (31 %) land is categorized as *technical irrigation areas*, while 1.12 million ha (10 %) as *semi - technical irrigation areas*,

0.77 million ha (7 %) as *simple irrigation areas*, 2.29 million ha (21 %) as *village irrigation areas*, 1.677 million ha (15 %) as *inland and tidal swamp* and 1.77 million ha (16 %) *rainfed areas* (Suprapto, N.A.). The classification of the areas depends on the sources of water and the provision of irrigation facilities (Suprapto, N.A.). Indonesia also got vast dry land and non-irrigated areas. About 61% of the rice grown in Indonesia is irrigated (6.7 million ha), of which over 80% comprises state-run irrigation systems (Hasan and Mansoer, 2007)

Indonesia got a natural abundance of water with an average annual rainfall of 2 700 mm. but only an average of 10 % penetrates as groundwater, while the remaining flows as runoff or surface water (Suprapto, N.A.).

In order to utilize land resources optimally for more productive agriculture, Suprapto (N.A) argues that Indonesia has to tackle a range of issues. Transformation of productive agricultural areas into critical land, conversion of paddy rice to non- agricultural land and infrastructure development of optimal irrigated area are only three of those problems. The latter, however, is in great interest to my project. Suprapto (N.A) reports "that there is about 6.3 million ha of unproductive agricultural areas because of the unavailability of irrigation infrastructure and facilities". This is a huge barrier for such a large country with so many people to feed.

Despite the tropical humidity and the abundance in rainfall, Indonesia's problems with water resources are still there, and this is mainly due to increasing population growth and water demand (Suprapto, N.A.). According to Suprapto (N.A.), Indonesia's Ministry of Agriculture has resulted that establishing "people oriented, sustainable and decentralized" agribusiness system would be a solution to this problem. A policy presented to resolve problems concerning water resources development is to "increase the efficient use of irrigation water, efficient water use technology and management" and "to empower water users' associations in such ways that eventually autonomous, socio - culturally rooted, and environmentally, oriented are established" (Suprapto, N.A.). This only strengthens my objective with assessing the transferability of a seemingly sustainable, autonomous irrigation system to an area with lack of such.

The fast expansion of inhabitants together with urbanization is creating a dilemma regarding production of enough rice; despite that approximately 70 % of the population is rice-farmers (Gany, 2007). The general issue of Indonesia that hinders the rice production is the small land

ownership per farming household, forcing people to earn additional income in the cities (Gany, 2007). This results in poor maintenance of the agricultural fields. The current annual paddy rice production of Indonesia is estimated to be 50 million tons per year, however to keep up with the population growth, they have to increase their production with 900,000 tons per year (Gany, 2007). It all comes down to the efficiency of the production process, and within; all the aspects that enables such.

Bali:

Bali is an island of the Republic of Indonesia, located south of the equator between Java in the West and Lombok and the rest of the Lesser Sunda Islands in the East, and is fairly small with only 5,632 square kilometres (Baliguide, N.A). Bali is divided into eight districts, whereas each is further divided into sub-district equivalent to a township or city (Mitchell, 1994). The year is divided in a *wet* (October to March) and a *dry* (April to September) season (Mitchell, 1994). In the former, the annual rainfall is 2000-2500 mm annually (Eriksen, 1998; Geertz, 1971). Agriculture, and especially rice crop growing, has been the main economic foundation in Bali, but after the tourist boom and urban growth in the recent past, land areas have been reduced as a result (Mitchell, 1994). While Indonesia is mainly a Muslim country, more than 90% of the Balinese population practices Hinduism (EAP, 2011), or more specific; *Balinese Hindu*. This religious orientation is a merger between Hindu religion and a deep love and respect for nature, and has a fundamental philosophy; *Tri Hita Karna*. This ancient Balinese philosophy refers to three sources of prosperity: the existence of equality, harmony and balance between human beings in relation to their Gods, to other human beings, and to their nature and environment (Nyoma Rudana, 2007 and WEPA, N.A). These values are connected with many of the core ideas related to sustainable development (Mitchell, 1994:193).

Flores:

Figure 1: *Map of Flores Island*. Credit: Lomboksailing.com

Flores is another island of the Republic of Indonesia with 17,164 square kilometres, and is one of the Lesser Sunda Islands in the Nusa Tenggara province (Columbia Encyclopedia, N.A). The island has a population of 1,831,472 (BPS, 2010) and is divided into eight kabupatens (regencies); Manggarai Barat, Manggarai Tengak, Manggarai Timur, Ngada, Nagekeo, Ende, Sikka and Flores Timur (Skogseth, 2010). The population is mainly Roman Catholic (85%) (Skogseth, 2010); those in the West are primarily Malays, while those in the East Papuans (Columbia Encyclopedia, N.A).

Flores has been recognized as one of Indonesia's least developed areas due to its remoteness, long dry season, lack of infrastructure and lack of income-generating opportunities (Binnie & Partners, 1994:1.1). However, the island got fertile soil and available water resources that need to be utilized; about 284 individual watersheds, and if tributaries are counted separately; more than 800 rivers (Binnie & Partners, 1994).

Flores has a tropic climate, however the island lies in the dry zone of Indonesia with long dry-season and short and variable wet-seasons. While the coastal zone has annual rainfall of less than 1000 mm and as long as a nine-month dry-season, the mountainous regions have substantial more rain (Binnie & Partners, 1994). According to the Koppen system, the climate can be classified as *Awaiw*[1];

-With a tropical rainy climate having a dry-season with an average rainfall of less than 60 mm at the driest (Aw)

-Hot summers with temperature more than 22 degrees C in the warmest months (a)

-Isothermal subtypes with annual range of temperature less than 5 degrees C (i)

-A single rainfall maximum (w^1) (Binnie & Partners, 1994:3.1.1).

Due to limited available information regarding the island of Flores itself, I've chosen to use information from an informative tourist site, called the "West-Flores and so much more", found on FloresKomodo.com. This site is developed by the Swisscontact WiSATA project, based on Australian Government; AusAID initiative, and the information seems truthful in every way. According to this site, West-Flores has 116,607 ha with forest and 117,531 ha with grassland as the main vegetation characteristics. 20 % of the land area is irrigated field, dry fields, plantations and mixed gardens (FloresKomodo, 2008). Flores is a volcanic island, which means that it is mainly composed by volcanic materials, and the terrain is rough with many mountains and peaks; three-quarters of the island area has slopes in excess of 40 % (Binnie & Partners, 1994).

Ende and Moni:

The Ende population is approximately 260, 428 (BPS, 2010). The people of Ende are mostly agriculturalist growing maize, rice, vegetables and yams, and irrigated rice was introduced in 1947 (Binnie & Partners, 1994). Inhabitants of Ende have been resistant to recent influences such as Christianity, however Moni, located south in Ende, is mainly Roman Catholic. The southern regions of Ende have some of the most divided and steepest land of the island, which is a challenge for the agriculture as it increases the chance of soil erosion.

Moni is a small village near the Kelimutu Crater Lakes in Ende Region and lies in the hillside in the middle of the island, more accurately; 53km northeast of Ende and 98km west of Maumere (Lonely Planet, 2010). The Ende-Maumere road goes right through Moni, which makes it an easily accessible destination. The climate is cooler and lusher than the lowlands, and due to surrounding rivers, farmers have regular access to water. Small irrigation schemes have been developed here, but there is potential for further development, as my thesis will explain.

Manggarai and Lembor:

The Manggarai Barat regency have a population of 221, 430 (BPS, 2010). Lembor is located in the lowlands of this regency; more accurately at 150 m above sea level (Binnie & Partners, 1994). About half of the inhabitants are Catholic, while the other half are Muslim. The Manggarai language is distinct from and mutually incomprehensible to other Florenese languages (Binnie & Partners, 1994).

In 2004, almost 32 % of the inhabitants in Manggarai were considered poor according to the Indonesian Government (World Bank, 2006). 35 % of all the desas in Lembor are classified as ’needy’ and ’very needy’ in the Master Plan Report anno 1994, and these are mostly remote desas (Binnie & Partners, 1994).

Lembor lies on volcanic alluvial fans, rather than riverine alluvium (Binnie & Partners, 1994:2.1.2). Alluvium is nutritious soil material like volcanic ash, sand, cinders and gravel that are carried by streams and when it is deposited on the stream's flood plain, it is often in the form a fan, hence alluvial fan (Mount Shasta Companion, 2001).

The people of Lembor are agriculturalists cultivating mostly paddy, corn, cassava leafs, candle nut trees, jackfruit and a variety of fruits, such as bananas, mangoes and papayas. Lembor is known for its vast rice fields, and is often referred to as the rice barn of NTT (Muhajir, 2003), and that might be due to the quality of the soil. Lembor has a vertisolic soil, which is to be found on parent materials containing more than 60 % clay (Dr. Pennock and Dr. Anderson, N.A). The vertisolic soils are suitable for irrigation as its ‘heavy’ and retain water.

Social stratification in Florenese culture:

In the Florenese culture, the Musalaki is the chief (*kepala*) of a clan (*suku*) and the one who governs culture (*adat*), and he is also referred to as the *kepala suku* and *kepala adat*. In Lembor, he is not referred to as Musalaki, but the *Tua Golo*; however his responsibilities are the same. He gets legitimate powers from God though ceremonies, and in the Waturaka village, the Musalaki also got the entitlement of *aremoke*. Aremoke is a labor arrangement between the Musalaki and the farmers within his territory that declare that the people have to

work for him once every three to four years. The work revolves mostly on repair and construction of his private houses but also of the common property such as the traditional house. If they do not obey this rule, they must leave the village. The loss of authority of the Musalaki declines from generation to generation, but he possess a large amount of land.

Tuantano is the one who distribute the land, and if there are any issues regarding land, the Tuantano is the one to solve the situation *together with* the Musalaki. The Tuantano and Musalaki have a collaborative relationship, and when land is to be divided; the Musalaki is the one to gather the people, while Tuantano is the one to announce the distribution to the people. He is also in the position to distribute land to the government, if the government ask for it. The land however, is only used in governmental projects that benefit the local farmers. Nowadays, most of the land has been distributed. As in for Lembor; the last piece of land was distributed in 2008, leaving the Tuantano's role only important in terms of resolving land conflicts. His knowledge regarding land rights and who in the village that owns which property has been transferred to him from his ancestors that have also been Tuantanos. In Moni, the Tuantano and the Musalaki is one and the same person.

The *kepala desa* is the leader of a village and the one upholding the dialogue with the government.

3.0 Irrigation:

Introduction:

Irrigation has existed for as long as humans have cultivated the land (USGS, 2011). The Indonesian Government Regulation No. 20/2006 defines irrigation "as the means to provision, regulation and releasing of irrigation water for appropriate support to agricultural implementation" (Gany, 2007:3), or simply; as the supply of water to the soil. Irrigation is the best insurance against drought and about 70 per cent of the global water withdrawal is from irrigation (UNEP, 2007).

"A reliable and suitable irrigation water supply can result in vast improvements in agricultural production and assure the economic vitality of the region" (Walker, 1989). It is not stated as a fact, but some have estimated that as little as 15-20 % of the global sum cultivated area is irrigated (Walker, 1989). Irrigation involves drainage, soil renovation, and erosion control,

and when these aspects are ignored or mistreated, agricultural productivity will decline (Walker, 1989). In agriculture, there are many factors that are significant for productive result, in terms of technology, management, geology and climate.

The future of irrigated agriculture does not look bright due to the inefficient use of water. As much as 40 % of the water used in irrigating agricultural land is wasted at farm level through either deep percolation or surface runoff (Walker, 1989). Even though some of this water will serve as a resource in other contexts, the loss will off course pose as a limitation to the local farmer who is unable to fully utilize the water resources at hand. A more apparent future issue is the increase of alternative demands for water such as urban and industrial needs (Walker, 1989). For these reasons especially, maximizing the efficiency of irrigation is crucial for future agricultural production.

Irrigation in Indonesia:

Indonesia accomplished notable improvement in water resources development within thirty years till 1997 through governmental projects, but the institutional development to sustain this progress got inadequate attention (Gany, 2007). The farmer's role has been ignored through the development process, together with the rehabilitation, routine operation and maintenance of irrigation infrastructures (Gany, 2007).

The Medium-Term Development Plan/ Rencana Pembangunan Jangka Menengah (RPJM) recommend increasing public investment in irrigation infrastructure and management (World Bank, 2006). The maintenance of irrigation systems of at least one-third of the 3 million hectares of government-designed irrigation schemes has been improved twice in the past 25 years (ADB, 2004a *cited in* World Bank, 2006). Indonesia in general suffers from water scarcity which is sensitive to a range of underlying factors such as; the increasing expenditures of developing new water sources, soil degradation in irrigated areas, groundwater depletion, water pollution and the degradation of water-related ecosystems, as well as the wasteful use of existing water supplies (World Bank, 2006:87-88). To embark upon this, a cross-sectoral effort between the concerned line-ministries is needed (World Bank, 2006). However, the RPJM also suggests increased participation by the water users. In recent years, the government has developed a localized water-management model that places WUAs at the centre of decision-making, in close cooperation with local governments. Experience shows that such WUAs are effective in enhancing good water use, leading to

higher productivity (World Bank, 2006). However, as the Master Plan Report of Integrated Water Resources (1994) notes, these organizations are not well developed, and farmers tends to see these associations as another way to get money from them without giving anything back (Binnie & Partners, 1994).

There are many villages that are lacking a WUA, or have one but without fully legalization or operational capacity. As Gany (2007) argues, despite the vast number of WUAs in Indonesia the effectiveness of their operation is quite poor (Gany, 2007:11). This is partly due to the low levels of income to many farmers. Farmers with small land holdings, typically those operating in marginal subsistence farming, are not able to contribute financially or with labor for the operation and maintenance (O&M) of irrigation schemes. One reason for them not to be able to contribute with labor might be due to an additional job for extra income. However the farmer's participation in O&M, or lack thereof, is also due to complicated constrains on socio-cultural and organizational predicaments (Gany, 2007). In addition, securing protection and equity for existing non-formalized customary rights to water resources is a prerequisite to establishing orderly, equitable and transparent processes of water re-allocation in order to meet communities' changing needs. This will require strengthening the nascent basin organizations' approach to water-resource management in order to better manage scarce water resources and to optimize their allocation (Binnie & Partners, 1994).

Irrigation Management in Indonesia:

The maintenance of the irrigation structures in most places in Indonesia are rather poor, due to lack of finances and experienced manpower (Hasan and Mansoer, 2007). As Hasan and Mansoer (2007) argue, the irrigation *technology* (constructional) they use is simple, while the *operation* is not. The process often concerns hundreds of control structures with gates, thousands of hectares with fields, and thousands of farmers with varying need for water at different time (Hasan and Mansoer, 2007). For the operation to go smoothly, the farmers and local community have to agree on a common irrigation structure which requires cooperation, commitment and participation. To increase the production, improved O&M is necessary.

In Indonesia, the government is responsible for the O&M of the primary and secondary irrigation networks, while the farmers, through the WUAs are in charge of the O&M of TUs (Gany, 2007).

The Central Government is responsible for O&M of independent irrigation scheme larger than 3,000 ha; the Provincial Government is responsible for administrating irrigation scheme having independent commanding area between 1,000 and 3,000 ha, while the local government is responsible for managing irrigation schemes having less than 1,000 ha per individual scheme, and the Village Government responsible for development and management, as well as rehabilitation, reconstruction and upgrading of village irrigation scheme (Gany, 2007:3).

The WUA is also responsible for the implementation of tertiary irrigation development and management such as maintaining an effective O&M of the schemes, but also for the authorization for development, utilization, as well as reconstruction, rehabilitation and upgrading of them on the basis of *participatory* approach (Gany, 2007).
"In principle (…) irrigation has to be implemented based on participatory, integrated, transparent, accountable and sustainable principle" (Gany, 2007:4). This approach demands an involvement of the farming community at all levels of the operation.

Irrigation service fee (ISF) is a monetary contribution paid by farmers to finance the O&M of the irrigation networks (Gany, 2007). As Gany (2007) argues, this fee is to encourage the participation of the beneficiaries. However, this water fee has not been implemented within the entire irrigation areas of Indonesia.

Xie (2007) argues that ISF helps the farmer to see that their irrigations systems are functional and productive. Beneficiaries should pay ISF in order to cover O&M costs, as this will help to ensure the sustainability of the irrigation system; however, this has not been implemented in many irrigation projects as governments have failed to raise enough revenues (Xie, 2007). Xie (2007) claims this has led to a weakening of infrastructure and inefficient use of water, which then again leads to a no-achievement of the established project objectives.

Policy changes in Indonesian irrigation system management:

Primarily, irrigation systems in Indonesia were developed by local communities which by diverting water from a river or lake to a field, revolutionized rice cultivation (Pasandaran, 2004). At the end of the 19th century, Dutch colonial rulers implemented irrigation as an important public policy instruments. Reasons for this is due to irrigation systems as effective measurements in draught periods, foreign estate companies leasing land for cultivation, and reducing poverty of the natives in Indonesia (Pasandaran, 2004:83). As a measurement to the latter, a public agency was arranged in response to the implementation of big irrigation schemes in Java (Pasandaran, 2004). This was also the era of centralized management of irrigation development and of rice intensification (Pasandaran, 2004:83).

In the early 1970's, the Government decided to rehabilitate the irrigation systems in reaction to the altered technology of the Green Revolution. The development of uniformed water users' associations was improved using procedures that disregarded the tradition practiced by the local communities (Pasandaran, 2004). This however led to an increase of Governmental involvement and a decrease of the local communities' participation. An important argument that Pasandaran (2004:89) makes is that "there is need to define the acceptable role of both local communities and the government in the whole process of both land and irrigation system development".

The Government of Indonesia reformed the management of irrigation systems in 1999 by making a legal framework to help the local communities to obtain more responsibility in the management of public irrigation systems (Pasandaran, 2004). However, as Pasandaran (2004:89) notes, we have to be aware of the pitfalls form the colonial period when large scale irrigation systems were expanded and the principles used in irrigation management were determined.

Irrigation History of Bali:

During the Dutch colonial rule of Bali (1800-1949), the colonial government found it necessary to define a role for itself with respect to irrigation (Lansing, 2007). They thought they could increase the efficiency of the irrigation scheme, both the managerial work and the engineered system. Efficiency would lead more tax- money to the government, resulting in prosperity of the island.

Lansing (2007:25) informs how an investigator from the Dutch colonial government was set out to examine the economic situation in those areas under direct Dutch government with the purpose to establishing a taxation system. The investigator's report back to the government recommended the colonial rulers to keep out of the irrigation system, as it "functioned very well without direct government control" (Lansing, 2007:28). However, the taxes were raised significantly.

"The Bali Irrigation Project" (1981) was set out to benefit a vast area through a larger number of small-scale irrigation systems, and increase the food production (ADB, 1981). This Green Revolution approach tried to convert subsistence crop to cash crop, which involved the use of chemical pesticides that went against traditional irrigation methods and a disregard of the water temples (Sepe, 2000). The new farming system of the Green Revolution tried to increase the production by growing rice in a continuous production, and not only twice a year which is the traditional Balinese system of crop growing. But the production results were not that great, and areas planted with high yields varieties (genetically improved yield), declined, resulting in farmers leaving this new system for their own traditional (Bardini, 1994). According to the Bali Rice Ecosystem Simulation Model, ecological consequences, such as disruption of the ecosystem as result of heavy use of pesticide and increase in crop intensity, were the main reason for the decrease of rice yields (Kremer 1989 *cited in* Bardini, 1994).

The recognition of community driven irrigation systems was presented by Witzenburg (1936 *cited in* Pasandaran, 2004:84) when he observed that the productivity of the subak system was about 50% higher than the public irrigation system in Java. The reason for this, he stated, was due to the water management in the subak system.

