Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.5, No.6, 2015

The Efforts of Spring Conservation through Local Wisdom at Lingsar, West Lombok, West Nusa Tenggara, Indonesia

Ahmad Jupri[1,2]* Zaenal Kusuma[3] Kliwon Hidayat[3] Mangku Purnomo[3]
1. The student of Doctoral Program of Agriculture Science, Univeristy of Brawijaya, Malang, Indonesia
2. Department of Biology, Faculty of Science and Mathematics, University of Mataram, Mataram, Indonesia
3. Department of Agriculture Science, University of Brawijaya, Malang, Indonesia
* E-mail of the corresponding author: juprizikril@gmail.com

Abstract

Water is a vital requirement for living things either for plants, animals and humans. The needs of water during the rainy season can be fulfilled from rainwater, whereas in the dry season water demand is supplied from springs. In west Nusa Tenggara Indonesia, There is water crisis in 53 sub-districts and 232 village. So it is urgent condition to conserve the spring for the next generation. Water could act multipurpose, for drinking, bathing, washing, toilet also for economic activities in agriculture, plantations, animal husbandry and fisheries, tourism; the role of water for religious worship activities are also very important. The purpose of this research are: (1) Identifying the characteristics of the soil (land), vegetation and climate in the three spring catchments at Lingsar. (2) Studying the relationship between patterns of utilization of natural resources with the preservation of water resources at Lingsar. (3) Studying the relationship between traditional values in Topat war to the patterns of natural resource management. This study includes two (2) domain which is quantitative research to investigate biophysical soil, vegetation and climate and social fields, economic and cultural uses qualitative research. The survey results found three (3) types of springs based on the discharge at Lingsar namely Sarasute and Sarasuake spring (large discharge), Pure lingsar I/Kemalik (medium discharge) and Pure Lingsar II/aik mual (small discharge).

Keywords: water, spring conservation, local wisdom

1. Introduction

Source of local wisdom in the form of kemalik, pujawali and Topat war in West Lombok Lingsar derived from religious teachings of Islam. Based on factual condition in the research area, the principles of their local wisdom-based on religious ecological / ecosystem. Celebration of local wisdom conducted at the end of the year highly filled with ideas and values relating to the management and conservation of natural resources and the environment, including water resources.

This already indicates a saving and environmental conservation efforts that public made since ancient times which can be seen from several things, among others,: at the activities of pujawali and topat war performed in the courtyard around kemalik calls for the requirements and various ingredients derived from plants and animals in the form of : setaman flower, *Rombong* (small barn), *Sesaji* (dish), *Kebun Udik (Mini garden),* Lamak, Momot, male buffalo, *Topat* (rhombus), in which all the materials are held and made by mutual cooperation and paraded around kemalik three rounds before the start of the Topat war; The next rhombus thrown as the main ingredient in the Topat war spread at fields and gardens for plants to flourish and fruiting so that the harvest is abundant.

Besides that, there are awaig awig around kemalik that must be obeyed by the local community or anyone who visited kemalik. From Kemalik, as far as 900 meters to the east, west, north, south should not be : (a) Making the destruction of nature (indiscriminate tree felling / without permission), (b) Immoral activities (adultery and liquor and kind of), (c) Raising pigs, (d) Eating pork (including the newly finished eating pork even from far away then he should clean up himself first, and may enter into Kemalik.

1.1 The factors That Influence Spring Discharge

1.1.1. Climate (Rainfall)

The influence of rainfall on springs can be seen from the fluctuations springs discharge according to the seasons. Davis and De Wiest (1966) mentioned generally spring discharge fluctuated in response to the amount of rainfall.

1.1.2 Vegetation

Vegetation interacts with the soil in influencing the hydrology of the region, so it can regulate the flow of rain

water into the groundwater, i.e. : (1) vegetation canopy intercept and evaporated back the rain water to the atmosphere or running it into soil surface through stem flow and throughfall; (2) vegetation litter will protect the soil from direct blows of the rain water and can add BOT, so it can maintain bio-physical characteristics of the soil; (3) vegetation roots provide a channel for the flow of water through the flow prefrential of the unsaturated zone to the groundwater, mainly on the ground that have low permeability, resulting in increased groundwater recharge; (4) extraction of groundwater in the unsaturated zone by plant roots to perform transpiration, decreases the amount of water percolation, which reaches the saturated zone (recharge); and (5) extraction of groundwater in the saturated zone as the discharge process of evaporation of a system that can lower the piezometric surface (Maitre *et al.*,1999).