Bali Sustainable Development Project:

Bali Sustainable Development Project (BSDP) was initiated in 1989 as a five year project focused on how to promote economic growth while protect local values, tradition and the environment (Mitchell, 1994). Especially, the project sought to find out which environmental, cultural, social, economic, and institutional stresses that were activated as development activity (Mitchell, 1994).

Mitchell (1994:190) notes that 70% of the Balinese live in villages, and any strategy for sustainable development has to take into consideration of Balinese cultured and conditions at the village level. The project was based on a definition of sustainable development as:

> . . . "The continuity of natural resources (basic life supports), the continuity of cultural resources (from values and legends to ceremonies and structures), and the continuity of production" (BSDP, 1989: 3; BSDP, 1991: 2 *cited in* Mitchell, 1994:190).

Mitchell (1994:207) notes that the comparative analyses of eight villages of Bali in the BSDP showed that the traditional ways of life (culture and traditional governance) based on agriculture, are continuing. The traditionally organization and governing of local villagers is based on cooperation and harmony with the nature and fellowmen, and Mitchell (1994) argues that this provides a solid foundation on which to apply sustainable development ideas. However, the subak system is under substantial pressure, which is mainly due to urbanization.

Bardini (1994) uses a translation method to understand the failure and success of the Revolution in Bali. Translation "is the process that constitutes a sociotechnological network" (Bardini, 1994:153). Bardini (1994) compares the work of J. Stephen Lansing of the sociotechnological subak system with an analysis of the Green Revolution, and argues that the results of the Green Revolution were *socially constructed.*

Lansing (N.A. *cited in* Bardini, 1994) argues that there is no "natural conditions" in the Balinese agricultural system; rather the ecosystem (and nature) is socially constructed representations. Lansing has a special interest in reexamine 'the black box of the Green Revolution package' in view of the social reality of Bali (Bardini, 1994).

Bardini (1994:164) uses a translation method to interpret two different system of knowledge; scientific and indigenous, and argues that "Lansing's model translates the traditional way of thinking so as to make it understandable within the rationality of western science". Bardini (1994) concludes that Lansing's work has an important position in the understanding of the Green Revolution, as it acknowledges the rationality of *indigenous knowledge systems* (IKS). Bardini (1994) further states that Lansing's work during the debate of the Revolution translated the IKS and made it understandable for the experts in westerns science. Lansing actually acted as a translator between different cultures and different systems of knowledge (Bardini, 1994). Bardini (1994:164) underlines the importance of this as he argues that no science has a ""neutral point of view" as long as science is based on human activities"..." we

must therefore study such different rationalities in their own terms, and not select them by comparison with the criteria provided by our rationality".

Irrigation history of Lembor:

According to Thomas Pedo, the Tua Golo of Wol village in Lembor, the *Dalu*, -chief of the villages of Wotong and Bajo, made a statement in front of the government 17th of July 1962 that the Lengkong Lembor area would be government property. These two villages decided jointly that their common land, that wasn't yet divided, should be equally distributed and governed by the government. They wanted the government to implement a more effective irrigation system to empower the farmers, as part of the National Community Empowerment Program (PNPM), *Pember Dayam.* The one who took the initiative to implement the irrigation system through a government program, were the local people who moved to Lengkong Lembor under the government program on transmigration. The irrigation program started in 1962, but was not implemented until late 1982.

The distribution was, in theory, easy to execute; there were 5000 hectare of land to be divided between 5000 farmers through lottery. But some farmers claimed that they were given a poorer area than others, and refused to be part of the program. They thought the whole thing was unfair.

There were 150 workers who dug up the channels leading from the local Sesap River into the rice fields. A team from the government organizes the water, and for this, the farmers have to pay an annual tax (ISF) of 25.000 Rp.

The government tried to conduct a survey first, followed by implementation. In the late 1980's, the government asked people from eight villages to register themselves as projects participants, but some were not interested, so as for now, the irrigation project is ongoing in four different areas;

- Lengkong Lembor
- Watu Lendo
- Poco Koe
- Lengkong Rutang

According to the Master Plan Report of Integrated Water Resources (1994) (Binnie & Partners, 1994), the level of technology of the irrigation network of Lembor is classified as technical; however the condition is *rusak* (bad).

In the 1970s, farmers in Munting Village, Lembor, joined the Green Revolution way of farming (Muhajir, 2003). This area has abundance of water, and can plant rice all through the year. The farmers were introduced to agro-chemicals to enhance the rice production. Later they struggled financially because they had to buy agro-chemicals since they need more chemicals to produce a certain amount of harvest (Muhajir, 2003). The farmers took loans from middlemen and settled up the loans by selling off the yield before it was harvested at a very low price to the middlemen (Muhajir, 2003). As Muhajir (2003) tells that a Czechoslovakian NGO, *Yakines*, introduced the System of Rice Intensification (SRI) in 2004, which is a system that uses less water and inputs (Muhajir, 2003). The farmers stopped using chemical fertilizers, but started to control pests by using gamal (*Glicidia maculata*) leaves, and since they used local inputs, the debts to middlemen were reduced and the yield increased (Muhajir, 2003). Also, the findings of Mr. Muhajir (2003) showed that the farmers started to apprehend the value of working together as more beneficial in terms of burden-and profit-sharing.

Agricultural land use in Flores:

There is not so much information regarding irrigation in Flores. However, we know that irrigated rice was introduced for about 60 years ago (Binnie & Partners, 1994).

The agriculture in West-Flores is divided into two types of crops; subsistence- and cash-crops. Subsistence crops; rice, corn and cassava, are cultivated for the farmers own consumption, while cash-crops; tobacco, cacao, coffee and cashew nuts, are produced for a market in exchange for money (FloresKomodo.com, 2008).

Slash and burn technique is widespread in many developing countries, especially in tropical areas, as an inexpensive resources of clearing forest land for agriculture (Varma, 2003). This method involves cutting vegetation and setting it on fire (Varma, 2003:159). This technique increases soil fertility as it releases nutrients into the soil, however the technique is widely discussed as it endanger biodiversity of the forests where the fire is lit (Varma, 2003). This

method is also used in some parts of Flores, as an ancient form of farming, but is no longer considered economically- nor environmentally sustainable (FloresKomodo.com, 2008). This agricultural practice leads to deforestation and destroys the forest.

Human activity can lead to degradation of land quality (UNEP, 2007). Soil erosion can occur due to poor land management, such as an overuse of fertilizers and pesticides (UNEP, 2007). However, *terracing* is one countermeasure that overcomes the impacts of land degradation (UNEP, 2007) and is practiced in the steep slopes of Flores.

Picture 2: *Terraced rice fields, Flores.* Credit: Bought at istockphoto.com

Nutrition depletion is a decline in the levels of plant nutrition, such as nitrogen, phosphates, potassium, and organic matter (UNEP, 2007). In order to avoid nutrition depletion, farmers add these nutrients in great amounts. However, this creates an imbalance in the ecosystem and in the long run, degradation of soil fertility. When adding for instance nitrogen to the fields, only half of it is consumed by the plants while the rest is leaching into the rivers and

groundwater, contaminating the water (UNEP, 2007). It leads to algal blooms in the water and depletion of oxygen that may cause fish kills (UNEP, 2007). The byproducts of the algal are toxic to animals, but can also be a direct threat to human health as its lower the quality of drinking water.

Irrigation techniques:

There are different types of irrigation techniques, and in this project I am focusing on the subak irrigation system and Florenese irrigation system. Both techniques are referred to as *surface irrigation* which can be classified into four formations; (1) basin irrigation; (2) border irrigation; (3) furrow irrigation; and (4) uncontrolled flooding (Walker, 1989). Within these configurations, both the Florenese and Balinese system have characteristics of basin irrigation which is the most common form of surface irrigation. "If a field is level in all directions, is encompassed by a dyke to prevent runoff, and provides an undirected flow of water onto the field"..." it may be furrowed or corrugated, have raised beds for the benefit of certain crops, but as long as the inflow is undirected and uncontrolled into these field modifications, it remains a basin" (Walker, 1989). However, both have also characteristics of furrow irrigation, where "water is pumped or brought to the fields and is allowed to flow along the ground among the crops" (USGS, 2011). An important notion is how the water flows by the force of gravity, so they are also referred to as gravity-flow systems.

In Indonesia there exist two different community driven irrigation systems. One is the *village community irrigation system*, mainly to be found in the hillside areas, but also in the coastal zones of Java (Pasandaran, 2004). Decision making process is at the tertiary unit (TU) of the public irrigation agency, while the irrigation management is an integral part of the village administration (Pasandaran, 2004). Disregarded the variations in the management due to amongst typographical conditions, we find inherent principles of water allocation whereas the management varies in relation to the access of water. The management array from decentralized when water is in abundance to centralized when water is scarce (Pasandaran, 2004). The irrigation systems where I conducted my research at are village community irrigation systems, while the subak system is an example of *autonomous community driven irrigation system*. The meaning of this will be explained later in the paper.

Limitations:

The majority of irrigation systems in Flores rely on stream flows, however an increasing number are using groundwater (Binnie & Partners, 1994). According to Indonesian law, all natural water resources belongs to the state, however the first priority in the use of water goes to drinking and domestic needs (Binnie & Partners, 1994:5.4.3).

Resources for irrigation in Flores are being developed, as the water use in the current schemes is wasteful and the productivity per unit water is low (Binnie & Partners, 1994). Regarding constraints to irrigation and water availability in Flores, the climate and typography is of importance. Even though the annual rainfall is high, it mostly rains in intense periods in the months of December to April, and the overflow results in floods which over time have paved their way through ravines where the water is difficult to control (Binnie & Partners, 1994). Due to this typography, storage of water by the ravines, such as dams, is expensive as it requires advanced-technology to build such a plant with the need for spillways for sediments that can withhold intense floods (Binnie & Partners, 1994).

4.0 The subak organization:

A subak is an independently, completely autonomous social "irrigation society" (Geertz, 1971). It is a self -contained social organization, with the purpose of irrigating fields, mostly paddy fields. Subaks are individually named units and consists of all the rice terraces irrigated from a single water canal (Geertz, 1971:27). This irrigation system is gravity-fed and flows from mountain lakes and springs (MacRae, 2006:94). One subak organization may cover and area varying from 10 ha (or even smaller) up to 800 ha depending on the topographical conditions (Gany, 2007). As Gany (2007) reports, on the small island of Bali, there are 1,283 independent subak organizations all with distinct irrigation infrastructure, farmers' organizations and regulations.

What is meant by autonomous is that the organization and management of everyday life is *disconnected* from the organization and management of agriculture; though the hamlet and irrigation society are built on similar principles, they are built separately and functions autonomously (Geertz, 1972). Therefore, there is a distinction between the settlement unit,

referred to as *banjar*, and the irrigation unit, the subak. A subak is defined as all the rice terraces irrigated from a single weir and major canal, and all individuals possessing such land are citizens of the subak in the same way as all the people living on the land of a banjar are its citizens (Geertz, 1972).

The subak system is amongst the famous traditional WUAs, which are assemblies of water users cooperating in the management of a water system. These organisations are operating at a limited localised level, and are joint associations of individual water users who wish to carry out water-related activities for their mutual advantage (Carter, 1998). A WUA is basically a participator, bottom-up organisations and may employ management control only if they have been assigned the authority to do so (Carter, 1998).

Picture 3: *Irrigated rice terraced fields in Jatiluwi, Bali.* Credit; Bought from istockphoto.com.

Geertz (1971) argues that subak is a *technological unit*, referring to the dam and channels, a *physical unit* in the landscape, a *social unit* upheld by cooperation, a *religious unit*, as it has its own temple, and a *legal unit* involving laws and regulations written down in a book called "awig-awig". Geertz (1971:28) explains the structure of the subaks as a corporate body, a social system, and a cultivation regime.

The subak is an institution separate from the village as the association consists of all the farmers that acquire water from the same canal (Lansing, 1991). The subak is such an efficient water user association due to the structure between the different above mentioned units.

The engineered structure of the subak system is quite complex, and is not going to be described in detail in this thesis. However, as Geertz (1972) notes, the main characteristic is the one-dam-one-subak relationship. First of all, the subak system does not involve artificial tanks or storage of water, thus is dependent on seasonal flow of water from rivers which varies from wet to dry season (Lansing, 1991). Weirs are located one underneath the other down the canal which brings the water to the subak, often in long tunnels (Geertz, 1972). When the water enters the subak, it is divided by many adjusted bamboo 'tubes' spread around the subak, in a way that what was a single incoming channel is now divided into numerous bamboo veins into the terrace field (Geertz, 1972). A subak includes a main water inlet and a complex system of collectively owned, virilocal, compound units (Tanah Lot, 2010).

This unit of water, the quantity of land it irrigates, the quantity of rice seedlings needed, and the quantity of paddy gathered from it is referred to as one *tenah* (Geertz, 1972). Consequently "the total of tenah in a subak adds up its total water supply, to its total area, to its total rice seed demands, and to its total production- depending upon whether you interpret the tenah in its water, areal, seedling, or rice-harvest meaning" (Geertz, 1972). The number of tenah is arranged by the existing pattern of successive water distribution whose form is determined by the subak as a corporate group; however it will vary between various subaks (Geertz, 1972). The total water supply varies according to ecological factors, as does the size of the tenah in water.

The farmers think of their land property utterly in a tenah term, as it is also the essential unit for subak taxation, agricultural planning, transfer of land, even their rights and obligations within subak are referred to in tenah (Geertz, 1972). However the one thing they do not express in tenah is in voting; each subak member has only one vote regardless of how many tenah they have. This emphasizes the democratic aspect of the subak organization.

The subak council consists of all of the members of the subak, each with an equal vote. The head of the subak is democratically elected by all the subak members. In Tihnigan, where

Geertz (1972) performed his research, the subak head is referred to as the *klian subak*. Beneath him is numerous elected *klian tempek*, and under them again are the water group members called *pekaseh* (Geertz, 1972). The council collects taxes, sets general policy, and employs priests to perform rituals in accordance with the subak temple (Geertz, 1971). The dividing and water allocation is executed in intermediate administrative units called *tempek*, which are territorial in terms of water, permanent and unchaining subvision of the subak (Geertz, 1972). The subak is a knit unit founded on collaboration and palm-leaf constitutions. The council performs the duties of water regulations and irrigations system maintenance. Through the subak organizational structure, the "farmers work to create a fair and equitable level of public welfare" (Bali Discovery Tours, N.A). They learn organizational skills, environmental conservation and how a democratic process works. The structure of the subak work group is highly compound, and functions as the "official arms of the subak" (Geertz, 1971:29).

As noted, the technological structure of the system is complex, but it is at the same time quite fragile. Every farmer in the system depends on the water that travels through many kilometers long and delicate channels and pass neighboring fields. An interruption of the water flow will jeopardize the crop. As the subak system is a gravity-flow system, some very few subaks are located higher up in the river stream, obtaining all of the irrigation water directly from one source, while the neighboring down-stream subaks are dependent on them to release water. This embedded cooperation has to do with the technique of pest controls. The method is coordinated fallow periods, which establishing a further set of constraints for water management (Lansing, 1991:48).

Subaks belonging to separate irrigation systems may synchronize their harvest to reduce pests, but for this to be effective many hundreds of hectares have to be coordinating their practices of water sharing and pests control (Lansing, 1991:48). This is what Lansing (1991) exemplifies as system *of social controls*.

Water temples and agricultural practices:

Temples in Balinese social life are sacred structures which hold different purposes in relation to which part of life they are dedicated to. There are various temples and each of them marks out the borders and emphasizes the meaning of one or another sort of association. For instance

house-yard temples honor ancestors; nation temples respect traditional patterns of political loyalty, and subak temples ensure fertility and good water supply (Geertz, 1972).

Subaks rely on a temple network for guidance, a network which is regulated by priests (Sepe, 2000). These temple systems govern daily activities, farming schedules, and religious ceremonies (Sepe, 2000). The temple networks sustain good harvest by establishing planting schedules that provide enough water for every farmer in the subak system (Lansing, 1991). This reflects the importance of understanding the religious aspect of this organization.

Picture 4: *Pura Ulun Danu Temple (water temple), Bali*. Credit: Bought from istockphoto.com

Regional water temples are the ones who set cropping patterns and irrigation schedules. One water temple includes all farmers from one village, and there is one temple for each subak. Every farmer meets at the water temple, and discusses decisions, rules, laws and regulation concerning planting season etc., but after the meeting, the discussion is carried down to each subak (Lansing, 1991:45). The meetings in the water temples only take place when the planting schedule is to be changed, however the ceremonies are continuous (Lansing, 1991).

The rules regarding planting practices vary from each water temples. During the rainy season, it is common for all of the farmers to plant the same variety of rice at the same time to ensure a crop-free/fallow period (Lansing, 1991:48). In the second planting during the dry season, the crops to be planted are chosen by the water temples. The type of crop is determined in

accordance to the amount of available water, as some plants require more water than others. Rotation of irrigation is also initiated if needed.

Next to every spring connected to the irrigation system, is a holy place. Worshippers of this shrine are all the farmers who use irrigation water from this source (Lansing, 1991). Below the weir is a water temple, symbolized as the "Head of the Rice Terraces" (*Pura Ulun Swi*) with the same congregation as the above shrine (Lansing, 1991). The goddess of this temple is called "Deity of the Ulun Swi temple" (*Ida Bhatara Pura Ulun*). All water temples are located upon the water stream which they claim control over (Lansing, 1991:53).

Lansing (1991) recognizes two aspects of the dependency in the subak system; the association between the water temples, the worshipers, and the ecosystem it represents. The weir is a man-made physical construction in the landscape, and a shared responsibility. The concept of an anthropomorphic weir-god evokes collective social presence which leads to the second type of relationship; the interdependency of temples along the irrigation system (Lansing, 1991). All farmers have their own shrines (*bedugul*) at their field where they give offerings to the Rice Goddess. Up-stream from the farmer's shrines is the subak temple, representing rice terraces with the common water sources (Lansing, 1991:54). Additionally, each lake, have their own shrines or temples. The largest water temple is the temple of the Crater Lake which is the water source for all the subak organizations within its river boundaries (Lansing, 1991).

The religious system of temples is to be found in all subak organizations; however they vary from different locations. There are not just the temples that have an importance in this system; the water itself is holds great meaning. Up-stream and down-stream water possess two different symbolic assets. Up-stream water is the nourishing and life giving water, regarded as a gift from the Goddess of the lake, while downstream water is the cleansing water (Lansing, 1991).

Agama Tirtha is the religion of holy water and central to the subak organization. However, the water's ability to cleans and cause growth is only due to the water being controlled through a socio-technical network. Holy water is not just sacred or a symbol of the up-stream water source, but it is also linked to the concept of hierarchy. Holy water never flow up-stream, in other words; water from lower-ranking temples is never used in rituals in higher-ranking temples.

Agricultural rites:

Agricultural rites within the subak system coordinate many water temples and are performed in form of annual cycles of agricultural offerings, connected with transforming forest into farming areas (Lansing, 1991). As Lansing (1991) notes, it's not the rice plants that are in focus, but also the productive units in the water temple system. In short, water temples starts a new productive cycle every ten years, with the "opening of the waters" (*mapag toyo*) ceremony at the Ulun Swi temple. The rite includes all farmers that are getting water from the same weir, and involves offerings of gifts to the gods. By performing this rite, the farmers acknowledge the collective reliance on their weir (Lansing, 1991). The hierarchic structure of the water temple is intricate, and the structure varies from area to area.

A cultivation cycle in the subak system represents a merger of many individual cycles, which are listed on a common calendar called a *tika*. In other words; all the individual cycles marked on the tika calendar constitutes the subak cycle, and in a similar way, all the subak cycles constitutes the cycles of an Ulun Swi (Lansing, 1991). Presented in this way, the hierarchical order is evident.

The basis for the tika calendar is to synchronize parallel productive cycles which may be of different lengths (Lansing, 1991). By following the tika calendar, many simultaneous cycles can be managed with precision, synchronizing the labors of numerous farmers.

The Temple of the Crater Lake is the supreme water temple in Bali. The goddess of the lake, *Dewi Danu*, has a material spokesperson, called *Jero Gde*, who decides upon water allocation in the name of the goddess (Lansing, 1991:77). The Jero Gde is neither fully human, nor fully divine, but is the origins of society, "the essential mystery of the transformation of nature into humanity" (1991:93). He is at the summit of the water temple system of central Bali.

Farmers in the subak system have to pay a land tax, also referred to as a rice tax, to the sacred ruler each year at the temple festival. The offerings are made to the Goddess at Tampurhyang, if taxes are not paid; the farmers will be cursed (Lansing, 1991). These offerings are called *soewinih*. Lawfully, any disagreements concerning irrigation have to be handled under the jurisdiction of the government office of the sedahan.

The flexibility of the subak system:

After checking with different sources, I find that the rites and customs vary between subaks from different areas, even between subaks within the same area. However, as Barth (1993:68) states, there are similarities as "elaborateness, participation, and presence of idioms paralleling human life cycle rites".

Barth (1993) states a central point when he argues that we have to distinguish between the formal appearance of the subak system and the way it actually functions. As the intention of this project is to evaluate the subak systems developmental value in Florenese agriculture, I have to analyze the subak system with respect to how it functions in productive activities. Barth (1992:75) further notes that:

> "if we choose to exoticize less, and look closely into the particular facts of how any specific irrigation association is constituted and operates, we are able to form a more realistic understanding of the subak as a highly adaptable and functionally variable organization, with a distinctive Balinese stamp but without the uniformity a purely cultural analysis might lead us to imagine".

Barth (1993) argues that the organization is flexible. As I interpret it, an argument of his is not to just look into the cultural aspect of the subak, but also investigate the technological aspect detached from the culture.

The adaptability of the subak system in Luwu, Sulawesi:

An interesting case presented by Roth (2009) gives perspective to this project. Roth (2009) focuses on the relationships mounting between the Balinese subak system which is being reinvented in a migrant setting in Luwu, a large district in South Sulawesi Province, and the state-introduced WUAs of the TUs (Roth, 2009:5). WUAs were implemented in the 1970's to operate and sustain the irrigation system at the level of TUs, pieces of land irrigated from tertiary canals (Roth, 2009:7). Later in 1984, WUAs were made compulsory in all Public Work irrigation system leading to a shared administration, in which the Public Workers kept the responsibility of O&M of the system, while the responsibilities of TUs was transferred to WUAs (Roth, 2009). The decentralization was significant as TU administrated irrigated land belonging to one or more administrative villages, WUAs cuts across village boundaries (Roth, 2009:7). Roth (2009:8) notes that the decentralization of management is founded on a

superficially ideology of ‘community participation’, as the farmers was delegated limited managerial tasks, leaving the leadership of the administrative villages with the main responsibilities.

The Balinese migrants established a subak upon arrival which later was divided into four different subaks as more settlers arrived. Subak regulations were implemented and had similar functions to those subaks in Bali; however the membership of the subak were decided in accordance with pattern of land allocation rather than water flows, which is the local custom in Bali (Roth, 2009).

The subak system is a more autonomous organization relying on the temple network for management, and Roth (2009) stresses that the land distributed to the Balinese immigrants had to be religiously altered into irrigated fields. Balinese custom acknowledges spirits and gods as social partners in irrigation; more precisely one can say that the rice production is cooperation between gods and farmers (Roth, 2009).

When the establishment of WUAs was made obligatory, the subak organization was forced to separate the religious–ritual and management functions (Roth, 2009:11). However, the subak organization continued to have relevance in irrigation and agriculture, *so* much that elements form the subak organization appeared into the WUAs system. This integration later led to a decoration of the TUs and WUAs (Roth, 2009). In the words of Roth (2005 *cited in* Roth, 2009:12): “wherever the Balinese have organized around water management, *subak*-derived arrangements and practices have become the institutional ‘glue’ that keeps the state-imposed WUAs together”.

5.0 Theory; Linking technology and knowledge transfer for development:

In order to study a possible transfer of the subak system to Flores, it is important to have a theoretical foundation to support the analysis on. The theories that I have chosen to explore in relation to my project discusses the transferability of technology and knowledge but also the concepts of indigenous technical knowledge (ITK), community-based development(CBD), and community-based natural resource management(CBNRM). The theories and concepts

presented in this chapter provide insight into the complexity of any transfer of technology and knowledge between cultures.

The chapter begins by examining the nature-culture relationship as the most general basis for evaluation of any socio-technical/socio-ecological system transfers. Then the transferability of technology will be considered where I advocate technology as a social system. Next I explore what technology transfer really entails, emphasizing that the technology to be transferred need to be socially and culturally suitable. This is elaborated in the next section where I discuss the cultural aspect in technology transfer. Then I examine the transfer of knowledge where I again emphasize the importance of focusing on the *social context* of technology. Next is a presentation of the concepts of CBD and CBNRM, before I stress the significance of participatory irrigation management (PIM) as this is helps to create a sense of ownership amongst the farmers, which further is motivating for O&M of the irrigation scheme. Next, I present irrigation management transfer (IMT) where I highlight the value of transition from a centralized to a decentralized management of irrigation systems. This is further accentuated when I discuss common property resource management in the light of Elinor Ostrom's (1990) theories. Finally I discuss the importance of the institutional context for technology transfer and development, were I underline the value of involving the locals in the research and development (R&D) phase of projects.

Theoretical framework:

First, it is necessary to define the distinction between *nature* and *culture*. Nature refers to the ecosystem, while culture to "that complex whole which consists of knowledge, belief forms, art, morality, law and customs as well as all the other skills and habits a person has, that people have acquired as members of a society" (Tylor, 1968 *cited in* Eriksen, 1998:17[own translation]). There is an interaction between ecological (nature) and social (culture) factors; traditional irrigation systems are founded on these relations. When considering such framework, -the division between nature and culture and at the same time the interaction in-between, it is perhaps easy to fall into a mechanical deterministic pitfall and believe that the environment explains the main features of the culture (Eriksen, 1998), however, it is not that simple. But we can say that nature sets limits on human and societal opportunities (Eriksen, 1998). When it comes to the fundamental philosophy of Tri Hita Karna, we get an idea of how important it is for the Balinese to live in harmony with nature, values which according to

Mitchell (1994) lies at the heart of sustainable development. So the distinction between nature-culture (way of life) gets somehow blurred. This concept of the nature-culture relationship has relevance in my project as I evaluate the transfer of a system, based on values, norms, customs attached to one specific location to another.

The *technical* sophistication of traditional farming has been a respected tenet within agricultural development, which is referred to as *indigenous technical knowledge* (ITK) (Groenfeldt, N.A). Indigenous knowledge, in general, can be defined as "the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment" (UNEP, N.A). This definition includes all forms of knowledge that allow the community to function and make a living in their environment (UNEP, N.A). All knowledge is socially constructed, and can only be right or wrong in a particular social context (Winch 1970, *cited in* Eriksen 1998:319). Local knowledge encompasses all the elements of a society, and is a phenomenon to take into account in my project because of this.

Transferability of technology:

Pfaffenberger (1988:236) argues that technology is a *total* social phenomenon; "it is simultaneously material, social and symbolic", and further states that there are two schools of thoughts in Western discourse: technological somnambulism and technological determinism. In a technological somnambulistic view, technology is represented as the cause of social formations, while in a technological deterministic view; history is dictated by a chain of technological events (Pfaffenberger, 1988). In other words; technology determines the structure of society and cultural values.

But as Pfaffenberger (1988) states, technology is a product of human choices and social processes. It transpires when one set of meaning achieves dominance over other ones, and "wins expression in the technical content of the artefact" (Pfaffenberger, 1988:240). He argues that technology should be seen as a system of social behaviors and techniques. However, in Western societies it is viewed as an intangible unit, consisting of tools and products only (Pfaffenberger, 1988). Social relations are not viewed as a part of this entity, which makes it a *fetishised* object. What's missing in a true understanding of technology is the social performance which people employ when they generate or utilize technology (Pfaffenberger, 1988:243). Pfaffenberger (1988) argues that we have to see technology as

humanized nature because it is a social phenomenon. Pfaffenberger (1988:246) refers to gravity-flow irrigation technology as not just a matter of things, but as a system of human social behavior. In this task, technology is defined as "the corpus of culturally transmitted knowledge which is expressed in manufacture and use (Tim Ingold, 1979 *cited in* Eriksen 1998:273[own translation]).

To construct a technology is not just to organize materials and techniques, but it has to be constructed within the social, cultural, political framework that the technology is set to function. As MacKenzie (1987, *cited in* Pfaffenberger, 1988:250), states it, to create a "'successful' technology also requires creating and disseminating the very norms that define it as successful".

This project is looking into the interaction between people and technology; the individuals are acting within the technological constructions of the irrigation systems. The goal of this project is to evaluate the development value of the subak technology's transfer to Flores, and whether it will be able to function within the social reality of Flores.

What is technology transfer?

Green (1999) states that 'technology transfer' is a simple concept, but argues that an encompassing view of all the aspects technology has to be considered in order to obtain a successful technology transfer. The aspects of technology that are important in a transfer process are the *cultural* (including ethical codes, belief in progress, goals), *organizational* (economic and professional activity) and *technical* (knowledge, skills, techniques, tools, resources) (Pacey, 1984 *cited in* Green 1999:1134). Complications can arise if some of these aspects are not well-matched with those of the local arena it is to be transferred to. If there are mismatches between the donor and the receiver's culture, problems occur frequently due to the specific features within the technologies (Aasen et al., 1990 *cited in* Green, 1999). Aasen *et al.* (1990 *cited in* Green, 1999) further states that these features of the technology and the organizational framework within the location where the technology is to be transferred will affect how the technology will be implemented.

In order to achieve a sustainable technology transfer, all the skills and resources necessary in the transfer of a system needs to be provided (Green, 1999). All the steps of a project transfer, as well as all the technological aspects need to be presented to the users and to the

rest of the project members. Education must also be given about the technical aspects of the technology at the different levels of understanding of the user, technicians, and project implementers (Green, 1999). The technology needs to be socially and culturally suitable, since;

> "Socially appropriate technology is that which enhances the quality of life – rather than merely increasing the consumption of goods. It receives cultural acceptance by the community as the technology is assimilated, promotes equal participation by stakeholders and facilitation of the devolution of power to the people rather than its concentration in the hands of the elite" (Green, 1999:1136).

According to Kaplinksy (1990 *cited in* Green, 1999) mechanisms for technology transfer includes the complete purchase of apparatus and know-how, as well as appropriation of technology by achievement of technical knowledge or flow of human resources. Further he argues that the transfer of human knowledge and the purchase of know-how have given higher profits in the transfer of technology than hardware. This links the next section which underlines the importance of cultural aspect of technology.

The cultural aspect in technology transfer:

Cultural aspects are important in transfer of technology between cultures. Culture is the system of shared beliefs and behavior that participants have acquired as member of a community or group (Eriksen, 1998:110). The behavioral aspect within a community or group reflects on its inherent culture which is; rites and rituals (Hussain, 1998). It is therefore evident, Hussain (1998) argues, that the culture of a group either facilitates or hinders the process of technology transfer from external relations. Even though Hussain's (1998) analysis deals with cross-cultural technology transfer between *business organizations*, the models can easily translate to my project.

Two questions raised by Hussain (1998:1191), essential in any cross-cultural technology transfer, are;

- What kind of group/community culture related specifications are essential to achieve success in technology transfer?

- And could these specifications be summed up, compared, modified or blended with those of the donor community?

These questions are important to my project because the social organization within the agricultural setting might differ between the donor and recipient community. Even though the technology transfer will take place within national borders, it will cross cultural barriers. Will the local arena of Flores be receptive to introduction of a 'new' technology? Hussain (1998:1192) argues that the "degree of flexibility in adopting foreign culture organization may well determine the success or failure of the process of technology transfer. Thus the importance of both external and host (local) cultures can be associated with the degree of success in technology transfer". He emphasizes the importance of possessing an understanding of culture in technology transfer.

My project involves an assessment of whether fundamental values and technological construction can be detached from the holism of the subak organization and function in the structures of another setting. I use this approach as the subak system is founded on religion, which reflects in the cultural behavior of rites and rituals, and hence will be impossible to transfer in its *entirety* to another cultural context. However, as technology is a social phenomenon, the technology itself reflects social relations and social performance and cannot be ignored in any cross-cultural technology transfer.

Hussain (1998) presents three categories/models that he relates to his study of the joint ventures of two companies in regard of technology transfer; however I choose to single out the general main outlines:

(1) *Technology transfer in full* refers to a situation where a complete transfer of technology from various countries has taken place (Hussain, 1998). This model is characterized by the process being accomplished with almost total acceptance of the donor's culture, with a minimization of possible conflicts with the local culture (Hussain, 1998).

(2) *Partial technology transfer* refers to situations of partial technology transfer where the transfer has involved components of their culture that are considered essential for successful operation of the joint endeavor (Hussain, 1998). This model is characterized by mutual respect to each other's culture.

(3) *Technology transfer with a minimal impact on the local culture* refers to situations where the technology transfer has been achieved within the limits of local culture and its norms.

Hussain (1998: 1196) further argues that if "an organization is neither conducive to science and technology (S&T) or open to change in work culture, the transfer of technology is certain to be extremely limited or of a short duration only". This theory is applicable to cross-cultural technology transfer between communities or groups as well. If the local community in Moni and Lembor do not want to change their current irrigation practices, it goes without saying that any transfer will be restricted. *Absorption capacity* is a concept that refers to the readiness of a society/ group and how capable it is to be introduced to new technology. For instance, nations with low literacy and thus low levels of S&T literacy does not inherit high enough absorption capacity as well as capabilities to manage with technology transmission (Hussain, 1998). A nation, community, organization, or group has to recognize fusion of cultures and lowering of cultural barriers to facilitate the process of technology transfer (Hussain, 1998:1197).

Knowledge transfer:

As an underlying factor in this project lies cross-cultural sharing of knowledge. The anthropological view on knowledge is that knowledge is culturally relative and does not reflect universal standards, but rather "projects a locally grounded reality that is constructed by a social group (Schweizer 2001 *cited in* Baba, 2003:21).

There are three kinds of knowledge:
Episteme, which is universal and context free knowledge, such as laws of physics. This knowledge is also referred to as declarative or 'know-what'. *Techne* is knowledge that is contextually influenced and generates a product, also known as procedural or 'know-how', while *phronesis* "is knowledge of a specific context that is used to make judgments about what is right in a particular situation from the standpoint of a given set of interests" (Baba, 2003:26), also referred to as evaluation knowledge, or 'know-whether'.
The technical and managerial knowledge within a subak is procedural, 'know-how' knowledge, as this knowledge is not context free. But what happens when the socio-technical subak system crosses a cultural boundary? Even though we are talking about a transfer *within* national boundaries, it is certain that the cultural boundary very much exist. To elaborate

further: technological change often leads to problematic cultural changes. Hughes (1983) argues that technical and cultural development should not be studied as two separate phenomenon with different structures and dynamics, as these processes are continually integrated and woven into each other. In other words; if one of the processes is developed, development of the other will follow. This is what Hughes (1983) refers to as "a seamless web". Development of technology and culture go hand in hand.

When transferring and integrating a technology into different cultural contexts, the process must be considered as dynamic (Levold and Østby, 1993). We have to focus on the social context of technology. Taking the perspective of Pfaffenberger (1988); technology as social performance and a social phenomenon only emphasize the need for a dialectical understanding of the interaction between technology and culture.
Though, it is not just the technology that is to be transferred, managerial knowledge needs to be taken into account as well. The managerial knowledge that the subak system contains is inspiring to less efficient irrigation systems. Development, change and mobilization of human resources will be necessary when changing the organizational structure of irrigation or any organizational structure at all. However, this may challenge existing roles in the recipient's establishment.

Community-based development (CBD):

Community- based development (CBD) "is a form of development that takes place within the community, emphasizes maximum participation of community members in its design and implementation, is ongoing, meets real needs, and is basically self-reliant" (Vail, N.A.). *Civic action* is a key concept in this matter, the ability and willingness to collaborate with other citizens, for the benefit of the common.

Social capital is to be found within social structures and human relations. Magno (2001:265) defines it "as a strategic asset embodied in trust, norms, obligations, and networks that can improve the quality of development outcomes by facilitating coordinated activities". The coordinated activity is resource allocation within the subak system.

Examining the concept a little further, Coleman (2000:98) argues that "in theory of rational action in which each actor has control over certain resources and interests, social capital constitutes a particular kind of resource available to an actor". Coleman (2000) further argues

that this concept entails a variety of different entities which all consists of some aspects of social structures. They facilitates certain actions of actors, whether individuals or group actors, within the structures (Coleman, 2000). Social capital is productive as it enables the achievement of certain objectives that without would not be possible, and information is significant in providing a foundation for this action (Coleman, 2000). "Social relations constitute a form of social capital that provides information that facilitate action" (Coleman, 2000:104): However, individual's actions are shaped, reshaped, and hindered by the social context.

Biological surroundings, such as lack of water or abundance of it, *allow* a particular technology, which in turn necessitates collective organization based on collaboration (Eriksen, 1998: 268). Humans are part of the ecosystem, while at the same time being outside of it (Eriksen, 1998). One can argue that community based irrigation systems are socio-ecological and socio-technical systems, as there is an interaction between social, ecological and technical factors**.** An social-ecological system (SES) is an "ecological system intricately linked with and affected by one or more social systems"(Anderies *et al*, 2004), while a socio-technical system consist of physical arrangements, as well as people and their norms, values, behavioral styles and relationships (Strategos, N.A).

This can be related to how Evans (1996) understands social capital as a "soft technology", which holds the quality of uniting societies to enhance development (Magno, 2001). Even though Evans (1996) only refers to the social system, social capital is a certain *knowledge* which both creates and maintains the structure. As a community based scheme, the subak system is founded on norms and networks that enable collective action (Adams, 2009).

In order to fully comprehend the management of natural resource systems; we have to have a multidimensional perspective, and understand both the natural system- and the human management sphere.

Community-based natural resource management:

According to Ministry of Foreign Affairs of Denmark (MFAD) and Danish International Development Agency (DANIDA) (2007:ii), Community-based natural resource management (CBNRM) has three objectives: poverty reduction, natural resource conservation and good

governance. In this thesis, the concept is focused on how the community is joined for natural resource management.
CBNRM means that "the local populations have a greater interest in the sustainable use of natural resources around them than more centralized or distant government or private management institutions" (Tsing *et al*., 1999, *cited in* Twyman, 2000:323). The beneficiaries get the responsibility of utilization of the local natural resources, i.e., participatory resources management. By transferring a certain level of responsibility to, in this case; the farmers and the surrounding local community, it helps to reinforce their understanding regarding *sensible* recourse utilization.

What is interesting with the subak system is that it has been in operation for a long period of time, hence a *traditional* system. That means that CBD, CBNRM, and O&M haven't been implemented with the intention to fight poverty or function as a natural resource conservation strategy, which so many development projects have embarked on.

Participatory irrigation management (PIM):

In early 1980's the Indonesian Department of Public Works carried out pilot projects to study participation in irrigation (Tobing 1989 *cited in* Bruns, 1993). The idea was that if the farmers could strengthen their sense of ownership, then this would lead to improved development and management of irrigation systems, and it was community organizers that assisted the involvement of farmers in design, construction and management of both small and large irrigation projects (Bruns, 1993).

The many pilot projects and the studies of these led to a government policy to steadily assign all systems irrigating less than 500 hectares to WUAs, and in the beginning of 1987, the Department of Public Works began developing methods for carrying out the turnovers (Bruns, 1993). As result, the government had reassigned more than four hundred irrigation systems to WUAs by the middle of 1991(Bruns, 1993).