1.1.3 Soil Biophysical Characteristics

The potential of subsoil layer to absorb water is determined by the capacity of percolation. Soil properties that determine the percolation capacity is soil permeability values. Permeability is the ability of soil water movement through the aquifer because of the influence of hydraulic pressure difference or the volume of water moving through the soil cross section per unit time (Walton, 1970).

1.1.4 Characteristics of Hydrology

Infiltration capacity correlated with the physical properties of the soil, which is positively correlated to porosity and organic matter content, and correlated negatively to the clay content and soil unit weight (Lee, 1990). Degradation of soil physical properties due to forest conversion into a mixture of coffee agroforestry causing a decrease in water infiltration in the forest 5,05 become 1,01 mm.second $^{-1}$ on a mixture coffee plantation without litter.

1.1.5 Geophysical characteristics

Aquifer characteristics that will affect the processes and mechanisms of groundwater recharge, that is types and geological formations zone (Asdak, 2002). Type of aquifer (rock type) will determine the level of the aquifer permeability. There are three types of source rock formations namely *fractured rocks formation*, porous rock and unconsolidated rock.

1.1.6 Local Wisdom Application in Forest Management in Indonesia

According to Rahmawati (2004) forest management involving the community called (*Community-Based Forest Management)*. Community-Based Forest Management based on the alignments to the people, especially the people who live in and around forest areas, with the principles of : a) community as the main actors, b) community as decision makers, c) institutional exploitation determined by community, d) certainty of rights and obligations of all parties, e) government as a facilitator and program guide, f) The approachment based on biodiversity and cultural diversity.

2. Materials and Methods

The steps in research activities initiated:

1) Identifying the characteristics of the soil (land), vegetation and climate in the three spring catchments at Lingsar with data collection conducted in 3 places, namely :
   a. The area with the large springs mostly are forest with trees / large timber with large canopy and the litter are fairly thick.
   b. The area with medium springs located on the plantation / agroforestry
   c. The area with small springs (number and small debits) even in the dry season the water is dried, located in the area that has been converted into rice fields and ponds.
2) Studying the relationship between patterns of utilization of natural resources with the structure of Topat war.
3) Studying the relationship between traditional values in Topat war to the patterns of natural resource management.

This study includes 2 domains namely biophysical domains and socio-economic and institutional domains. At biophysical Domain the data in the form of numbers, then the data processing with quantitative analysis. While the socio-economic and institutional domains is a qualitative descriptive study.

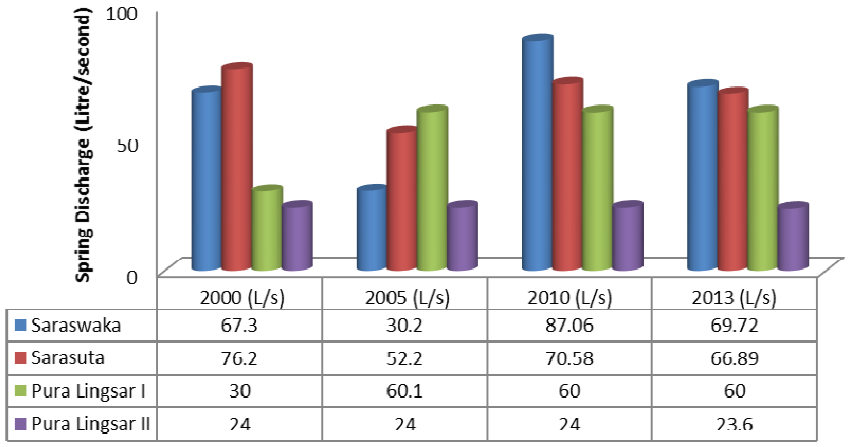
3. Result and Discussion

Lingsar as a village is also the capital of the Lingsar subdistrict lies in a lowland near the foot of Rinjani Mount

with a height of 116 meters above sea level. In 2010 the population totaled 11.685 people (men 5.734 person and women 5.951 person). The village borders as follows, at east is the village of Batu Kumbung,at west is the village of Peteluan Indah and the village of Bertais, at north is the village of a Sigerongan and at south is the village of Dasan Tereng.