A key factor of these projects has been the use of a manager trained and paid by the project to work with farmers and assist them in organizing and taking part in project activities, and most often, this position has been assigned to university graduates (Bruns, 1993). However, when the funding ended, the positions could no longer be upheld, and the solution was to train existing staff, such as irrigation inspectors, and experience showed that this was feasible

(Bruns, 1993). Further, Bruns (1993) findings illustrated that using farmers as organizers seems to have significant potential, but this is dependent on local social conditions. For instance, this organization can generate discouragement to the spirit of local voluntary cooperation if some get paid while others are not (Bruns, 1993). An important factor in the whole participatory management concept is that the organizers need support from people with the necessary knowledge and experience to make this approach sustainable. This is regardless of the organizers being farmers or agency staff, and the support can come from the immediate supervisors of organizers as well as staff with more specialized skills (Bruns, 1993). Farmers have local knowledge about their area, what we refer to as IKT, and "participatory approaches offer an opportunity to combine this farmer knowledge with the technical and financial resources of an irrigation agency" (Bruns, 1993).

In the approach of improving irrigation systems, participation of farmers and organizers is not enough. Innovation in design of structures and channels is also a central factor and can facilitate a development of simpler and more affordable structures by using local materials (Bruns, 1993). This again can help backing up local economy. Involving the farmers in the construction phase is also a good initiative as it can create a sense of ownership; reduce the cost and also improving the value of government investments (Bruns, 1993). Farmers can contribute buy paying a share of the construction cost as this may encourage them to take better care of O&M of the scheme.

Participation in maintenance of the scheme:

Maintenance, repair and improvement face the problem economists refer to as 'moral hazard', meaning that if an object is fully insured, then the owner has less motivation to avoid destruction or loss (Bruns, 1993). Translating this to maintenance of irrigation systems; if the government is responsible for making major repairs and/or rehabilitations, then the farmers will postpone fixing minor defects until they are big enough for being a governmental matter. The principle promulgated in Indonesia is that the farmers should not pay repair cost that are beyond their capacity, but that these should be covered by the government, although there are no apparent criteria for initiating the policy (Bruns, 1993). This means that when the Indonesian government receives repair and cost requests, they have little basis for declining them. Farmers are led to believe that they might receive support, and are thus unenthusiastic

about doing the repairs themselves; and the reality is that they get little response from the government (Bruns, 1993).

However, the problem of moral hazard should not be exaggerated as the slow process of getting the application evaluated at the government, encourage farmers to do the repairs themselves, if possible (Bruns, 1993). Bruns (1993) argues that the risk of losing crop is a strong motivation for farmers to do at least the most urgent maintenance and repairs. Further, if the farmers pay share of the cost, they get a saying in the construction. In other words; cost sharing is an important mechanism for decentralizing decision-making (Bruns, 1993).

Irrigation Management Transfer (IMT):

"Politically and technically, it has now been recognized that unless farmers are involved in operation, management, and maintenance of irrigation system, the objective of increased utilization and production from irrigation commands cannot be realized" (Hamdy, 2007:20).

IMT is the turning over of authority and responsibility of irrigation management from government agencies to WUAs (Hamdy, 2007). This involves a transition from centralized to decentralized management of irrigation systems; from the government authorities to the beneficiaries, which define what the irrigation services will be, as well as the authority to arrange for provision for those services (Hamdy, 2007). The management responsibilities cover the O&M of irrigation infrastructure and in some countries also the determination of irrigation service fees and collection (Xie, 2007). The reason for such a transfer is often in order to reduce public expenditures.

The reasons why irrigation in some location has poor performance, might be due to the under-utilization of irrigation facilities, poor management of the system, the gap between the bureaucracy and the beneficiaries hinders an efficient and responsive management, and inadequate maintenance of infrastructure (Geiger, 1995 *cited in* Hamdy, 2007:23). We have evidence to believe that increased authority and autonomy to the beneficiaries and improved management skills will be a right step towards the streamlining of the irrigation water and subsequent efficiency of production, by looking at the subak system.

Overall, this thesis examines the transfer of a socio-technical and a socio-ecological system between cultures. The subak system has both technological and managerial qualities that can

pose as an inspiration to other irrigation systems. However, in any transfer of such systems, 'the seamless web' (Hughes, 1983) has to be taken into account.

Common property recourse management:

Elinor Ostrom (1990) discusses how managing common pool resources without falling into the pitfalls of the "tragedy of the commons", the theory that enlightens the degradation of the environment to come about whenever many individuals use a scarce resource in common (Buck, N.A.). The main resources discussed in this project are the irrigation water and the soil farmers cultivate their crop from, and both may result in a tragedy of the commons.

Another theory relevant for analyzing my findings is referred to as "the prisoners' dilemma". In short, the theory argues that each actor/farmer benefits from mutual cooperation, but if only one of them choose to cooperate, the deserter will benefit more, while both will lose if both desert (Ostrom, 1990). This theory is underpinning the value of collective action, and further CBNRM.

Picture 5: *Rice Planting, Bali.* Credit: Bought from istockphoto.com

Common pool resources are characterized by a shared use of resources of a group of consumers and by subtractability, meaning that an extraction by one consumer decreases the amount of the resource left for other consumers (Buck, N.A.), and it "refers to a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use" (Ostrom, 1990:30).

Water is a common core resource that requires social organization to distribute. The social organization in the subak system is quite strong an effective, resulting in sustainable utilization of resources. This in turn favours the users of the resources, as they are able to enjoy more of it in both current and future time.

Irrigation canals are *resource systems*, and as Ostrom (1990:30) defines it; as stock variables that are able of producing a maximum amount of flow variables without damaging the stock or the resource system itself. While *resource units*, are what individuals are using from the resource system, and in my project that would translate to the irrigation water.

In managing common resources, the community rules of access and management are required to maintain it, but problems arise when one individual determines to utilize it without contribute to its maintenance, which over time will damage the system (Buck, N.A.). According to literature, two solutions are often presented; centralized governmental regulation or privatization. However, Ostrom (1990) offers a third alternative; the establishment of a cooperative management system, governed by the consumers. Ostrom (1990) denies the benefit of a centralized regulation as the danger of misinformation and miscommunication between the authority and the locals is likely.

The importance of the institutional context for technology development:

Through the last four decades, there have emerged different theories on how to best position science and technology as a driving force of innovation, of which two of them differ noticeably. The earliest view, referred to as the *linear* or *transfer of technology model*, recognize scientific research as the main force of innovation, creating new knowledge and technology that can be transferred to different contexts (Hall *et al*, 2007). While the other, referred to as *the system view* recognizes innovation as an interactive process and "that any innovation requires the putting together and use of complementary pieces of information in ways that respond to local situations and needs" (Hall *et al*, 2007:79).

Innovations are new creations of economic importance; pristine or a combination of old existing elements and can be of assorted kinds, e.g. organizational or technological (Edquist, 1997). Technological innovations are complex due to the appearance and dispersal of knowledge elements as well as the translation process of these into new products or production processes (Edquist, 1997). According to Edquist (1997: xiii), "Innovation

processes are influenced by many factors; they occur in interaction between institutional and organizational elements which together may be called 'systems of innovation'" (Edquist, 1997: xiii).

My project embarks on an analysis of the subak systems transferability to Flores and an assessment of the transfers' developmental value. The research does not involve an innovation per se, but it will involve transfer of system *elements* that will merge with local institutions. Ideally, this in turn will lead to a creation of an innovative system that fit the needs of the local arena, a situation in line with the system paradigm.

According to Hall *et al* (2007), when developing agricultural technology, regardless of the planning employed, it is difficult to achieve success unless the technology users are consulted and involved in the R&D processes from an early phase.

My project is concerned with the evaluation of putting technology and knowledge into use in the recipients' local arena. In my point of view, the most realistic way of achieving a desirable result, which is a successful transfer of system elements from the subak organization, would be to employ a system view and consider innovation as an interactive process. In the process of technology transfer and innovation, local processes of experimentation and learning assume greater importance in the innovation process (Hall *et al*, 2007:78).

Further, institutional contexts, in this case the agricultural society of Flores, are central to innovation process, as they determine the extent to which technology-related innovations result in technological change(Hall *et al*, 2007). In that way, institutional settings decide whether agricultural technology contributes to a development process or not (Hall *et al*, 2007).

Technological alteration changes the natural environment and results in intensified exploitation of the natural resources (Eriksen, 1998:274). As Pfaffenberger (1988 *cited in* Eriksen, 1998) argues, technologies and techniques are cultural products that are integrated into the society's ongoing processes, and therefore cannot be studied apart from the rest of the society. This is underlined in Eriksen's (1998:274) statement; "the techniques shape our relations, but our relations also shape the techniques". What is interesting, Eriksen (1998:276) argues, is not the technology itself, but rather what skills people develop, and for what purposes it is transmitted and institutionalized, and how the distribution of skills is related to the production of cultural meaning and social organization.

When investigating the current irrigation and agricultural practices in Flores, the institutional context must be taken into consideration in order to understand the relationship between the human and natural environment. This interaction is also important to understand the Florenese irrigation system's deficiencies and the importance of agricultural traditions. When assessing any system transfer between cultural boundaries, the system must be adapted in ways that respond to local condition and needs.

We can manage this by viewing technology and technique as a social phenomenon and the social life as a dynamic process. I will close this chapter by citing Geertz (1971:16) to emphasize the importance of analyzing the relationship between human beings and nature, and as I have suggested; viewing it in terms of socio-ecological- and socio-technical systems:

> "It used to be thought that, although environment might shape human life at primitive levels, where men were, it was said, more dependent upon nature, culture-evolutionary advance, especially technical advance, consisted of progressive freeing of man from such conditioning. But the ecological crises has divested us all of that illusion; indeed, it may be that advanced technology ties u in even more closely with the habitat that we both make and inhabit, that having more impact upon it we in turn cause it to have more impact upon us. It is not just the Balinese, looking out at the perfect geometry of their rice terraces, or the Moroccans, looking out at the ad hoc irregularity of their irrigation ditches, but us looking out on nervous, smoky confusion of our streets, who see the image of themselves".

6.0 Method:

Introduction:

In research, the discussion is ongoing regarding which method is the most suitable for which type of research; a qualitative, quantitative, mixed method or action research. There is not a clear answer to this debate; rather each unique researcher has to assess the project and find out which method is the best suited for the specific project. I have resolute that a qualitative method will be the best way for me to use to get answers to my research questions, as a qualitative method is an approach that emphasizes words and thick descriptions of a certain phenomenon, rather than quantification in the collection and analysis of data (Bryman, 2008).

In the connection between theory and the actual research, there are both *epistemological* and *ontological* considerations to relate to. The former philosophical category concerns how we see the world, and how we can achieve knowledge about it (Martinsen, 2000). This orientation has two orders; positivism and *interpretivism*. The latter is relevant to the qualitative method as it concerns with how researcher has to grasp the meaning behind social actions (Bryman, 2008). An ontological orientation referred to as *constructivism*, is significant in qualitative methods, as it emphasizes how social phenomenon's do not exist separately of our interpretation of them, but rather is constantly created and upheld in social relation between individuals. The interpretation or meaning of social phenomena affects social reality (Christou *et al*., 2002). The role of the social scientist in this tradition is to study the social life and interpret in a subjective manner.

In order to explore the subak system, I have used literature that describes what socio-cultural norms and values which constitute its foundation. I have gone through different sources of information, such as books, web sites and articles in order to fully recognize the scheme's function in the community, and to highlight its inspirational characterisations. In addition to this literature research, I have undergone an ethnographic study of the irrigation system at two different locations in Flores; Moni in East and Lembor in West. The fieldwork took place in February 2011.

My most evident concern regarding the use of a qualitative method is the method's characteristic of being subjective. The qualitative method is criticized for being too subjective and impressionistic and that the findings rely too much on the researchers own interpretation and random views about what is considered important and not in the research (Bryman, 2008). It is a fine balance of over- interpretation and understanding the fundamentals and meanings behind the system. The danger is that the researcher gets it all wrong and presents different findings that do not correspond with reality. In Flores, I have tried to see the reality through the eyes of those being studied, and "in order to understand social actions we must grasp the meaning that actors attach to their actions" (Taylor, 1993 *cited in* Bryman, 2008:385). I cannot interpret what my observations separated from the actual reality, but rather look for the 'true meaning'. And it's a fact that this has been difficult, mostly due to different explanations of the same events, tradition, etc.

The research has to be *valid*, meaning that I must make sure that I have examined what I'm supposed to examine, and that it is a good match between theory and empiric observations (Bryman, 2008), and I feel that this has been achieved. However, it is difficult for a qualitative study to meet the criteria for *reliability*, referring to the degree of which a study can be replicated (Bryman, 2008:376). However, a way to ensure the validity of my project has been to get a second opinion of my findings from some of my informants. I have asked them;"have I got it right? / is that what you mean?", and in that way minimized the possibility that their answers have been misunderstood or lost in translation.

In practical research, most researchers find pragmatic ways trough the philosophical/theoretical positions, so we cannot blindly add these theories into our research, but rather find our own path in between and across them, to ensure the utmost reliability and validity (Rye, 2010). The "theoretical categories are a useful guide into practical research as they can help you to get a deeper understanding of what you are dealing with" (Rye, 2010). I found my own way by being spontaneous, outreached, and without any particular knowledge about the areas I underwent my research at. In that way, I found it easy to gather information without being influenced by other researchers' opinions.

Research design: case study with comparative design elements:

Case study as a research method in social science has for a long time been looked down upon as a weaker approach than the others and critics have argued that case studies lack precision (i.e. quantification), objectivity, or rigor (Yin, 2002). However, Yin (2002) begs to differ and argues that the method has been misunderstood and underestimated. Case study is an ideal approach when the focus is on contemporary phenomenon within a real-life context (Yin, 2002). A case study allows the researcher to retain the holistic and meaningful characteristics of real life events (Yin, 2002:2), and in my case, managerial processes and cultural life.

A case study is defined by Stake (1995, *cited in* Bryman, 2008:52) as a research "concerned with the complexity and particular nature of the case in question", it is the construction in which data is collected and analyzed (Bryman, 2008:31). Further, a case study makes it possible to attain many details about the actuality of an organization (Elgsaas Hilstad, 2001:13).

Comparative design is when one is "set out to examine particular issues or phenomena in two or more countries with an intention to compare their manifestations in different socio-cultural settings" (Hantrais, 1996 *cited in* Bryman, 2008:58). I chose this design as I had to examine two different socio-cultural settings in Indonesia, one through literature review only, while the other through observation and interviews. The particular phenomenon that I have examined is the subak system, but also the irrigation system in both Moni and Lembor. Then I have assessed their similarities and differences in order to determine whether the system can be implemented in the socio-cultural setting of Flores.

This project has in a way taken on a *representative* or *typical case study,* as irrigation systems are both a commonplace situation and fundamental arrangement, which are to be found most places on earth. However, the type of arrangement and scale varies relatively. My research approach and objectives has allowed me to experience the local reality in Flores at hand, and by conducting a research through a case study with comparative design elements, I have been able to get close to the objects in its own milieu. However, my research has also a *descriptive* strategy as I am describing the subak system and the agricultural practices in Moni and Lembor.

Methods for data collection:

When I examined the subak system, I used a pure secondary data analysis method, in other words; I used other researchers' data. One reason for this is limited resources and time. However, this is also a strategy to ensure the quality of my own research. Hence the above mentioned barriers and the fact that I'm only a student, I'm not able to produce a data set of comparable quality. Nevertheless, it should be said that the subak system has been researched so much that the system as a research area is close to being saturated. However, analysing its transferability to another specific location will highlight the systems developmental utility. Additionally, this data collection method allowed me to perform a cross-cultural analysis.

Despite these benefits of secondary analysis, there are some limitations by using this data collection method. I have only read my way to knowledge regarding the subak system, and in that way, automatically been distanced from the material. However, I feel that the literature is of good quality, and helps to ensure both the reliability and validity of my research.

I have used both ethnography/participant observation and qualitative interviewing in order to obtain knowledge about the current agricultural practices and irrigation system in Flores as well as the customs within the community. Ethnography/participant is when a researcher is staying for a period of time in a society or organization, and interacts with its members to become familiar with their culture and organization (Bryman, 2008). My stay in the two research areas in Flores was short, but long enough to obtain my goal. I stayed in local guest houses, or 'home- stays' and motels, but was often invited home to the informants, and thus, I gained first hand information from the local arena. Ethnography and participant observation evolves participation in activities, listening to conversations, asking questions at the particular site of relevance, and I did exactly that in Flores, as well as I executed individual interviews.

The interviews were *semi-structured* and *un-structured*, as I then did not constrain the informant's answers. Such interviews aim to gather descriptions of the informant's life, and due to its vague structure they are easier to analyze than open interviews. I conducted interviews with farmers in order to get information that I needed to understand the impacts and relevance of the local irrigation system on the community, but I did also interview some local leaders to get another perspective of the local community, customs and traditions.

Sampling:

I used *probability sampling* to select my informants, in order to keep the sampling error at the lowest. The specific type of probability sampling I used were *simple random sampling*, in that way, each unit of the population had an equal chance of inclusion in the sample (Bryman, 2008:171). In other words, I chose my informants entirely by chance, and I asked them to be interviewed as my project went along. As planned, I conducted 25 interviews which is a proper amount when considering their quality.

Data analysis:

After the data has been collected, the next action is to organization it so that one can extract meaning from it; this is what we call data analysis. Data collected in the field is at first confusing, unstructured, and often of great quantity, and that is why we need to review it frequently and separate the relevant information in order to answer the research questions.

And for this I used a qualitative data analysis strategy/methodology called *Grounded Theory*. This method is defined by Strauss and Corbin (1998 *cited in* Bryman, 2008) as theory that derives from data, and which is systematically gathered and analyzed through a research process. In sum, a grounded theory is "an inductive, comparative, and interactive approach *to* inquiry that offers several open-ended strategies *for* conducting emergent inquiry" (Charmaz, N.A).

Grounded theory is an approach to the generation of theory out of data, where a key indicate is that the data, analysis and eventually theory have a reciprocal relationship (Bryman, 2008:541). By combining grounded theory and case study, I am able to study the phenomenon in a natural setting and generate theories from practice (Hart, 2005). I can also answer the research questions that lead to an understanding of the nature and complexity of the irrigation processes in both Flores and Bali. As strength, the close connection between theory and data makes it more possible for the theory to be further tested and expanded by later studies (Hart, 2005).

The field data that I collected in Flores was structured and transcribed after each day in the field. Afterwards, I went through the data numerous times and coded it to extort repeating answers. Coding is the main process in grounded theory, and involves breaking down the raw data into smaller elements and then labelling them. I reviewed the data many times and categorized the respondent's answers with codes. For instance, 'resources' is a repeated code. After the coding, I went through the answers again, compared the responses and highlighted general findings. I compared the codes, the respondents' stories and statements. The code 'resources' evolved for instance to 'lack of human resources' and 'abundance in water'.

Challenges encountered in the field:

A challenge I faced in the field was the difficulty of translating and interpreting between cultures. The *Sapir-Whorf hypothesis*, a relativistic theory, argues that there is an intimate connection between the language's categories structure, and the way people are able to experience the world (Eriksen, 1998:14). It argues that people will develop linguistic tools to solve problems; therefore, other language will give us much information about how they think (Eriksen, 1998:314). However, this gives us a translational problem; is it possible to describe other cultures in another language than their own? (Eriksen, 1998:314)

The verbal communication is an important thing to consider when performing research. The questions in the interview guide were in English, but it was necessary to use an interpreter as most of them did not understand the language. I felt prepared for the issues of illiteracy and language barrier; however the latter was still prominent with one of the translators. Her English skills were sub-par, and as a result, the interviews took lasted longer. However, I was thorough with checking the answers by asking them the same questions several times through the interview.

Another challenge was to get foothold in the local communities as I visited them for a relative short period of time. The respondents met me with various interest and manners, but mostly they were accommodating. I tackled it by respecting their customs, such as going to church on Sundays, bringing small gifts to interviews (mostly cigarettes and biscuits), learning phrases in local language, and dressing properly.

However, I got frustrated when I experienced having to pay money for information. This only occurred once, and that was when I met with the Musalaki of Koanara Village in Moni. In a way I felt extorted but on the other hand I went along with it as I really needed the information. The interview lasted for hours, so in the end I felt it was worth it.

7.0 Findings and Analysis:

Introduction:

"It must always be an interaction between our general hypotheses and theories on the one hand, and the world as we perceive it through fieldwork, on the other" (Eriksen, 1998:36[own translation]). Including details in the empirical data obtained in the field helps giving a full description of the informants' culture and society, but we must also be able to view the details in a comprehensive context in order to compare the data with the theory to present patterns and regularities (Eriksen, 1998). The relationship between theory and empirical data is essential in all empirical science, and this section includes detailed empirical information which is aligned with the theory presented earlier in this thesis.

As stated in the research questions and objectives, my aims for this study are to map the current irrigation practices in Moni and Lembor, uncover their deficiencies, explore the significance of the agricultural traditions and finally analyze how the technology of the subak

system can be transferred to enhance agricultural efficiency in Flores. This chapter presents my findings during my fieldwork executed in February 2011, includes an analysis of the irrigation organization in Moni and Lembor, and discusses the transfer of the subak system in relation to my findings. Finally, the chapter draws the link between a traditional agricultural practices and development.

The current irrigation system in Lembor and Moni:

In Lembor and Moni we find two constructional differences in the village community irrigation system; the *manual*, which are water channels made from mud, and *permanent* channels which are made from cement. The locals refer to this as two *different* systems; however, the manual and permanent distinguish only in building material. The structure is roughly the same; however the permanent allows a more efficient utilization of the water. In the manual systems, the water easily infiltrates into the ground, while this do not occur in the permanent.

Research area nr 1; Lembor:

Current irrigation practices in Lembor:

I conducted interviews in four villages in Lembor area; Wae Nakeng, Bel 1, Wol, and Watu Lendo. Since these villages are fairly close to one another, the farming practices are basically the same; however Watu Lendo stands out with its enhanced organization.

In Lembor, the fields with the governmental implemented permanent systems have larger water ‘containers’ were the water from the main sources; the river Sesap and Sele Raho, first pass before it is divided into permanent channels. From every permanent channel leading from the containers, there are water gates which are used to control the water flow going into the different fields, however, the channels leading into the farmers’ fields are manual.

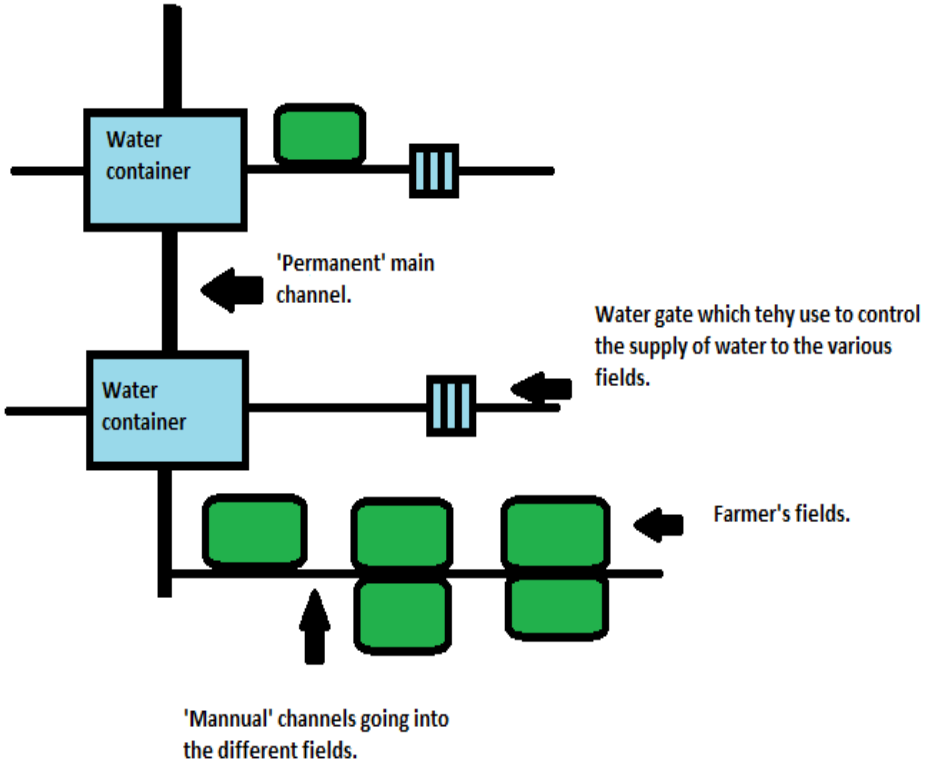

Figure 2: *The technical irrigation model in Lembor*. Credit: Private.

Picture 6: *The manual channels going in to the different fields in Lembor*. Credit: Private.

Picture 7: *Watergates in Lembor*. Credit: Private.

The majority of villages in this area have partly permanent irrigation system provided by governmental program, except from one. The fields in Wol village do not have any irrigation system at all, and the farmers here just wait for the rain to water their fields. According to my interviewees, the climate in this area is unstable; which means that they have to plant whenever they are able to, making it impossible for them to follow a fixed agricultural calendar. As a solution, they cultivate crop suitable for drier soil, and the village is covered with what is referred to as 'dry-fields'.

The agricultural practices in Lembor:

The agricultural calendar:

Most of the farmers in Lembor do not follow an agricultural calendar. Some of them claim that this is due to the abundance of water, while other blames lack of governmental involvement. – They argue that the government has 'forgotten' them, resulting in people planting and harvesting according to their own will. A common practice is that they usually

prepare the fields in August and plant in October, as the rainy season normally starts in October. If the rain does not com, they will not plant their rice. If the rain continues, usually they will harvest 3-4 months after planting. Generally, most farmers in this area claim that they have easy access to irrigation water, and they feel that they have to make the most of this advantage. As a result, many farmers double the recommended two-times-a year-planting.

According to tradition, the Tua Golo is the one to announce when it is time to plant and harvest; however most farmers do not follow his organization of agricultural schedule, but rather decides for themselves. They will not get a fine by ignoring his recommendations; rather take the risk of' being on their own'. A few I interviewed stated that farmers who are not following the Tua Golo, gets lower yields.

Unlike the rest of Lembor, all farmers in Watu Lendo village follow an agricultural calendar given by the agricultural department, and plant only two times a year. For the planting of paddy rice, they prepare their fields between November and January, plant the rice seeds, and waits about four months before harvesting. The Tua Golo does not have any influence in the agricultural practices. However, it is not only that they systematically stick to an agricultural calendar that makes them contrasting to the rest of villages in Lembor, they are organized into a type of WUA referred to as GP3A.

Water user association (WUA): GP3A

GP3A is an organization of farmers, made by the farmers as an incentive to create empowerment for farmers. This WUA is formed of water users only, and founded on democratic principles as well as the morality of 'Gotong Royong'; working together and helping each other out. The idea is to increase the welfare of the farmers and their families and execute a sustainable agricultural practice.

In this village, the GP3A is in charge of the water distribution and ensure that all farmers follow the agricultural calendar. After each harvest, the GP3A board and the rest of the water users holds a meeting were they democratically discusses everything concerning agriculture and irrigation. They review regulations, such as when to prepare the fields, plant, harvest, when to leave the fields to rest, as well as how much irrigation water each farmer will be given in accordance to the size of their field. As this is a democratic association of water

users, each famer's voice will be taken into consideration and further discussed jointly. Farmers themselves argue that this can be an excellent forum to resolve any conflicts between farmers.

In order to legally establish a GP3A, the group must be registered with a full members' list, specify the names of those in the board, including a chairman at the local District Court. The members have to pay a minor fee which helps finance construction cost of the irrigation system (ISF). To obtain monetary support from the government, the group gathers to compose an application where they stress the monetary amount needed for repair of the schemes.

They use the agricultural calendar as the age of mature rice is 130 days. One cannot plant more than 2 times a year if one will reap fully grown rice. After harvesting, they leave their fields to rest in order to maintain its nutrition. As a result; this village harvest more yield than the surrounding villages in Lembor area. The farmers within this WUA are well informed and know the danger of planting more than two times a year. One of my interviewees told me, and I quote; "to cultivate 3-4 times a year is expensive as you need costly chemicals to do so, you need to rent labor and in the end you wind up with lower yields and income. I cannot see the logic of this practice".

This WUA also involves a farmer's organization that makes organic fertilizer, trained by and in collaboration with the Czechoslovakian NGO; Yakines. This home-made organic fertilizer results in an improved rice quality, which means that it can be stored longer. As these farmers are organized into a legal and democratic entity, in control of the irrigation management, and contributing to the construction fees, in theory this would strengthen their sense of ownership, which further would lead to improved development and management of the irrigation system. And my findings support that. When I talked to the farmers, a striking notion was how enthusiastic they were to this association and its results. A farmer from this village told me that the crop is giving him a secure income, and that was because he showed responsibility for his own work and at the same time acting collectively. Further he argued that they benefit from cooperating as they learn from each other and help each other out in the field (the Gotong Royong system). The farmers from this village could not understand why the other villages did not follow their example.

Pemberdayam (PNPM):

All the irrigated fields in Lembor are a part of a governmental program referred to as "National Community Empowerment Program" (PNPM) or *Pemberdayaan* (empowerment) as they call it in local lingo. The rationale behind this program is to empower the local farmers and reduce poverty, and it is advocated under the slogan; "empowerment for people!" Encouraging participation and innovation, the management of development decision activities take place without governmental interference (Ganie-Rochman, 2010). However, the project is financed by the government and that includes the administrative management facilitators from the local to the national levels (Ganie-Rochman, 2010). The project is not flawless. Generally, apart from the unavailability of a reliable facilitator, the program itself do not seem prepared to take into account the character of local communities in decision making "democracy", as most of the people at the local level before the PNPM program was initiated did not have much experience in collective decision-making activities (Ganie-Rochman, 2010). My findings verify this statement.

The farmers gather in meetings called "Kelompok Tani" (farmers' meetings) to collectively discuss any issue concerning the farming practices as well as the organization, but this discussion forum does not lead to much progress. One informant from Bel 1 was honest and said; "we complain allot, but we do not report to the government". The farmers cannot expect any change if they do not take action. However, this is not a general attitude amongst the farmers groups. The other I interviewed brings the meeting to village level and includes the Kepala Desa; together they formulate applications which they hand over to the government. But the process is slow and most often they do not receive the funding needed to repair the resource systems. Some even feel cheated by the government, and claim that the government has given them a system without provide any further knowledge about it. The government is not involving themselves enough, and one argue; "how can we improve the system ourselves, when we can't even read?"

In Lembor, team of farmers chosen by the government is in charge of distributing the water in the various fields, but only in the dry season when the water is scares. The team is using a schedule with the aim of justifying the distribution of water and to prevent any conflicts between the farmers. According to the ones I talked to, the *division* of water is equal, however the channels itself is leaking and reducing the amount of water to the fields in the periphery. The government project has supported the farmers with permanent irrigation channels, but

only the main channels that surround the fields. The smaller one protruding from them are made of mud. Due to landslides in the fields during the rainy season, the manual channels fall apart and hinders the water from running freely. Some farmers even told me that the ones receiving less water have to stay awake at night in order to get hold of enough water, as some farmers are 'steeling' it.

Adat and ceremonies:

Agricultural ceremonies are a part of the agricultural practices.
Thabar is the ceremony some farmers take part of before harvesting. The Thabar is an offering of a pig, a goat and a chicken to their ancestors, their God, and spirits. They offer to their ancestors as they were the ones who gave the land to the people, they offer to their God as he was the one that created the land, and they offer to the spirits as they are the one who protects the land.

In Lembor some territories have what is known as *spider-web rice fields*, called *Lingko* in mother tongue and symbolize unity of the Manggarai people and is a characteristic of their culture. One informant told me that "we are different, but united and the Lingko illustrates this". Whole of the field is shaped like a circle and divided into smaller triangular. One farmer is the owner of one triangular.

Picture 8: *A spider-web rice field in Lembor*. Credit: Private.

During the harvesting, there are two kinds of Thabar; one *general* and one *special* ceremony. The general Thabar is performed by the Tua Golo at the center of the field, in *Lodok* and is a ceremony that includes the whole community, while the special ceremony is performed privately by the owner of each field.

During both the general and special ritual, they put betelnut mixed with cocked egg together with a chicken heart on a *sangkar*, which is a sacred altar. Then they have to get an ear of a pig, an ear of a goat and a wings from å chicken and place it together with the other offerings on the sangkar. They do not know why they use these specific items as offerings, only that their ancestors have done it trough all times.

Due to the irregularity of the planting and harvesting, when and if they perform this ceremony varies. The farmers, who do perform this ritual, do it because they believe it increases the harvest, and that it will disappear or decrease if they do not. If they leave out the ritual, the spirits will no longer guard the crop. However not all informants that I talked to believed it had any effect. Some claimed it is pointless and a waste of resources.

They also have a cleansing of the field ceremony they perform before planting, called *Dhara Wini*. This ceremony is a way of asking the spirits for permission to use the land, and if they do not perform it, they believe accidents within the field will occur due to the spirit's wrath.

Randang is a ritual that is performed to pay respect to the spirits and ask for their protection for the plant growing within the field and also for the people working there.

Usually the Tuantano is approached by spirits in his dreams, asking him to performer the ritual of cleansing and approval. They will ask him to prepare a buffalo to be slaughtered in the field. This will protect the harvest and make sure it will be good. If they do not perform the ritual, their harvest will be poor and the people working inside the land might be exposed to accidents. This can be sudden deaths, illness etc. that standard educated doctors cannot determine the cause of or heal. In order to get well, they have to go to a traditional healer. However, this is a one-time ritual; if the field has been 'approved' once, even though for 100 years ago, the field will remain approved.

Not all are performing the rituals; it depends on ones belief and resources. The importance of these ceremonies have become less significant with time, both due to new the generations and their lack of interest to keep them 'alive', a natural evolution in a modern time, and a stronger

emphasis on Catholic religious beliefs. One even told me that "the ceremonies are expensive, so I don't perform them anymore, and it is better not make the spirits proud and demanding!"

Land rights:

Most of the farmers in Lembor have their own land which is either given to them from the Tuantana or inherited from their ancestors. The ones who have privately owned land (*hak kepunyaan pribadi)* are able to sell it if they like but it depends on their needs. However, generally the land is not sold as they think the land should stay within the family. If they want to sell it, they have to inform the Kepala Desa and the process has to be witnessed by the Tuantano and Tua Golo. Also, all the three characters will receive a share of the profit. The information regarding how much the Tuantano and Tua Golo receive was vague, but the Kepala Desa gets 10% of what the land is sold for. They have this arrangement as they once received the land for free as insurance for the future of the generation, which is why they have to pay some back now if they sell it. It's almost like a fine. They can freely distribute the land within the family, and as the Tua Golo in Wol Village told me, farmers may avoid the fee when selling land to non-relatives if they approach him in a polite manner, and in Florenese culture, that is equal to bringing cigarettes. For some, this arrangement is a bit too unstructured, and a farmer said "the regulation is good, but not the implementation".

Research area nr 2; Moni:

In this section, I have dedicated a significant amount of pages for a descriptive presentation of Moni's history and agricultural practices. Both history and traditional (agricultural) practises can help give an understanding of the human behavior. Despite that this is a matter of history and ceremonies that are no longer executed to the same extent as before; they apply guidelines with respect to norms and values, for present interaction and social organization. On this basis, I argue that it is important information to include, especially considering that the ceremonies and rituals reflects the social organization of a society and groups. And it does not impair their impact that the traditional practices are not practiced today, as cultural guidelines take a long time to change (Eriksen, 1998). In addition to supplementing important information in the context of technology transfer, this bit of history helps to localize my

project. However, it is important to emphasize that this information is not necessarily *facts* as it is based on orally transmitted legends and stories.

The history of Moni:

Long ago, people emigrated to Moni from the *Mojopahit* kingdom of Java, before that; no humans inhabited this area [*to'o sai liru lera mesi deso*]. People left Java to escape Islam, as Mojopahit was influenced by the Muslim *Sriwijaya* Empire. The tale says that only eight people emigrated from Java to the Kelimutu District. The one who told me this story was the Musalaki of the Koanara Village in Moni, and according to him, the people bear great respect and pride by keeping the history alive, and that it is quite important to include the details.

The emigrants stopped in Mbuli Watusobo beach as their boat foundered, forcing them to continue on foot to Wakuleu. From there, they parted and went in pair their separate way; two people went to Ndor*i*, 2 people went to Nggela, 2 people went to Roga Sokoria, and the remaining two brothers, the protagonist of this story, *Rongge and Ranggo,* went to the north through the village of Ratembue. Their travel continues through the North Wolomoni and then down to *Woloara* Village, called in mother tongue; "*Moni gole kolo so, Moni dhana tiwu Bata*". In Wolowaru, Rongge and Ranggo met an unusual woman named Moni which had the ability to separate her soul from her physical body. In mother tongue she was referred to as; *Ae lako Sekke'a ae Wowi sekke'a,* and Moni got the area named up after her, which formerly was called *Moni Kekere.*

After a while, they went jointly down to Woloara to work as farmers. All three spent much time together and established a good relationship, but eventually, both Rongge and Ranggo fell in love with Moni. However, the story says that she was only in love with Rongge (the youngest), something that was unavoidably frustrating for Ranggo.

In three days, a flood ravaged the area of Moni, and Ranggo did his best to win Moni from his brother, something which their tradition forbids. The flood separated Ranggo from Rongge and Moni who stayed in their field in Worogheta, and due to strong currents, they were unable to go to Moni Worolau and Ranggo. They stayed in Moni Worogheta for three nights before Ranggo called Rongge and Moni, and he shouted over the stream;

"Ooo Rongge, datang ke sini segera Karena Ini Akan Gelap"; which means:

"Ooo Rongge, come here because soon it will be dark".

Ranggo tried to call them 3 times,

Rongge answered: "*Ooo Ranggo saya, saya sudah memotong bambu untuk membuat rakit, tetapi saat ini terlalu kuat",* meaning; "Ooo my Ranggo, I have cut some bamboo to make a raft, but the current is too strong".

Ranggo was afraid that something bad would happen to his younger brother Rongge, so he screamed and ordered him:

"Ooo Rongge, jangan lupa segala sesuatu yang saya telah mengatakan kepada Anda, dalam pilar utama dari rumah!"

Meaning; "Ooo Rongge, don't forget everything that I have told you; in the main pillar of the house!"

Ranggo as the eldest brother transferred his power to his youngest brother Rongge and enabled him to perform the traditional ceremonies in the village, such as agriculture ceremony in Worogheta. He gained his brothers authority, but only within the specific area of Worogheta. However, Ranggo still possesses the authority in Moni Worolau.

Moni nowadays consists of two villages:

1. Moni Worolau(Woloara)
2. Moni Worogheta (Koanara)

In the period of Wangge Elu (the 13th offspring of Rongge) the area of Moni was enlarged, as a result of the wining the war with their neighbouring area.

Those who are called 'Moni people' include people from N'duaria, Moni Kuru, Nuamuri, Koanara, Woloara and Waturaka.

For long, the lifestyle of the Moni people has been influenced by what their ancestor believed in. This is a spiritual form of worship which stresses the authority of deceased relatives on their way of life. In recent times, intern conflict has somehow shattered this concept and many natives have left it. Another reason for this change is external influences such as technology which not corresponds with their attitude and behaviour inherited from their ancestor. However, many values are still preserved, but the majority of them are changed. The

transformation has made it hard to differ between the values that are traditional and those that are not. And amongst the young people of Moni, the tradition tends to be an unfamiliar thing since their motivation to grasp and preserve their inherited culture seems to have lost its purpose in modern time.