3.1 Spring Characteristics and The utilization

Springs in the subdistrict of Lingsar divided into three locations namely: (1) Location of springs with large discharge namely Sarasute and Sarasuake, (2) Spring with medium discharge namely Pura Lingsar I (known as Kemalik/Pancor Siwaq). Kemalik is a purified spring water and sacred by the community surrounding Lingsar, is the site of local wisdom that became the center local wisdom ritual pujawali which the peak of the show is Topat war. (3) Spring with small discharge namely Pura Lingsar II (Aik mual) which serves as a water source community (Figure 1).



	2000 (L/s)	2005 (L/s)	2010 (L/s)	2013 (L/s)
Saraswaka	67.3	30.2	87.06	69.72
Sarasuta	76.2	52.2	70.58	66.89
Pura Lingsar I	30	60.1	60	60
Pura Lingsar II	24	24	24	23.6

Figure 1. Average Springs Discharge the Last 14 Year at Location Research

3.2 The characteristics of springs based on the discharge and discharge relationship with rainfall

Discharge of springs depending on rainfall few months earlier, generally rainfall data in Subdistrict of Lingsar West Lombok regency is high as shown in Figure 3. The influence of rainfall on of springs can be seen from the fluctuations of springs discharge according to season, both the rainy season and the dry season, as seen in Figure 2.

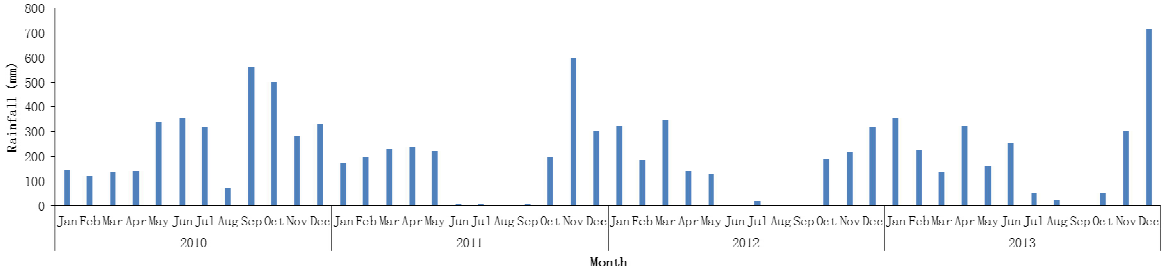
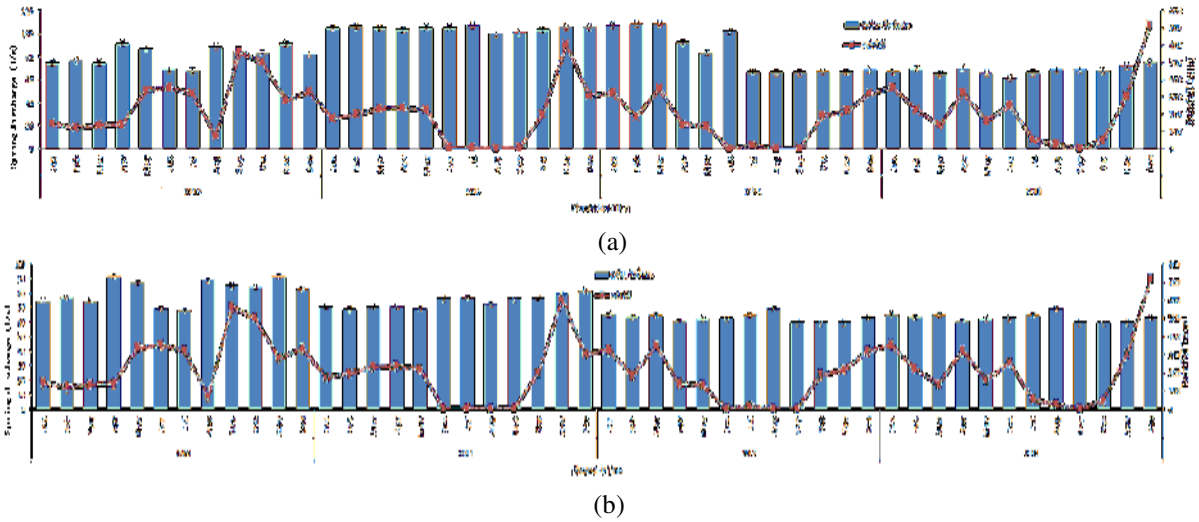