The agricultural practices in Moni:

To understand the significance of the agricultural traditions, as an important aspect to consider when evaluating the adaption of a new irrigation system, this section presents the agricultural ceremonies in Moni. However, it is important to state that the only one that claims that these ceremonies are still being practiced is the Musalaki of Koanara village. The other farmers I interviewed informed that they have abandoned them as a result of a new generation that have little knowledge about them as well as little interest in practicing them. My informants further explained to me that the main reason is a dispute that has been going on for a while between two Musalaki's in neighboring villages, which has resulted in a *prohibition* of performing the agricultural ceremonies. The story goes like this;

In this region it is a tradition to respect your ancestors with the offering of a pig in situations of misbehaviour. A few years back the main Musalaki acted up, but did not bother to offer a pig to his ancestors to show regret and respect. This action spread a sort of distrust amongst the village people to adat and the Musalaki order. But my informant states that the problem really started a generation ago when a Musalaki who had no sons, asked the second Musalaki's slave to become the new Musalaki. The second Musalaki became very angry with him for making such a foolish choice of a Musalaki, and since he had chosen a servant rather than him. The second Musalaki then went to the farmers and told them that they did not have to bother with following any commands from the new Musalaki, and that they were free to choose for themselves when to plant, harvest, etc. This new 'rule' later became applicable for whole of Kelimutu District.

When I confronted the farmers that I interviewed after being aware of this, they could confirm the argument, but hesitated to speak up about it. Even though the Musalakis' powers have been reduced over time, he is still to be respected.

The agricultural calendar:

The majority of farmers in Moni do not follow a set agricultural calendar, but predict the weather to decide when it is time to plant and harvest. Usually, they join each other's production cycle, especially if they grow the same crop, as this provides safety in the ability to consult with each other. As the history of Moni tells, the Musalaki used to be the one to decide when to plant and harvest the crop, but due to the dispute and a natural development towards modernization, his role in agriculture has been weakened. Some farmers have stopped using the calendar as they claim it is inefficient because of all the rules and argues that they encompass more freedom without having to perform the agricultural ceremonies. However, this is a perception that not all farmers share. A few claim that adat is important to agriculture in the sense of providing greater amount of crop, and the abandonment has lead to a decrease in production. The ones that share this view whish for adat to again be a part of the agricultural system.

The following section presents the original agricultural calendar; the one that The Koanara Musalaki still claims is in use. The list includes an overview for when the agricultural ceremonies apparently are to be performed:

- ***Dusoko-Jengi jebu***, last from September until October, and the purpose are to burn the land and prepare for planting.
- ***Oro Te'u and Po'o Te'u***, October: the purpose of this ceremony is to chase away mice from the houses and the agricultural fields.
- ***Loa Telo-Pole moge***, October: this ceremony is to determine when it is time to collect the rice seeds.
- ***Kede wini***: its purpose is to prepare the plants.
- ***Paki Kolu***: a symbolic first-planting of the seeds performed by the Musalaki
- ***Woge Moka***: to prevent the plant getting attacked by diseases.
- ***Wula more***, November: no agricultural practices.
- ***Wula Ndru***: December: no agricultural practices.

- January and February: According to my informant, at this time of the year there are no religious ceremonies due to the shortage of food. January is the worst month; referred to as *Wula beka Ria*, the 'big famine', while February is called *Wula beka lo'o*, the 'small famine'. After the harvest of corn and some other vegetables, the farmers spend their time weeding their fields and gardens.

- ***Wula Fowo,*** March: *Fowo* means odor. Due to continuing rain the compost and garbage leave an unpleasant fowo.

- ***Wula balu Rae,*** April: This month the people of Moni believe that great evil is lurking around and causing illness amongst the people. My informant puts it this way; "it is little hope for life at this time". The people have 'the disease', and depend their lives on fortune in Walu Balu Jie (May). But simultaneously they are given hope as it is soon time for rice harvest, as well as they are given the prediction of how many babies there will be born the upcoming year.

  Before harvesting, the Musalaki must perform the "Rego" ceremony, and afterwards the harvesting will be continued by the farmers. An important notion is that the Musalaki is to be the first one to (symbolically) harvest the rice. The Musalaki plant the rice himself in the uma Nggua field, and this rice is called *keti mulu*. After been harvested, the rice will be kept in a small bowl called *Mbola lo'o*, and it's assumed to be carrying strong magical powers. My informant says that the purpose of this special rice it's to act as the soul keeper of the rice in Moni.

- ***Wula base***, June: no agricultural practices.

- ***Wula bas ae***, July: The most humid month and the time to plant corn.

- ***Wula Base Gega***, August: dry season, the farmers start to work in their fields, *Reku Riwu*, meaning 'wakeup of the human corpses'.

Governmental support:

In Kelimutu district the government has helped some villages to implement permanent irrigation system. This program started 25 years ago, and has been developed through five

periods. This process is very slow, and according to some of my informants from this area, their village farmer's organizations have to apply every year for support to develop and improve the permanent system as they only get a minor sum compared to the applied amount. In other words, the process of constructing the system is continuous. The government is handing over the work to build the channels to contractors, which use local labor. To me, this seems like a beneficial arrangement to boost the local economy. According to the Kepala Desa of Koanara village, the permanent, cement made system are made by hand and it takes approximately three months to finish 25 hectares.

In 2007, farmers in Moni joined a governmental agricultural program with intension to increase the rice production from two crops a year to three, by using chemical fertilizer (*pupuk kimia*). However, the program required that the farmers bought fertilizers from the government at a high price, which was unfortunate for the farmers. They practiced this technique for 2-3 years, but after that, the crop stopped to grow. The fact is that the soil had been cultivated to hard and got depleted. To reverse this, the farmers had to ask the government to go back to their former practice. In meanwhile they had to buy their rice at the market, as they left the soil to rest and to regain its nutrition and quality.

This increased frequency in cultivation is a trend amongst many farmers I have interviewed, especially in Lembor. Earlier, all used to harvest only two times a year, but nowadays many have increased the production three-four times by using chemicals, with often a decreasing crop as result. Why?

The reason for this is due to restricted access to land which leads to a frequent utilization of the soil leading to soil degradation. They want to harvest a sizable crop and buy expensive chemicals with borrowed money to enhance the production. In order to pay back the money, they have to harvest often. The chemicals they use together with the intensification of the production, leads to diminishing of soil nutrition, and an inevitably decrease of crop. When I asked a farmer why he continued this practice when the outcome is worsening his economical situation by ruining his livelihood, he answered that he cannot stop because the wish to increase his income was so strong that he literally believed that' the more you work, the more you earn'. Poor people are forced to put immediate needs before long-term quality of the land (UNEP, 2007: 209). Many farmers simply lack knowledge about the effects of such practices, and they blame governmental objectivity. They say that the government never comes to

inform the people, but to me it seems that at least some of them that I spoke to are well aware of the problem. So this is literally a result of deficient human resources.

The Kepala Desa in Koanara village:

The Kepala Desa office in Koanara village was established in 1965, and they have changed Kepala Desa five times since then. For how long the Kepala Desa remains in his position seems to vary from village to village. A common denominator is that he is paid by the government and does not receive any kinds of 'benefits' from the village people. However, as I was informed in Lembor, their Kepala Desa would receive 10% of a field's sales price if sold.

The Kepala Desa office has collaboration with the village priest, the government and the village farmers. The purpose of the office is to establish and maintain a relation between the people and the government. If the village people have any complaints or needs to be fulfilled that demands governmental assistance, an application will be sent from the Kepala Desa's office to the district office and from there to the leader of the regency, called *Bupati*. In two or three villages there will be one Kepala Desa, and under this body, there are different unites composed of farmers called *erthe.*

This office processes issues from five topics; *social, education, economics, tradition* and *religion.* Within the social sphere, 'farmers and socialization' is the main concern. This entails officials from the governmental agricultural office teaching farmers how to increase their crop production. When it comes to education, the concern is both education for farmers and children. Agricultural education often involves how to make fertilizers. This practice is ongoing. Typically economical issues are within agribusiness, and the farmers can apply for agricultural support from the government through the Kepala Desa office, such as request for seeds. When it comes to adat, the government has to know about the local practices. In the ceremony of Po'o Te'u, Kepala Desa will stop all governmental activities that day to observe the ceremony. Even school will be closed. In relation to religion, the Kepala Desa will have meetings with the local priest twice a year to discuss the plan on how to streamline crop production. The priest is an influential character within agriculture as he will talk to the people every Sunday in church and preach good values, such as the importance of education and hard work. And as a priest, his words are of great importance.

The Kepala Desa reports to the central government of Ende regency in occurrence of disasters such as flooding in order to get assistance, but this is a slow process. His proposal to the government might take as long as four years to be processed. This is due to the amount of territories in this regency, which has as much as 214 desas to be concerned with.

The agricultural ceremonies in Moni:

Dusoko jengi jebu is the ceremony performed to find out when it's time to plant the seeds. The Musalaki holds a meeting in *Keda*, the village's traditional house, from the afternoon until the evening for three consecutive days. On the third day the Musalaki leaves his house with a bundle of wild sugarcane and fire, while striking a gong on the way to the ceremonial place. The Musalaki prays to their ancestor's spirits who are taking a part of the traditional ceremony by 'controlling' the fire. If the fire is burning strong after the ceremony is conducted, it symbolizes that they will gain good harvest, but if the flame is burning weak it means that the farmers will face starvation. If this is the case, the farmers will get a two-day prohibition from entering the fields and harvest.
The following ceremonies have the purpose to decrease plant disease, mouse, and plaque caused by the plant hopper:

The Oro Te'u is a clearing of the field's ceremony. It involves all the people in the village and lasts for three mornings in a row. For two days the ceremony is performed in ulu nua and is carried out by singing traditional songs to chase the mice from the farmers' fields. The third day the ceremony, now called *Po'o Te'u,* continues in eko nua. At this stage, the Musalaki brings a chicken, rice and a live mouse to use in the ceremony. Some women cook the rice using bamboo as firewood, and then they take rice and meat and serve it in a sacred pillar which is to be found in every house. Then, this rice and meat is served on a bamboo stick shaped like a boat that has a sail made from corn leaves. On this 'boat', a mouse is placed, and shipped off on a nearby river while people are singing the same traditional songs to chase the mice away.

In the afternoon, they will go back with the Musalaki to the traditional house. On the way, they will keep silent until the Musalaki make the *sesajen* (offering of food to the sprits) and announced *so'o ghale me no'o ulu, lau me no' eko,* meaning that they have permission to

speak again. At the traditional house they will be served what is left of rice and meat in the *wisu*, a sacred corner of the traditional house.
If the people break the prohibition of silence before they get permission to speak, mice will attack their crop. If this happens, the people have to sing and scream while beating a stick in throughout the house to chase away the bad spirits that have caused the damage on the crop. The song goes like this:

Lau-lau-lau-lau-lau-lau, etc
Lolu lau: lau lelo pare gedo edo
Lau taba pare mbaka jata
Lau kisi mboko biji
Lau ngetu jawa wewu
Lau ka mboko ara

Meaning:
There are, rice, corn, and other kinds of plants,
that the mice may eat, so the mice do not destroy,
the farmer's plant.

Loa Telo- Pole moge is a ceremony that is performed to determine when the *kede wini* ceremony will be held. Eggs and rice are brought to the traditional house (*kopo kena*) by the Musalaki. Here, the Musalaki writes on the shell of the eggs by using *usu no'o ra nata* palm leaf and betel nut as ink. He will draw symbols of 'their' people and 'others' on the egg, and pitch it.
Then the Musalaki will break the egg carefully while saying;

Wengi tera mesa (nine days later)
Wengi lima rua (7 days later)
Tau kela kipa (as the best day)
This day is for kede wini

Kede wini is a ceremony held in a traditional house where the Musalaki brings the best rice seed to plant in the fields. The seeds are placed in a traditional house and blessed by the Musalaki. It is performed here in order to get the blessings from the sprits and God who has the power of the moon and of the land .The following morning, the Musalaki will know the place of the field (*Uma Nggua*) to held the next ceremony; *Paki/Kolu*.
Paki/Kolu signifies that the Musalaki is the first to plant the seeds on Uma Nggua, the day after the prohibition day. The next day the people may plant the corn or rice in their field.

Woga moka is a ceremony held in Uma Nggua to resist plant disease and pets. In this field, the Musalaki take some *Moka* (a kind of pest which destroys the root of the plants) and mix it with eggs, rice and meat to symbolize that the moka had been fed by his special food. Then he cut the moka and put its head on *kuko* (a local tool) and finally together with the food; they send 'the plague to the sea'.

Mea Uta muri is a ceremony that signalizes when it is time to harvest and eat the crop.
The wife of Musalaki is the one to first harvest some vegetables (*keti uta*), often jawa (corn) in uma Nggua. She brings it to the Musalaki which then takes it to the traditional house. Here, the Musalaki eats the food, and by doing so, symbolizes that the people may harvest their crop the next day.

Uwi is held by the Musalaki to predict how many children of which gender there will be born in the village the upcoming year. This ceremony is held in the traditional house, and here the Musalaki cut various kinds of tubers (*sete uwi*) by using a special sword (*sudhu jawa*). Afterwards, the uwi is thrown into the ground and if the uwi cracks open; it means that the pregnant woman will be given birth to a son, while an uncracked uwi means she will get a daughter. This ceremony is performed once for each pregnant woman.

Rego sepa is a ceremony performed after the rice is harvested. Prior to this ceremony it's prohibit for anybody to bring their paddy out of their region. This ceremony is held in a sacred place called *ola sepa.* Water bamboo (*gera)* is decorated with rice, corn and other vegetables, and thereafter brought from Sa'o Nggua to ola sepa and planted into the ground. It is a way of showing gratitude to the spirits. Afterwards, they eat what's left of the offerings.

Wesa keli Ola/ Rue kibi is a 'happiness' ceremony; in short, it's all about eating the crops together with the other village members to celebrate the harvest.

Picture 9: *Village panorama.* Credit: Bought at istockphoto.com

Social classifications:

Why is it that the Musalaki claims that these ceremonies are still in practice while others are denying it? In a changing time due to external influences and internal rebel against tradition, the powers of the Musalaki is getting weaker. His role in society is changing, and the way I see it, the Musalaki insists that the traditions are still maintained as an attempt to claim his original authority. As his powers are only valid through traditions; these need to be recognized by the community to have any relevance. Thus, the citizens are themselves possessing control; they can either keep to the traditions or break out of it. In a sense, this seems to be an internal power struggle.

During the interview with the Musalaki in Koanara Village, I got additional information regarding social classification in Moni. Social classification has the purpose to account for the local way of organizing the world (Eriksen, 1998). Social classifications are socially constructed lines and ranks within the local community. According to Marx and Engels (*cited in* Eriksen, 1998), there are universal criteria for social differentiation. It seems that all societies operate with important distinction between man and women, old and young, between community members and outsiders.

According to the Musalaki, the social stratification in Moni is like this;

- *First aristocracy*: The Laki raja family, called *Ine ame.*
- *Second aristocracy*: The Laki Lo'o family or functionary family.
  Every family who have been given land or have extended the land included in the Laki lo'o family, also divided into Boge Ria/Lo'o and Hage Ria/Lo'o, where Boge families are considered higher up in the social stratification than Hage families, therefore there are also two different Laki Lo'o councils; Boge Ria and Boge Lo'o and Hage Ria and Hage Lo'o.
- *'Field workers'*: *Fai walu ana kalo* are people who have freedom in life and allowed to work on alliance land.
- *Slaves /servants*: *Ata ko'o*
  My informant claims that there are no slaves nowadays, and when I asked around in the fields, people were reluctant to answer questions about social stratification in general. The Musalaki adds that despite social stratification, all are very friendly towards each other. The villagers greets each other politely, like: *Eja* (brother in law), *eda* (uncle), *ine lo'o/ mama kecil* (the youngest of a mother's sister), *Ine du'a/ mama besar* (the eldest of a mother's sister), even if they're not necessarily related by blood. I for example, was referred to as a 'sister' and a 'mother' by the villagers. However, despite this sociability, people have to marry within their social class.

The Musalaki tells me, despite the social stratification, people in Moni *essentially* look at each person as equals. They have an idea that everyone in the village are family, and that the newcomers should be accepted and treated politely and be a member of the clan if they behave according to local norms. The trans-migrants can also get land and are free to follow their ancestor's will, but they must respect the local culture and tradition. The norms that are followed in Moni area are: *Mboko sutu tu gha tubu*, that is, the criteria and effects to offer the *tubu*, landlord, which in Moni is the same person as the Musalaki. Those who do not obey the norm will get a serious sentence toward an abdication from their status and have to leave the village and their land.

The land lord, - the Tuantano/Musalaki has created certain norms that the villagers must follow. The Musalaki is seen as a representation of the universe and thus, everyone must obey his requests, which are in line with God's commandments. The people must service the landlord and follow what he orders them to do. There is also a group of people with the

purpose to service the Musalaki patiently. They are known as the *Tuke du kebe sani*. Their duties are rewarded with land that can be handed from generation to generation, with the condition that they do not escape their obligations. This is currently practiced.
There are two characteristics about the Musalaki's role that one should remember. First, he is the *Ine tana Ame watu* (the owner of the universe); the symbol of fertility and fortune which enable the people to give birth to their child which can inherit their tradition and maintain their ancestors' names, and second, he has the authority to allow the people to work the lands.

The people of Moni always live after principals that create a harmony and comfort in life. They believe in unity, the importance of listening to each other, that they share the same heart, and the importance of helping each other. Their belief is that they descend from the same ancestors.
If one violates the law, one will be brought to the Musalaki or *Sao Ria tenda bewa* to face a proper judgment. They believe in confession, to open up their hearts in order to seek the truth, and at the same time get forgiveness from the people. This perception of human beings applies not only to fellow citizens within the same clan, but also towards neighboring clans. Every clan has its territory of power and tradition, norms and has mutual respect to each other. To assure this relationship, as peace tractate, known as *Tura Jaji*, has been made.

The way the Musalaki abolishes himself as 'the owner of the universe' the symbol of fertility and fortune as well as being the one giving people the privilege to have agriculture as a livelihood, is putting himself in the center of the social local community. And as noted earlier, during the interviews, my informants gave me the impression that his position in the community nowadays is significantly diminished. This supports my assumption that he clings to old traditions and history as a way to claim his original authority, which is authorized through the peoples performance and *belief* in the original traditions, values and norms; adat. Regardless of how the social stratification is today, the history and previous classifications can have an effect on my project. It is relevant because both history and social pattern are in a way inherent in the community and therefore apply directions which can limit or narrow the impact of my project's course of action.

Current cultivation practices in Moni:

Oro Te'u, the clearing of the fields, is the only ceremony that most farmers' claim still exists. Though, they said they only witness the ceremony out of respect to the Musalaki, and simply view it as a symbolic act with little effect on the agricultural production. Most farmers perform their own measures against pests that they argue is the only method that works; kill the rats that live in the fields and clog the holes that they hide in.

After they have cleaned the land from pests and weeds, they wait 1 week before they plant the seeds. It is important that the soil is soft before adding the seeds. It is common for the neighboring farmers to help each other out with the planting and harvesting, and they use the same Gotong Royong systems as they use in Lembor to increase the efficiency. Some farmers have to wait a longer period before they can plant their crop, time which is well spent if they help out their neighbor. Sometimes farmers hire help, and this is especially common for elders who are unable to perform the burdensome work by themselves. Some even rent out their field, an arrangement which entitles the owner to 50 % of the crop, while the other 50 % goes to the tenant.

The structural organisation of the irrigation system in Moni is a bit different from the one they got in Lembor. As mentioned they have the permanent and manual system, but due to Moni being located in the hillsides, the structure is shaped after the hills. This is referred to as *terrace cultivation* and is a method of growing crops in slopes by planting on adjusted terraces built into the mount. This method is labor-intensive, but is effective as to make the most of arable land area in variable terrains and to reduce soil erosion and water loss (Encyclopædia Britannica, N.A). The terraces of Moni is built of clay and mud and shaped like small pools, with channels going into the terrace and out of it. Usually terraces are built on a slight grade so that the water in the channel leads slowly toward the terrace passage (Encyclopædia Britannica, N.A.). The terrace structures in Moni have the source of water located on top of the slope, and from there water flows through each terrace field.

Picture 10: *Terrace fields in Waturaka.* Credit: Private.

The technical structure of the irrigated fields of Koanara and Waturaka differs. Waturaka has steeper slopes and fits the description of terrace fields, while Koanara, located down in the walleye, only has a slight slope, and the gradient of the fields is less. The principle in the irrigation is the same but Koanara has a more developed permanent system. Unlike Waturaka, Koanara did not have to apply for loans to support the construction, they just got it. Several of the interviewees believe that this has to do with Koanara being located further away from the main water source in the mountains and therefore were needier of the permanent channels. In the northern part of the village fields, the area is totally covered by cement dykes that surround the whole of the village territory. However, the rest of the fields that lies within this surrounding cement dyke and beneath the northern corner only have manual system. This is just like the fields in Lembor; only the main channels are made out of cement. According to my informants form this village; the government is no longer interested to develop this area any further.

Summary; what can we derive from this?

Based on the research I have conducted in Moni and Lembor, there exists constructional inadequacies as well as weak social capital. Looking at technical construction, I found that none of the fields that I visited in Moni and Lembor were fully covered with the permanent system. Only the main channels surrounding the fields were made of cement. Also, many

sections of the permanent channels were falling apart or had fractures, which hinders the water from flowing with full potential. This shows that the channels made out of cement is not at all permanent. The manual channels are quite time consuming and exhausting to maintain, as human activity, rain, and larger quantity of water (which often is present in an irrigation system) shatters the channels.

Several farmers I talked to complained about the current system. According to them, the system is not effective enough, as the permanent system is not fully covering the fields. Some also noted that the famers that have their fields located some distance away from the main channels are getting less water than the ones located near. This is due to either water evaporation or that it is used by someone else on the way to the periphery fields.

But the system does not only have constructional design flaws, it has also an inadequate social capital. As stated in the theory chapter, social capital is a resource for individuals; it involves a range of diverse entities that consists of characteristics of social structures that facilitates certain actions of actors within the structures (Coleman, 2000).

The people that I have interviewed have a willingness to cooperate, and cooperation can be seen as a fundamental value of this irrigation system. This is reflected in Gotong Royong system, were the value of teamwork is essential. The farmers know how to mobilize, and they do this by gather in farmer's organizations. In Watu Lendo, Lembor, farmers have congregated into GP3A and are in collaboration with Yakines. This is collective action; the farmers are joined for irrigation management. This is demonstrated in the democratically driven farmer's organizations were they are discussing any issues regarding agriculture that may concern them. This cooperative initiative is not flawed, but the fact that they leave all the responsibility to the government, I think is a defect. Most farmers' organizations apply for monetary support to the government in order to get the irrigation channels repaired. But as the application process is slow, they wait whilst complaining and blaming the government for not doing enough for them. It is an evident concern that farmers 'disappear in the government's backyard' and many lack initiative to take matters into their own hands.

Regarding the trend of cultivating more than the recommended two-times-a year which leads to impoverishment of the soil; the farmers need information and guidance to avoid a continuation of such practice. Perhaps they should be encouraged to find alternative ways of gathering money and/or information that can help them to perform sustainable agricultural practices. This evidently brings us to another barrier, as many of them are illiterate.

Many do not only lack knowledge regarding cultivation frequency and alterations in soil nutrition, generally they require knowledge about maintenance of the irrigation system. My findings show that very few of the farmers cared to maintain the permanent system themselves. This is due to funding problems and not just the lack of willingness or initiative. As stated earlier, an important factor in participatory irrigation management is that the organizers (in Lembor, the organizers are farmers chosen by the government to distribute the water in the dry season) need support from people with the necessary knowledge and experience to make it sustainable. However, they do not receive the necessary support to achieve sustainability. As social capital is a resource, my argument is that the famers in Lembor and Moni encompass inadequate social resources. This system's deficiency that I indicate is caused by governmental insufficiency as well as famer's lack of social resources. Farmers' actions in Lembor and Moni are hindered by the political and social context.

My findings show clearly that Flores will gain from improved irrigation systems. The system is flawed on several levels and need inspiration to achieve streamlining of the production. But in what way can the subak system be an inspiration?

How can the technology of the subak system be transferred to enhance agricultural efficiency in Flores?

To answer this question, I choose to structure the analysis in accordance with the three main aspects of technology transfer which was discussed in the theory chapter; the technical, organizational, and cultural. We must look at the different aspects in relation to the donor and recipient culture. In this respect, I find it relevant to point out the general similarities and differences between the Florenese and subak system. In that way, it is easy to distinguish what the subak system contains that the Florenese lack, and how it can be an inspiration.

Technical factors in cross-cultural technology transfer:

In this task, technology has been defined as culturally transmitted knowledge, a system of social behaviors and techniques, and hence a social phenomenon (Pfaffenberger, 1988). I have not emphasized technology in the sense of a *materialistic* structural understanding. A reason for this is due to my data that explain how subak and the Florenese irrigation system, materialistically/structurally, do not differ *radically*. The important disparity lies beyond the

materialistic structures; we have to reveal the social performance and the knowledge that maintains and creates the system.

But first, as technical/ structural units, the subak and Florenese system resemble as both are gravity-flow channel systems. When the water enters the field in the subak system, it is divided by many adjusted bamboo tubes, while in the Florenese; the water enters through a breach in the manual channels leading from the main, permanent channel. The subak system does not have any artificial storage of water, while Lembor uses large containers as intermediate links between the local rivers and main channels. In Moni, the main, permanent channels are directly linked to the water source.

The Florenese system has a constructional error with regards to the channels' poor quality. The manual channels leads to water evaporation, while the permanent, if not well maintained, gets clogged and fractured. Basically, this is a matter of better organization of maintenance which requires an improved structure between the different system units. This in turn necessitates willingness, consensus, and cooperation amongst the beneficiaries. In this respect, the subak system can be an inspiration.

Green (1999) argues that one of the aspects of technology that is important in a transfer process is the *technological*, a feature which includes skills, techniques, tools, resource, and knowledge. The resource that I focus on in this project is the social capital, or what Evans (1996) refers to as soft technology. This is the knowledge which both creates and maintains the structure of the social system.

This project is about a cross-cultural *transfer* of an irrigation system, which focuses on the social and cultural aspects of technology. Hussain (1998) argues that the culture of a group either facilitates or hinders the process of technology transfer from external relations. It can be assessed as the group's absorption capacity. As technology is culturally relative know-how knowledge as well as a system of social behaviors and techniques, the technology to be transferred must fit the receiver's culture. The technical factors that are significant in this cross-cultural technology transfer are the knowledge and resources that the subak system contain; how to better coordinate the different system units, how to operate in a more democratic manner through cooperation that leads to a better care of O&M of the system, a more efficient construction of the channels, and an understanding of how to sustainably utilize the available resources.

The group culture among farmers in the Moni and Lembor reflects values as cooperation and democracy that might help facilitate and achieve success in the adoption of a new irrigation system. However, in order to find out how the technology of the subak system can be transferred, we have to look into the other relevant aspects of technology; the organizational and cultural.

Organizational factors in cross-cultural technology transfer:

Another aspect of technology that is important in a transfer process is the *organizational*, a feature which according to Green (1999) includes economic and professional activity. More specifically, how the farmers are organized in their agricultural work. Aasen *et al.* (1990 *cited in* Green, 1999) argues that the features of the technology and the organizational framework within the location where the technology is to be transferred will affect how the technology will be implemented. The institutional setting, which in this respect is the agricultural society, 'decides' if the technology will be successfully implemented or not. To relate this to my project, I will discuss the organizational setting of the Florenese agriculture to that in the subak system.

The subak system is regarded as a legal unit. There are more strict rules in this organization than the ones in Moni and Lembor which is due to the palm-leaf constitution and the laws and regulations in awig-awig. Through this organization, the members learn how to conserve their resources which is something that most farmers' organizations in Lembor and Moni do not pay attention to. The exception though is the GP3A in Watu Lendo which practicing sustainable agriculture by following the traditional agricultural calendar and through producing their own organic fertilizer.

The subak organizations rely on a temple network for guidance, regulated by priests (Sepe, 2000), while the Florenese system *used to* rely on the Musalaki/Tua Golo. Since his authority has diminished, the farmers rely on the cooperative farmer's organizations or practice according to own preference. The Balinese acknowledges spirits and gods as social partners in irrigation, which is also considered as imperative in Florenese agriculture as they are believed to hold special powers to influence the outcome of the crop as well as the family's safety. Although despite this belief, many do not care to perform the agricultural ceremonies to please the spirits. However, the Catholic faith is respected and God is worshiped and

considered central in Florenese agriculture. One informant told me that it is all about “bekerja dan berdoa!” (Work and pray!).

Both the subak system and the Florenese system are WUAs and social units upheld by cooperation. -Though the subak has a more complex organisation, whit a council consisting of all the members of a subak, each with an equal vote, than the farmer’s organizations’ I visited. The WUAs in Lembor have a board of farmers chosen by the government. My informants told me that their opinions were taken into considerations in the meetings, but I do not believe that each of their voice have an exact equal impact. In Koanara village for instance, an elderly woman that I interviewed told me that her family receives less water than the rest of the farmers because they are immigrants. She felt that her family was discriminated for not being true ‘Moni people’, and as a consequence they have to stay awake at night so that they can open the floodgates and let in water to their field. This reflects the social stratification the Musalaki of this village claim exists, and in accordance to this rank, this family fit the class of ‘filed workers’. Due to this, the Koanara village seems less interconnected than Waturaka and the villages in Lembor. But I must emphasize that this was a case I only observed in this specific village, and this finding cannot be generalized.

The allocation of water, which in principle is equal, actually creates social diversity as the ones located near the permanent channels are receiving more water than the ones located further away. This is reflected in crop production which in turn leads to differences in income and wealth. This is an injustice caused by both poor constructions of the channels as well as an inadequate distribution of resources. In a way it is all about location of the field, although by not assigning more water to the ones that have an unfortunate localization, the social gap only increases. In Lembor, some farmers told me that they were ‘protesting against the system’, but it only lead to internal conflicts and negative vibes amongst the farmers.
The farmer’s organizations can be an excellent forum to resolve conflicts between the farmers, but in such situations it only creates frustration. In this regard, my assumption is that the willingness to cooperate will be negatively affected.
In both subak and the Florenese system, irrigation water is distributed in accordance to the field size.

The subaks, and the farmers within each subak, are much more coordinated than the farmers in Moni and Lembor. The collective social presence is stronger in the subak organization, and

this is due to what Lansing (1991) recognizes as the 'dependency in the system'. It exists between the water temples, farmers, and the ecosystem, and the interdependency of temples in the irrigation system. These relations show how important it is for the Balinese to live in harmony with nature. In a way, the subak scheme inspires to rediscover traditional values. The subak organization can inspire a sustainable utilization of resources as by enhancing a strong an effective social organization. The social organization in the subak system is due to a common consensus that all benefits from mutual cooperation. Collective participation, democracy, and coordinated management skills are all inspirational qualities that the subak system advocates.

The organizational factors that are important in this project regarding a successful cross-cultural technology transfer are the basic organizational principle that both systems have. Both are (more or less) democratic WUAs with similar values; belief in superior beings and their effect on agriculture, as well as the value of cooperation (demonstrated in the Gotong Royong institution and farmers organizations). In other words; these organizational aspects are well matched, which increases the chance of a successful technology transfer.

Cultural factors in cross-cultural technology transfer:

The last aspect of technology to be examined is the *cultural.* According to theory (Aasen *et al.*, 1990 *cited in* Green, 1999: Hussain, 1998); the more similar the donor and recipient's culture is, the greater the chance of a successful technology transfer. If there are mismatches between the donor and the recipient's culture, problems occur frequently due to the specific features within the technologies (Aasen *et al*., 1990 *cited in* Green, 1999). This section discusses the difference and similarities between the subak and Florenese system and what significance this has for a transfer of the subak technology to Flores.

As shown in the prior section, the subak and Florenese systems have some comparable technological and organizational characteristics, but what makes the subak system and the Florenese system differs from each other, *generally*, is the centrality of traditional practices. The subak system performs old traditional ceremonies, while those in the Florenese agriculture are dissolving. In Flores, there is no longer a common agreement on the agricultural tradition's importance and validity, such as the traditional agricultural calendar, ceremonies, and the Musalaki's/Tua Golo's authority and relevance. This is an alteration that

is due to both internal and external influences, which my informants themselves argue is as a natural development in a modern time. The traditional organization has more or less been abandoned.

In order to reveal the agricultural tradition's relevance by an adoption of a new irrigation system, we must uncover the social structure of society. The social *structure* is the system of norms and sanctions, while the social *system* is a set of social relations which are activated through interaction. This system is characterized by an agreement on the rules that are valid for interaction in the system (Eriksen, 1998:90). An implementation of a new technical system may change the recipient's social structure.
The agriculture can be viewed as a social institution, and the farmer's actions are based on culturally defined ways of doing things (Eriksen, 1998) that are in lines with the norms of the social institution. Actions that violate the norms are responded with sanctions.

The Florenese agricultural traditions that *some* still are practicing today are the Gotong Royong system, the Thabar-, Dhara Wini-, Randang-, and the Oro Te'u ceremony. The traditional agricultural calendar is also used by some farmers.
The Gotong Royong system is the one tradition that my findings show was practiced by the majority of famers, while the others only sporadically by some. The mainstream has abandoned them, but the reason why the Gotong Royong system still has an important significance is perhaps due to the profitability of cooperation. The work in the fields is a burden, but when performed collectively, the work is both more efficient and enjoyable. This cooperation helps to maintain the interpersonal relationships that define a 'community', holds great significance for a sustainable agricultural tradition, and reflects the importance of working together to achieve mutual goals.
This institution is based on *reciprocity* which is the principle for the circulation of material resources in a form of sharing (Eriksen, 1998). In the Gotong Royong institution, mutual obligations are created through the exchange of work. The norm can be regarded as a social and cultural value that maintains and strengthens the internal sense of community.
However, it must be stressed that although this institution is being practiced by the majority, there are many who choose to pay others to perform the work that has to be done in the fields, and in that way, distance themselves from the principle and obligations of reciprocity. The

majority of respondents who said they paid workers explained that it is too physically demanding to do it themselves.

In terms of the declining importance of the agricultural traditions, I believe their significance for an adaptation of a new irrigation system is with respect to the guidelines that they have created and which are inherent in the local culture and social structure. The traditions, although they are not practiced to the same extent as before, affect social organization and therefore apply directions which can limit or narrow the impact of any new system implementation. Depending on the perspective, the fading of the ceremonies might actually be an advantage as technological change often leads to problematic cultural changes (Hughes, 1983). In this case, the traditional ceremonies itself should not be the barriers for a new system adoption, but rather the internalized traditional norms and guidelines.

The guidelines which may be relevant in this project are the social stratification in Florenese society with respect to the Musalaki's/Tua Golo's previously impact on agriculture. Musalaki's/Tua Golo's character is weakened, and it is a general consensus among the farmers that he has no important role in agriculture, but despite this he has a respect in society that is legitimized through traditional norms. This situation that I analyzed as an internal power struggle where some choose to ignore and abandon cultural traditions while others, especially Musalaki of Koanara village is insisting on the tradition's continuation, has created an imbalance in the social structure.

The cultural guideline that characterizes agriculture in Lembor and Moni is first and foremost the value of the Gotong Royong system; cooperation, which in turn is manifested in farmer organizations. The farmer's organizations also underlines their ability to work together towards a mutual objective can make it easier to implement a new system since that requires a common agreement on new transformations. These transformations can be new ways of working, changes in technology, and possibly new social relations that can alter the local social structure. A possible scenario is that it can occur conflicts between those who are interested in the implementation of a new system and those committed to a preservation of traditional patterns. It is therefore important to make sure of a joint agreement of any new changes which both requires cooperation and unity. As Eriksen (1998:97[own translation]) argues; "values and social institutions can be changed through social processes, but they

change *from* something". I have recognized that cultural norms that can apply directions to a system implementation, but the question is whether in fact this will have a significant impact on the implementation of a new system, since the agricultural traditions are already weakened, as well as Musalaki's/Tua Golo's authority. The farmers' desire for an improvement and the existence of a cooperative spirit may be an adequate basis for a successful implementation, even if some of the aspects of their lives can be changed.

The cultural factors that are significant in this cross-cultural technology transfer are the importance of the cultural performances, norms, and guidelines, and the *meaning* they have in the institutional setting. For the subak system to be successfully transferred to Flores, the local value system must be taken into account.

-A barrier to development?

The people of Moni and Lembor are generally economically deprived which is mainly due to an inadequate utilization of their livelihood; their fields and its crop, as well as their resource systems and the resource units. *The majority* of my informants managed to only cover their basic needs, and some often need to borrow money which they later would struggle to reimburse. Traditional ceremonies are expensive to execute, and even though the majority have chosen not to pay any attention to them anymore, some still do. In Lembor, the agricultural Thabar ceremony in specific is a costly ritual and which still is performed by some. As Spinnangr (2006 [own translation]) asks; "how to achieve development without confronting such customs and traditions?" Such customs and traditions are what he argues to be *poverty-promoting*. The traditions itself do not create poverty, but the lavish ones prevent wealth from creating personal and societal prosperity that can evolve as a result of investing the money, etc. Seen from a social anthropological perspective, this seems both narrow-minded and ethnocentric, and I know that my emphasize on the cultural aspect of the agricultural practices and importance of comprehensive understanding of those prior to technology transfer, shows that I encompass a greater cultural understanding than to reduce them to poverty- promoting traditions. So I simply include this as to add another perspective to traditions and societal development, and to provoke some reflections.

8.0 Conclusion:

In specific, this paper has explored the subak irrigation system and evaluated it in terms of its transferability to Flores. Generally, this thesis deals with a cross-cultural transfer of a socio-technical and a socio-ecological system. This thesis has discussed the subak systems religious, cultural and technical aspects. It has emphasized the culturally aspect of technology and defined technology as a system of social behaviors, techniques, and knowledge.

The thesis has discussed the Florenese system's deficiencies and how the subak system can be an inspiration. It has considered the technical construction and the social organization of both the subak and Florenese system and looked into the similarities and differences to be able to clarify what the Florenese system lacks for sustainable resource utilization.

This thesis has focused on how farmers organize the work in the agricultural fields, in terms of WUAs, collaboration and participation, and advocated this as essentials for optimum and sustainable resource management.

Summary of results:

After a review of my findings, I uncover differences in the two project locations as well as within the various villages in those areas. However, there are general features to emphasize; a change in the social structure due to Musalaki's / Tua Golo's declining authority and importance in the agricultural institution; a reduced importance of traditional agricultural ceremonies, but at the same time a strong belief in the sacred and God, and a fellowship manifested through collaborative agricultural practices; Gotong Royong and farmer's organizations.

Despite the differences between subak and the Florenese system, and I argue that the basic values; cooperation, participation, democracy, and faith are common aspects. However, I also claim they have a stronger and more decisive importance in the subak organization than in the Florenese irrigation system.

Considering the systems shared values; the desire the farmers in Lembor and Moni have for an improvement of their current system; the environmental factors which allows a development; and the decreasing importance of adat, I believe the citizens of Lembor and Moni are capable of adopting the subak system, *if* the process is in line with the locals culture and norms.

For a system implementation to be sustainable, changes must take place on the locals own terms. They must agree to the adjustments that will take place, and thus should be included in the early phase of the system transfer process. This will help to secure that the technology transfer will have a minimal impact on the local culture, as the technology transfer has been achieved within the limits of local culture and its norms. If these principals are followed it will be an optimal preparation for a system adoption. It is imperative not to underestimate the importance of the recipient's norms but include the understanding of social processes and their meaning as part at every development phase.