Figure 2. Profile of Rainfall in The Subdistrict of Lingsar 2010-2013

Lingsar subdistrict has rainfall of 1677 mm with monthly rainfall 197 and 332 mm. However, the amount of rainfall in the study area did not show significant differences. While the dried months occurred in June-October 2011 has a rainfall of 215 mm with monthly rainfall ranges from 0 and 199 mm.

Sarasute-Sarasuake spring shows the pattern of the relationship between rainfall and discharge which almost not the same, discharge of springs has decreased during the dry season but not too significant and increased again during the rainy season. Sarasute springs discharge reaches the peak in January-March 2010 and January-March 2011 (Figure 3) after 2 months of the ongoing rainy season.



(a)

(b)

Figure 3. The Relationship Pattern of Rainfall and Discharge of Springs with Standard Error; a) Sarasute spring and (b) Sarasukaspring in the 4 last year

Sarasute and Sarasuake spring is the spring with the large discharge. Malvicini *et al.* (2003) mentioned spring with the large discharge are not related to rainfall. In contrast, spring with the small discharge closely related to rainfall. The lack of correlation between rainfall and discharge of the spring Sarasuake and Sarasute is caused by the aquifer characteristics. Aquifer of Sarasute and Sarasuake spring located at a depth of 1.5 meters and 0.8 meters. Aquifer at the site of this spring is a free aquifer (unconfined aquifer). The flow of water from the shallow aquifer is a local stream water flow which is rapid and residence times for a few hours to several months (Englund, 1986). Groundwater from this aquifer is called free groundwater (unconfined) and the aquifer itself usually called water-table aquifer.

3.3 Land Characteristics at Study Location

3.3.1 Soil

Soil Ordo at three locations of springs (the springs of Sarasuta-Saraswaka, Pura Lingsar I and Pura Lingsar II) in general can be identified as Inceptisol soil. This soil Ordo classified young soil with growing newly developed horizon but not yet perfect.

Enrichment of organic matter derived from crop residues is one of the the primacy of maintaining the presence of vegetation land cover. Organic materials have an important role to the three part of soil fertility; physical fertility, chemical and biological soil (Table 1).

Table 1. Levels of Organic Materials at the location of the observation of the springs

Location	The depth (cm)	Organics Materials
Sarasuta	0-20	3.15
Saraswaka	0-20	2.58
Pura Lingsar I	0-20	2.02
Pura Lingsar II	0-20	1.85

Total porosity values obtained on sandy textured soils dominated by macropores, so it can illustrate two things, namely how easy ground to pass water (in the form of gravity water) and the ability of the soil to store water (as water available to plants), which occupies micropores. Dominant macropores provide benefits to ease the movement of water and air (soil aeration), but less meaningful for supply water for plants.

3.3.2 The Rate of Infiltration at Three Locations of Springs

Infiltration rate was measured using the method of double cylinder at the three location of the spring; (1) Sarasuta-Saraswaka springs, (2) Pura Lingsar I (Kemalik) spring location and (3) Pura Lingsar II (Aik Mual) spring location. The results of measurements at three locations springs indicated in Figure 7 shows the differences in the rate of infiltration at any location of the spring. The highest average infiltration rate is at sarasuta-saraswaka spring locations 1:32 cm / min, at Pura Lingsar I spring location infiltration rate is 0.87 cm/min while the lowest at spring locations of Lingsar II which is equal to 0:57 cm / min. Viewed from the classification of Kohnke (1968), then the rate of infiltration at saraswaka sarasuta spring location relatively fast

while at location of the spring of Pura Lingsar I and the spring of Pura Lingsar II classified (slow).

The highest infiltration rate in the initial phase or the first minute according to the model, namely 1,32 cm/ min occurs in spring locations of Sarasuta-saraswaka with vegetation of banyan, mahogany with a population density of 350 trees / ha, trees average age ± 50 year at location. Infiltration rate at location of the spring of Pura Lingsar I namely 0.87 cm / min and at location of the spring of Pura Lingsar II namely 0,57 cm/min with vegetation of mangosteen (agroforestry monoculture) and vegetation of mango and banana (community garden) with a density of 125 trees/ha and 342 trees/ha (spring locations of Lingsar II dominated by the banana tree).

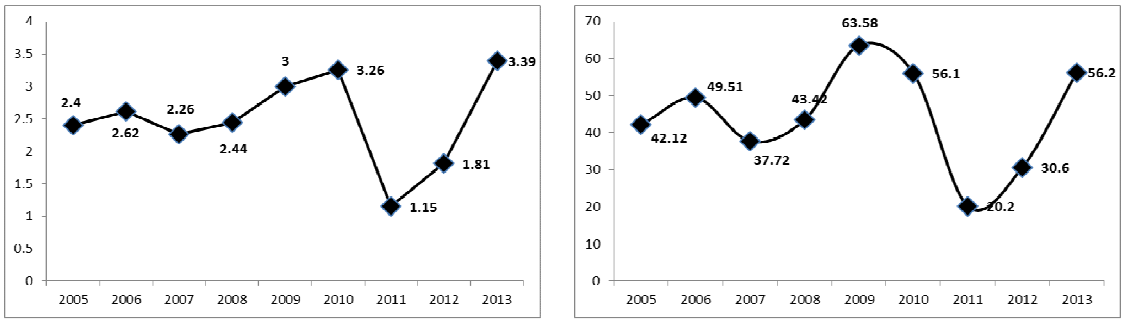
3.4. The location of the spring at Lingsar subdistrict and Its association with Watershed

3.4.1 Jangkok Watershed and Changes in Land Use

The implications of the change and the dynamics of the above, has led to changes in land use, mainly cause the decreasing vegetation cover at forest. Landsat interpretation results data show that the Forest Zone of Rinjani Lombok Island continues to have a change in land use, ie an average decline of 3.2 percent per year (Tjakrawarsa *et al*., 2009). These changes are associated with a variety of human activities associated with forest management practices by society and the birth of some product policies of local governments and central government.

3.4.2 Jangkok Watershed River Discharge

To determine the amount of water discharge in the river used several methods of measurement ie *Velocity Method* and discharge measurements with the method of hydrograph. Measurement results show that there is the occurence of fluctuations in instantaneous maximum water discharge as well as instantaneous maximum water level height. However, since 2007 until 2009 there was a significant increase. The enhancement of instantaneous maximum water discharge and instantaneous maximum water level height mentioned presented in the following figures 4.



(a) (b)

Figure 4. (a)Trend Maximum Water Interface Momentarily; (b) Trend Maximum Waterflow Momentarily (Central of Hydrology Department of Public Works NTB (West Nusa Tenggara) Province 2013 year processed)

3.5.Vegetation Characteristics at Study Sites

Based on observations in each study plot, vegetation cover is on sufficiently tight condition to very tightly with land cover coverage ranged from 50-90%. There was vegetation cover dominated by only one tree such as in the location of the spring of Lingsar I namely mangosteen tree.

3.51. The Composition of Vegetation Species at Study Sites

Inventory results of plant species at the three study sites found 84 species of plants with 10 tree species composition, belta 28 species, 22 species of shrubs and seedlings, herbaceous 26 species. The types of vegetation in the study area is a combination of forest trees, plantation crops, fruit trees and ornamental plants.

3.5.2.Canopy Cover

In the study site the characteristics of vegetation that plays an important role in the hydrological cycle is the architecture and vegetation canopy closure. Vegetation canopy cover at each location is determined based on the wide projection canopy cover of each plant, and then grouped according to vegetation classes, namely trees, Belta, shrubs, and herbs (Figure 5).