A successful transfer of the subak system to Flores will encompass a development value in the sense of increasing crop production which further can contribute to amplified wealth, achieving sustainable utilization of resources, and development of human resources. The development value is also due to CBNRM in the framework of traditional agricultural practices where the community is joined for natural resource management.

References:

- Adams, W.M (2009), "Green Development. Environment and Sustainability in a Developing World". Routledge, third edition.
- Anderies, John M., Marco A. Janssen, and Elinor Ostrom (2004), "A Framework to Analyze the Robustness of Social- Ecological Systems from an Institutional Perspective". Found at URL: http://www.ecologyandsociety.org/vol9/iss1/art18/ [accessed: 16.04.10]
- Asian Development Bank (ADB) (1981),"Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Republic of Indonesia for the Bali Irrigation Project". 25 August, 1981. Found at URL: http://www.adb.org/Documents/RRPs/INO/14014-INO-RRP.pdf [accessed: 19.04.10]
- Baba, M. L. (2003), "Working Knowledge Goes Global: Knowledge Sharing and Performance in a Globally Distributed Team". In *Anthropology of Work Review*. Vol. XXIV, 1-2, 19-29, 2003.
- Badan Pusat Statistik (BPS) (2010),"Hasil Sensus Penduduk 2010". Provinsi Nusa Tenggara Timur. Found at URL: http://ntt.bps.go.id/index.php?option=com_content&view=article&id=120%3Ahasil-sensuspenduduk-2010&catid=1%3Aberita&Itemid=8 [accesses: 18.09.2011]
- Baliguide (N.A), "Introduction to Bali, Indonesia". Found at URL: http://www.baliguide.com/geography.html [accessed: 16.04.10]
- Bali Discovery Tours (N.A.), "Bali's Subak System- Part of the World's Heritage. Preserving Bali's Water Conservation and Distribution System is in the Best Interest Bali and the Island's Tourism". Found at URL: http://www.balidiscovery.com/messages/message.asp?Id=5071 [accessed: 12.10.2011]
- Bardini, Thierry (1994), "A Translation Analysis of the Green Revolution in Bali". *Science, Technology, & Human Values*, Vol. 19, No. 2 (Spring, 1994), pp. 152-168. Sage Publications, Inc. Found at URL: http://www.jstor.org/stable/689746 [accessed: 20.04.10]
- Barth, Fredrik (1993), "Balinese Worlds". The University of Chicago Press, Ltd, London, 1993.
- Binnie & Partners (1994), "Master Plan; Integrated Water Resources in Flores Island, Indonesia". Republic of Indonesia, Ministry of Public Works, Directorate General of

Water Resources Development. Master Plan Report Vol. 2, Main Report and Appendices A to C, June 1994. Binnie & Partners Consulting Engineers, in association with Hunting Technical Services, Pt. Indah Karya, Pt. Multi Tehniktama Prakarsa, and Lembaga Bangun Desa Sejahtera.

- Bruns, Bryan (1993), "Promoting Participation in Irrigation: Reflections on Experience in Southeast Asia". In *World Development,* Vol. 21. No. 11(November 1993), pp. 1837-1849. Found at URL: http://www.bryanbruns.com/8reflect.html [accessed: 03.11.2011]
- Bryman A. (2008), "Social Research Methods", 3rd edition. Oxford University Press, New York.
- Buck, Susan J. (N.A.), "Governing the Commons: The Evolution of Institutions for Collective Action". A review of the book; *Governing the Commons: the Evolution of Institutions for Collective Action,* by Elinor Ostrom, 1990. Department of Political Science, University of North Carolina at Greensboro. Found at URL: http://lawlibrary.unm.edu/nrj/32/2/06_ostrom_governing.pdf [accessed: 16.10.2011]
- Bureau of East Asian and Pacific Affairs (EAP) (2011), "Background Note: Indonesia". U.S Department of State. Found at URL: http://www.state.gov/r/pa/ei/bgn/2748.htm [accessed: 18.09.2011]
- Carter, John (1998),"Water User Associations", chapter 8 in *National Water Act, (Act 36 of 1998).* The web-enabled version of the South African Water Act developed by John Carter of the Institute for Water Quality Studies. Found at URL: http://www.dwaf.gov.za/iwqs/nwa/tmp_Chapter_8.html [accessed: 30.08.2011]
- Charmaz, Kathy (N.A.), "What is Grounded Theory?" A PowerPoint presentation. Found at URL:http://www.google.com/url?sa=t&source=web&cd=9&ved=0CE4QFjAI&url=http%3A%2F%2Feprints.ncrm.ac.uk%2F208%2F1%2FWhat_is_Grounded_Theory.ppt.4-24-08.SS.ppt&ei=keBTv_rEIf44QTg4Nxy&usg=AFQjCNGyiAZDzz_IFz6YLzqUIQBxpGwZxw [accessed: 27.09.2011]
- Christou E., Valachis I, and Anastasiadou C. (2002), "Research Methodology in Hospitality Industry: The role of the Inquiry Paradigms". Found at URL: http://www.ul.edu.lb/fthm/papers/3rd%20Axis/Methodology%20greece.doc [accessed: 12.01.2010]

- Coleman, James S. (2000), "Social Capital in the Creation of Human Capital". In *The American Journal of Sociology*, Vol. 94, Supplement: Organizations and Institutions: Sociological and Economic Approaches to the Analysis of Social Structure. (1988), pp. 95-120. Found at URL: http://links.jstor.org/sici?sici=0002-9602%281988%2994%3CS95%3ASCITCO%3E2.0.CO%3B2-P [accessed: 07.11.2011]
- Columbia Encyclopedia (N.A.), "Flores". Found at URL: http://www.answers.com/topic/flores [accessed: 11.10.2011]
- Dr. Dan Pennock and Dr. Darwin Anderson (N.A), "Vertisolic Soil". The Department of Soil Science at the University of Saskatchewan. Found at URL: http://www.soilsofsask.ca/index.php?option=com_content&task=view&id=10&Itemid=41 [accessed: 29.03.2011]
- Edquist, C. (1997), "Systems of Innovation Technologies, Institutions and Organizations". London: W.W. Norton.
- Elgsaas Hilstad, Solveig (2001),"Flermedial Nyhtespublisering I NRK: Hvordan Teknologi Samspiller med Arbeidspraksis".University of Oslo, Institute of Informatics. Found at URL: http://folk.uio.no/solveiel/Oppg.pdf [accessed: 26.10.10]
- Encyclopædia Britannica (N.A), "Terrace Cultivation". Found at URL: http://www.britannica.com/EBchecked/topic/588178/terrace-cultivation [accessed: 27.03.2011]
- Eriksen, Thomas Hylland (1998), "Små Steder, Store Spørsmål. Innføring i Sosialantropologi". Universitetsforlaget AS, Oslo. Second Edition 1998.
- Evans, P. (1996), "Government Action, Social Capital and Development: Reviewing the Evidence on Synergy". World Development, Vol. 24, No. 6, pp. 1119-1132.
- FloresKomodo.com (2008),"Agriculture". In *West-Flores and So Much More.* A website developed by the Swisscontact WiSATA project, an Australian Government, AusAID initiative. Found at URL: http://www.floreskomodo.com/index.php?option=com_content&task=view&id=96&Itemid=114 [accessed: 26.10.10]
- Ganie-Rochman, Meuthia (2010),"PNPM and Democratic Development". At *the Website Secretariat Working Group for Poverty-Based Controller for Community Empowerment- The PNPM Mandiri*. Found at URL:

http://translate.google.com/translate?hl=en&sl=id&tl=en&u=http%3A%2F%2Fwww.pnpm-mandiri.org%2F [accessed: 09.11.2011]

- Gany, Hafied (2007), "Problems and Perspectives of Participatory Irrigation Management under the Small Land-Holding Condition: With a Special Reference to Indonesian Practice", In *Proceedings of the 4th Asian Regional Conference and 10th International Seminar on Participatory Irrigation Management*. Conference organized by Iranian National Committee on Irrigation and Drainage (IRNCID), International Commission on Irrigation and Drainage (ICID, International Network on Participatory Irrigation Management (INPIM). Found at URL: http://www.irncid.org/Books/PDF/PIMbook.pdf [accessed: 30.03.2011]
- Geertz, Clifford (1971)," The Wet and the Dry: Traditional Irrigation in Bali and Morocco". In *Human Ecology,* Vol. 1, No. 1, 1972. Found at URL: http://www.springerlink.com/content/nk6063275115001n/fulltext.pdf [accessed: 29.03.10]
- Geertz, Clifford. (1972),"Organization of the Balinese Subak". In: Coward, E. Walter Jr. (ed.): *Irrigation and agricultural development in Asia: perspectives from the social sciences*. Cornell University Press, 1980.
- Green, D. (1999), "Cross Cultural Technology Transfer of Sustainable Energy Systems: A Critical Analysis". In *Renewable Energy* 16 (1999) 1133-1137. School of Science and Technology Studies. University of New South Wales. Kensington 2052, Australia.
- Groenfeldt, David (N.A), "Accounting for Culture in the Paddy Cultivation; Toward a Broader Definition of "Livelihood". Found at URL: http://www.irri.org/publications/wrrc/wrrcPDF/session11-01.pdf [accessed: 19.04.10]
- Hall, Andy, Norman Clark, and Guru Naik (2007), "Institutional Change and Innovation Capacity: Contrasting Experiences of Promoting Small-Scale Irrigation Technology in South Asia". In *International Journal of Technology Management and Sustainable Development*, Vol. 6, No. 2, 2007. Published by Intellect Ltd.
- Hamdy, A. (2007), "Irrigation Management Transfer: Monitoring and Evaluation Concepts and Approaches", In *Proceedings of the 4th Asian Regional Conference and 10th International Seminar on Participatory Irrigation Management*. Conference organized by Iranian National Committee on Irrigation and Drainage (IRNCID), International Commission on Irrigation and Drainage (ICID, International Network on

Participatory Irrigation Management (INPIM). Found at URL: http://www.irncid.org/Books/PDF/PIMbook.pdf [accessed: 06.04.2011]

- Hart, Dennis N. (2005), "Information Systems Foundations: Constructing and Criticising". Presented at the Second Biennial Information Systems Foundations ('Constructing and Criticising') Workshop, held at The Australian National University in Canberra from 16-17 July 2004. Published by ANU E Press, The Australian National University.
- Hasan, Mohamad and Syamsudin Mansoer (2007),"Participatory Irrigation Management in Kelara Karalloe Irrigation Project, South Sulawesi, Indonesia". The 4th Asian Regional Conference and 10th International Seminar on Participatory Irrigation Management, Tehran-Iran 2-5 May 2007.
- Hughes, Thomas P. (1983), "Networks of Power - The Electrification in Western Society 1880 – 1930", Baltimore: The Johns Hopkins University Press New York: Softshell Books Edition, 1993.
- Hussain, Shabbir (1998), "Technology Transfer Models Across Cultures: Brunei-Japan Joint Ventures". *In* International Journal of Social Economics, Vol. 25 No. 6/7/8, 1998, pp. 1189-1198, MCB University Press. University Brunei Darussalam, Brunei Darussalam.
- Lansing, J. Stephen (1991), "Priests and Programmers: Technologies of Power In the Engineered Landscape of Bali". Princton University Press. Princton, New Jersey.
- Lansing, J. Stephen (2007), "Priests and Programmers: Technologies of Power in the Engineered Landscape of Bali". Princeton University Press, Princeton, New Jersey, USA. Preview, Google books. Found at URL: http://books.google.no/books?id=CBhVWuEXBpsC&dq=Priests+and+Programmers&printsec=frontcover&source=bn&hl=no&ei=gXrMS-HsFtrGONvP0agG&sa=X&oi=book_result&ct=result&resnum=4&ved=0CCAQ6AEwAw#v=onepage&q&f=false [accessed: 19.04.10]
- Levold, Nora and Per Østby (1993), "Skjønnheten og Udyret; Møtet Mellom Kultur og Teknologi". Historisk-filosofisk fakultet, NTNU, Trondheim 1993.Arbeidsnotat. Found at URL: http://www.hf.ntnu.no/itk/ikon/tekster/udyret.php [accessed: 12.11.10]
- Lonely Planet (2010), "Indonesia". Published by Lonely Planet Publications Ltd, 9th edition.

- MacRae, Graeme (2006), "*Banua* or *Negara*? The Culture of Land in South Bali", Chapter 4 in *Sharing the Earth, Dividing the Land; Land and Territory in the Austronesian World*. Pp. 88-105. Edited by Thomas Reuter, Published by ANU E Press, The Australian National University. Fond at URL: http://epress.anu.edu.au/austronesians/sharing/pdf/sharing-whole.pdf [accessed: 19.10.10]
- Magno, Francisco (2001),"Forest Devolution and Social Capital: State-Civil Society Relations in the Philippines". *Environmental History*, Vol. 6, No. 2, (Apr., 2001), pp. 264-286 Published by: Forest History Society and American Society for Environmental History. Found at: URL: http://www.jstor.org/stable/3985087 [accessed: 04.03.10]
- Martinsen, Vegard (2000), "Epistemologi". Found at: URL: http://www.filosofi.no/epist.html [accessed: 12.01.10]
- Ministry of Foreign Affairs of Denmark (MFAD) and Danish International Development Agency (DANIDA),(2007), "Community- Based Natural Resource Management". Technical Advisory Service, technical note, 2007. Found at URL: http://www.danidadevforum.um.dk/NR/rdonlyres/7515A187-A9A7-4BE8-B834-F38A30D6ACE2/0/Technicalnotemarts2007CommunityBasedNaturalResourceManagement.pdf [accessed: 02.09.10]
- Mitchell, Bruce (1994), "Sustainable Development at the Village Level in Bali, Indonesia". In *Human Ecology*, Vol. 22, No. 2 (Jun., 1994), pp. 189-211 Published by Springer. Found at URL: http://www.jstor.org/stable/4603123 [accessed: 19.04.10]
- Mount Shasta Companion (2001), "Ecological Types; Glossary". Found at URL: http://www.siskiyous.edu/shasta/env/ecotype/glo.htm [accessed: 28.03.2011]
- Muhajir, Anton (2003),"Farmers and Consumers Benefit from Sustainable Agriculture". In *Third World Resurgence* No. 223 (Mar 2009). Found at URL: http://www.twnside.org.sg/title2/susagri/susagri085.htm [accessed: 17.03.2011]
- Ostrom, Elinor (1990), "Governing the Commons; The Evolutions of Institution for Collective Action". Political Economy of Institutions and Decisions. Cambridge University Press, UK.
- Nyoma Rudana (2007), "Tri Hits Karana; The Philosophy Behind Nature Preservation in Ubud", Bali. Prepared for the UN Climate Change Conference in Nusa Dua, Bali,

3-14 December 2007. Found at URL: http://www.scribd.com/doc/3879695/Tri-Hita-Karana-in-Ubud [accessed: 12.04.10]

- Pasandaran, Effendi (2004), "Consequences of Policy Changes on Indonesian Irrigation System Management". Indonesian Agency for Agricultural Research and Development Secretariat, Jalan Ragunan No. 29. Journal Litbang Pertanian, 23 (3), 2004. Found at URL: http://www.pustaka-deptan.go.id/publikasi/p3233042.pdf [accessed: 21.10.10]
- Pfaffenberger, Bryan (1988), "Fetishised Objects and Humanized Nature: Towards an Anthropology of Technology". University of Virginia. In *Man*, 1988:236-252 (17 pages).
- Roth, Dick (2009),"Property and Authority in a Migrant Society: Balinese Irrigators in Sulawesi, Indonesia". Development and Change 40(1): 195–217.
- Rye, Ståle Angen (2010), "Final comments". From discussion at Fronter, UIA. Module 1, task 1.1: *Basics of Social Sciences*. Found at URL: https://fronter.com/uia/discussion/index.phtml?int_discussionid=24277&int_postid=101482#selected [accessed: 15.04.10]
- Sepe, Jonathan (2000), "The Impact of the Green Revolution and Capitalized Farming on the Balinese Water Temple System". Found at URL: http://eclectic.ss.uci.edu/~drwhite/Anthro129/balinesewatertemplesJonathanSepe.htm [accessed: 19.04.10]
- Skogseth, Ingrid Kvinge (2010),"Facts About Flores". Found at URL: http://www.uia.no/en/div/project/studytour_indonesia_2010/facts_about_indonesia/facts_about_flores [accessed: 15.10.10]
- Spinnangr, Kjellan (2006)," Tradisjoner Skaper Fattigdom". In *Bistandsaktuelt*, 2006. Norad. Found at URL: http://www.bistandsaktuelt.no/debatt/kategorier/tr%C3%A5der?thread=118537 [accessed: 27.10.11]
- Strategos (N.A),"Lean Manufacturing; A Social- Technical System (STS)". Found at URL: http://www.strategosinc.com/socio-technical.htm [accessed: 22.03.10]
- Suprapto, Ato (N.A.), "Land and Water Resources Development in Indonesia", Suprapto: Director General Agriculture Infrastructure Ministry of Agriculture, Indonesia. Produced by: Regional Office for Asia and the Pacific. Found at URL: http://www.fao.org/docrep/005/ac623e/ac623e0g.htm [accessed: 26.10.10]

- Tanah Lot (2010), “Subak: Irrigation Management in Tanah Lot”. Tanah Lot Official Website, 2010. Found at URL: http://www.tanahlot.net/home/index.php?option=com_content&view=article&id=677:subak--irrigation-management-in-tanah-lot&catid=1:latest&Itemid=46 [accessed: 21.09.2011]
- Twyman, Chasca (2000), “Participatory Conservation? Community-Based Natural Resource Management in Botswana”. In *The Geographical Journal*, Vol. 166, No. 4 (Dec. 2000), pp. 323-335. Published by Blackwell Publishing on behalf of The Royal Geographical Society. Found at URL: http://www.jstor.org/stable/823034?origin=JSTOR-pdf [accessed: 01.12.2011]
- United Nations Environment Program (UNEP) (N.A), “What is Indigenous Knowledge?” Found at URL: http://www.unep.org/IK/ [accessed: 17.02.10]
- United States Geological Survey (USGS) (2011), “Irrigation Techniques”. In *Water Science for Schools*. Found at URL: http://ga.water.usgs.gov/edu/irmethods.html [accessed: 19.09.2011]
- Vail, John (N.A.), “Community-Based Development in Tari- Present and Prospects”. Found at URL http://epress.anu.edu.au/ssgm/conflict/mobile_devices/ch09.html [accessed: 02.09.10]
- Varma, A. (2003), “The Economics of Slash and Burn: a Case Study of the 1997–1998 Indonesian Forest Fires”. *In* Ecological Economics 46 (2003), pp. 159–171.
- Walker, W.R (1989),“Guidelines for designing and evaluating surface irrigation systems”, in *FAO Irrigation and Drainage Papers*. Professor and Head Department of Agricultural and Irrigation Engineering Utah State University Logan, Utah, USA. Natural Resource and Environment Department. Fund at URL: http://www.fao.org/docrep/T0231E/T0231E00.htm [accessed: 19.09.2011]
- Water Environment Partnership in Asia (WEPA) (N.A), “Case 3: Construction of tunnels, dams and irrigation systems in Bali”. Found at URL: http://www.wepadb.net/ngos/activities/indonesia/case03.htm [accessed: 12.04.10]
- World Bank (2006), “Making the New Indonesia Work for the Poor”. Found at URL: http://siteresources.worldbank.org/INTINDONESIA/Resources/226271116833355099 9/PovertyAssessment.pdf [accessed: 21.03.2011]
- Xie, Mei (2007), “Global Development of Farmer Water Users Associations (WUA): Lessons from South East Asia”. Found on the Website of the Vietnam National

Commission On Large Dams. Found on URL: http://www.vncold.vn/Modules/CMS/Upload/13/Documents/MXieEW.pdf [accessed: 06.04.2011]

- Yin, Robert K. (2002), “Case Study Research: Design and Methods”. Third Edition. Applied Social Research Methods Series Volume 5. Sage Publications Inc, Thousand Oaks, California.