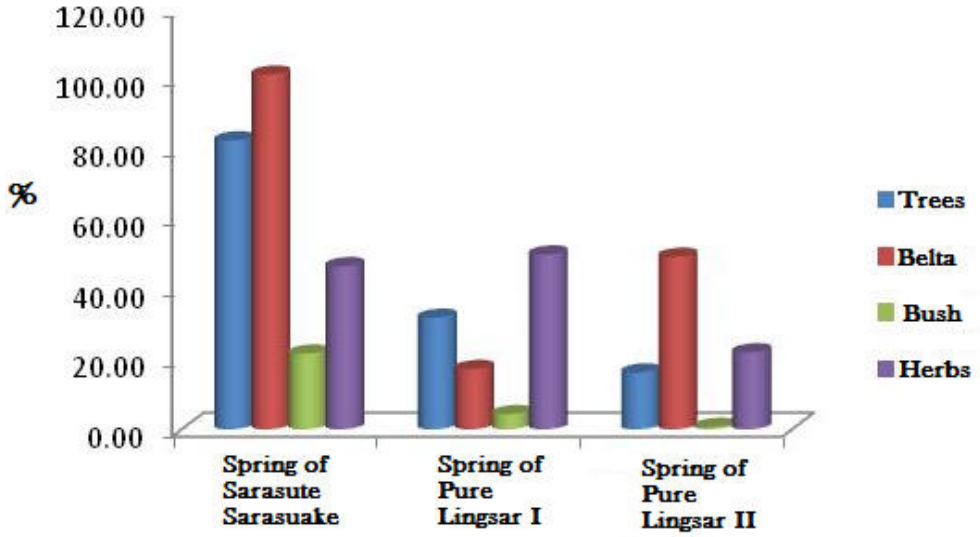


Figure 5. Percentage of area of vegetation canopy cover at each study site

3.6. Sosial Section

The implementation of Topat War conducted purely in mutual cooperation led by Pemangku kemalik. Mutual cooperation is performed by all good citizens whose Moslems or Hindu, they respect each other, silaturrahmi among fellow community keep maintained; farmers, farm workers, male and female, old and young, traders and civil servants, the rich and the poor regardless of social status and economic status between each other, they bring the materials and equipment needed for the event of pujawali and war Topat including making hovel or tetaring (a kind of canvas shelters/tents) which is the main raw materials such as wood and bamboo for poles and topped materials, while the roof is made of plaited coconut leaves.

When viewed from Awig awig springs maintainer group Pancor siwaq and structure of Topat war and springs protection committee structure Pancor Siwak Lingsar village which all led by Pemangku Kemalik (Mr. Supaman Taufik) which the members are pekasih included water user subak then automatically between Topat war structure and water management structures in the village of Lingsar have the very close relationship.

In addition, head of the Lingsar village also explained to protect water sources through reforestation the extinct trees (example nagasari tree that is in the environment of kemalik, division or distribution of water to subak Lingsar I derived from kemalik/kelebutan, mutual aid often led by pekasih, Village regulations regarding the protection of springs and natural resources are not written However unwritten rules remain to be implemented, among others, the use of water by the community for the fish pond where the water is wasted directly, arranged with the diameter of the pipe which is used to enter the water (small diameter) while for the pool where the water is not wasted / can be reused could use a pipe with a larger diameter to enter the water which would still ask for permission to pekasih, although water is always available and sufficient, the use of water is always economical / appropriate, Topat war as a sign of gratitude for the abundance of water community, utilization with rules agreed together (not arbitrarily, there are mutual cooperation, preparing completeness of Topat War, there were accounted for costs, labor, cooperative spirit shown especially if there were people died/death and marriage, using water and take water must have a permit of pekasih). The main function of the water from kemalik is for public drinking water, the purpose of worship / ritual, agriculture, plantation, animal husbandry and fishery as well as the object of religious tourism and ecotourism.

Based on the above description can be seen the development of water use at Lingsar from time to time as set out in Table 2.

Table 2. The development of Water Use at Lingsar from time to time

Potential	Past	Present	information
Water	Public drinking water, Toilets	Managed by regional water company	Rituals, worship
Agriculture	- Local varieties of rice (2 harvests a year) - Few types of vegetables are grown only for family needs	- new varieties of rice (3 crops a year) - Many types of vegetables grown intensively for commercial	- Rice barn of NTB -Kangkung vegetable exported to other regions
Plantation	Fruit trees planted at yard of the house only for family consumption	Fruit trees have been planted at fields or gardens and there were planted massively	- Fruit mangosteen, durian and rambutan exported out of the area
Fishery	Fish farming is only for hobby / fun and for meeting family needs	Raising fish for commercial purposes in the pond, farms, cages, minapadi system, bioplankton, UPBBI	Fisheries centre at NTB
Live stock	Raising chickens, ducks and goats for family needs and the needs of the feast. Raise cattle and buffalo to plow rice fields and its cages at their homes.	raising chicken massively cow for fattening commercial purposes. Cowshed collectively (for safety and environmental hygiene)	- chicken type namely broiler chickens and males - Type of cattle from the result of artificial insemination
Tourism	Local visitor for ritual purposes and treatment	Local visitors for the ritual and treatment, domestic and foreign tourists	Religious tourism and ecotourism

Economic commercialization on water resources at Lingsar resulting social response in the form of local wisdom to the management of water resources (Local Resource governance*)*

4. Conclusion

From the observation result at the field (*in situ*), at springs location, obtained several conclusions. The survey results found 3 types of springs based on the discharge at Lingsar namely Sarasute and Sarasuake spring (large discharge), Pure lingsar I/Kemalik (medium discharge) and Pure Lingsar II/aik mual (small discharge). Soil Ordo on the three springs namely inceptisol and soil texture included in Geluh Pasiran (Sandy loam) class, Levels of organic matter at Sarasute and Sarasuake is the highest followed by Pure Lingsar I and Pure lingsar II. The highest infiltration rate at Sarasute-Sarasuake is 1.32 cm/second, Pure Lingsar I is 0.87 cm/second and at Pure Lingsar II is 0.57 cm/second.

From the observation result Sarasute-Sarasuake spring shows the pattern of the relationship between rainfall and discharge which almost not the same, discharge of springs has decreased during the dry season but not too significant and increased again during the rainy season. Land use patterns at Sarasute-Sarasuake crowded with forest plants whereas at Pure Lingsar I and Pure Lingsar II is dominated by plantation crops (mangosteen, mango, banana). Vegetation area around the location of Sarasute-Sarasuake springs has the highest number of species than the location of the Pura Lingsar I and Pura Lingsar II springs. At that location, there are 18 kinds of plants with the dominant type of banyan with INP 116.8% and density of trees 67 ph / ha, followed by mahogany with INP 63.6% and a density of 350 ph / ha. It is already occurred economic commercialization on water resources at Lingsar resulting social response in the form of local wisdom to the management of water resources (Local Resource governance) namely Kemalik, Pujawali, Topat war. Operationalized through the organizational structure protection of springs as a form of institutionalization of the management of water resources that have legitimate law enforcement.

References

Asdak, Chay. (2002), Hidrologi dan Pengelolaan Daerah Aliran Sungai. Yogyakarta, Gajah Mada University Press.

Davis, S.N. and De Wiest, R.J.M. (1966). Hydrogeology. New York, John Willey & Sons, Inc., 463 pp.

Englund, J.O. (1986). Spring Caracteristic dan Hydrological Models of Catchments. *Nordic hydrology*. 17,1-20.

Kohnke. (1968). Siol Physic. New Delhi, Tata Mc Graw Hill Rubl Co.Ltd.

Lee, R. (1990). Hidrologi hutan. Yogyakarta, Gadjah Mada University Press.

Maitre D.C.L, D.F. scott and C. Covlin. (1999). A Review of Information On Interactions Between Vegetation and Groundwater. *Water south of afrika* **25**(2), 137-152.

Malvicini, C.V dan Sweetser, A.T. (2003). Kemiskinan dan Pembangunan Sosial.Pengalaman dari RETA 5894: Kegiatan Pembinaan Kapasitas dan Partisipasi II. Jakarta: Asian Development Bank. dalam Sistem Agroforestry. *Jurnal Penelitian Hutan dan Konservasi Alam* VII (2), 103-117.

Rahmawati W.S. (2004). Anatomi Buku Ajar. Jakarta, Departemen Pendidikan Nasional.

Tjakrawarsa G., Gede S., Dining A.C., Syafrudin, Fajar S., Basuki W., Agus J., Markum, (2009). Studi analisis hidrologis dan perubahan tutupan lahan kawasan Gunung Rinjani, Lombok. *WWF*. 87 pp.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar