Indigenous Knowledge (IK) of Water Resources Management in West Sumatra, Indonesia

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Abstract

This study aims to describe the indigenous knowledge of farmers at Nagari Padang laweh Malalo (NPLM) and their adaptability to climate change. Not only is water scarcity feared, but climate change is also affecting their food security. Local food security can be achieved if biodiversity in their surrounding area is suitable to the local needs. The study was conducted by using Participatory Rural Appraisal (PRA) such as observation and discussion. The combination of in depth interview, life history, semi structure questionnaire, pictures, mapping and expert interviews was implemented. Data was analyzed by using MAXQDA 10 and F4 audio analysis software. The result shows that the awareness of the people and scarcity of water conditions has allowed the people of NPLM to face this challenge with wisdom. Aia adat (water resources controlled and regulate by custom) is one of their strategies to distribute the water. The general rule is that irrigation will flow from 6 pm – 6 am regularly to all farm land under supervision of kapalo banda. When rains occur, water resources can be used during the day without special supervision. They used traditional knowledge to manage water resources for their land and daily usage. This study may be helpful for researchers and other farmers in different regions who encounter water scarcity.

Keywords: *Micro-climate changes; Traditional water management; West Sumatera*

Introduction

Water scarcity is one of the most pressing development challenges of the early 21st Century. According to securing water for food.com (2013) approximately 2.8 billion people—more than 40 percent of the world's population—live in river basins impacted by water scarcity. Nearly half live in areas of physical scarcity, where demand is greater than the available supply; the remaining 1.6 billion face economic water scarcity, where institutional, financial and human factors limit access to water despite an available natural supply. According to FAO (2012), agricultural water withdrawal accounts for 70% of total global water withdrawal. The assessment went on to estimate that up to two-thirds of the world's population would be living in water stressed countries by 2025 (Arnell, 2004).

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Climate change according to Intergovernmental Panel on Climate Change (IPCC) is refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2007). Changes in extreme temperatures have been observed. Furthermore, the IPCC in Working Group I explain that global average surface temperature rose 0.6°C, over the 20th century, total sea level rose 0.17 m in the 20th century and Arctic sea ice decreased 2.7% per decade since 1978 and the maximum area covered with frozen ground has decreased by 7%. The consequences of this, intense tropical storm and hurricanes as well as longer droughts occurring in tropical and subtropical are including in West Sumatra, Indonesia. Unpredictable and slight changes of climate affect farming systems, local people and water availability.

Water demand management is defined as any actions that reduce the amount of water used or enable water to be used more efficiently (Brooks, 2006); hence, the term water conservation is often used synonymously with water demand management (Baumann et al., 1998). According to Russell and Fielding (2010), some expert adopts the term “water conservation behaviour” to define and measure the broader concept of water demand management. Using Stern (2000) as a guide, the determinants of water conservation behaviours can be categorized into five underlying causes: attitudinal factors, beliefs, habits or routines, personal capabilities, and contextual forces.

Over decades farmers and indigenous people wisely adapt to any changes, including changes of their local environment. Indigenous knowledge of societies is accumulated over historical time and it is a belief system stressing respect for the rest of the natural world, furthermore evolving sustainable relations with the natural resource base (Oldfield, 1991). Many indigenous societies depended on a rather limited resources catchment of a few hundred square kilometers to provide them with a wide diversity of resources (Gadgil, 1993). Indigenous knowledge is herein defined as a cumulative body of knowledge and beliefs handed down through generations by cultural transmission about the relationship of living beings and their environment (Berkes, 1993).

This study is an excellent example that illustrates the practicality of local indigenous knowledge and the managing of biodiversity and natural resources. People in Nagari Padang Laweh Malalo (NPLM) are called Minangkabau. The mother plays a role from production until preserving the food. The interesting motivation of the Minangkabau`s is that they maintain their water resources in unique ways to achieve food security for themselves.

According to Carol et al (1988) who conducted research in Minangkabau she concludes that still there are a lot of aspects that can be elaborated concerning indigenous knowledge in agriculture system in Minangkabau based on the local agro-socio-cultural situation. The predominant focus is on the local level and what indigenous knowledge can contribute to a local sustainable-development strategy, potential, experiences, and wisdom. The aim of this study is to describe the indigenous knowledge of farmers at Nagari Padang laweh Malalo regarding their adaptability to climate change especially encounter water scarcity.

Methodology

The data collection method is Participatory Rural Appraisal (PRA) which is comprised of qualitative and quantitative data collection. The combination of in depth interview, life history, semi structure questionnaire, pictures, mapping and expert interviews were implemented. Data was analyzed by using MAXQDA 10 and F4 audio analysis software. The visit was done two times. A total 53 farmers between the ages of 22 – 73 years old were interviewed. Men and women are randomly interviewed. Interviews were started with the head of the clan and continue to groups of farmers and then households.

Result and discussion

Household characteristics

Based on interviews and investigation, the clan of *Sikumbang* had the largest land in comparison to other clans; *Chaniago*, *Koto*, and *Piliang*. *Minangkabau* is the widely spoken language among all clans. Farming is the main activity. A typical household characteristic according to our investigation is consisting of a father, mother and children (n=53) with a ratio of male to female being (1:1). The families investigated had a monthly income US$ 55.5 (n=16), US$ 55.5- US$ 111.1 (n=21) and more than US$ 111.1 (n=12). Most of them were farmers (n = 27), traders (n=13) and civil servants (n=3). They have side jobs such as livestock breeding (n=13), *lapau* (coffee shop) (n=1), *ojek* (motorcycle as public transportation) (n=2), woods trader (n=1) and fishermen (n=3). Land status is clan ownership (n=24), family ownership (n=6) and father ownership (n=2) and rent (n = 1). The families investigated have less than 1 ha (n=24), 1 ha –2ha (n=7), and 2 ha-5 ha (n=1). Since most of the lands (n=30) are under clan ownership therefore only (n=1) a farmer could show evidence of ownership. The clan's ownership has less freedom in managing the land rather than individual ownership.

Topography characteristics

Every year in West Sumatera (0º29'38'' and 0 º 35'30'' South Latitude 100 º 22'36'' and 100 º 31'44'' East Longitude) monsoons occur two times with peaks season in March and December. The lowest precipitations are in June and July. The maximum averages of precipitation reach 4000 mm per year, especially on the west coast and east of West Sumatera; the minimum average of precipitation is around 1500- 2000 mm per year. Diversity in soil and climate may lead to the diversity in cultivation (Ultisols, Inceptisols, and Entisols). The crops are grown also diversely from one site to the other (Soil Survey, 1999).

There many stones on the farmland which is typical of soil closer to volcanoes; located between Mt. Marapi and Mt. Singgalang. The stones often damage the farmer hoes. There other typical soil is Andisols, which has andic soil properties of 60 percent of the upper layer with one outstanding features of high natural productivity.

The water sources are coming from hills adjacent to the farmland. The spring used for irrigation of the rice fields, is also used for household activity. There are at least 18 springs, some of them merging to form a larger flow. The water resources come from several springs such as: *Aia Situngka Banang, Sungai Baliang, Bigau, Aia Batuang, Batu Hampa, Aia Ubun-ubun, Sungai Rak Ilia, Batang Lasia, Muaro Buluah, Aia Lalu, Pincuran Lubuk, Siku Banda, Sawah Jambak, Sungai Pakak, Aia Sawah Dukik, Umpia* (which is used as a source of drinking water in a clean water program). When the dry season comes, most springs will run dry even with a maximum annual rainfall of 4700 mm.

Indigenous knowledge of water resources management

Topographically this location experiences cloudy condition daily, the winds come from the top of the hill, north east of the NPLM. Interestingly, there is not enough rain pouring to the farmland even though data shows an annual rainfall is 4700 mm, the rain largely fall behind the hill. The people describe this phenomenon as “shadow of the rain area” (fig. 1a). Despite this high annual rain falls, the particular valley where they live does not benefit because the topography diverts water flow into adjacent regions. However, there are also some advantages to this local micro-climate. The dry wind blowing from the top hill creates conditions in which pests and plant diseases cannot survive.

This seasonal and predictable phenomenon provides the people with a water resources management strategy. One example of a traditional farming approach is that, in some places the irrigation system is managed by the *adat* (custom) (fig.1b). One person is chosen as *kapalo banda* (the head master of irrigation) to manage the system. The traditional irrigation systems are strictly managed by ninik mamak (indigenous elders), which are directly appointed *kapalo banda* (which regulates water sharing during the night – irrigation).

Aia adat is used only for paddy cultivation, with accordance to the quota; if there is a violation of the rule, customary sanctions are used to punish the guilty parties. The land will be watered at night from 6 pm until 6 am in the morning; people are not allowed to see the water flow. There is a punishment if somebody tries to break the rule. A similar study in Mali done by Vandersypen et. al. (2007) revealed that in conflict on water management issues, a mediator is often called upon to make a decision. Conflict management follows pre-eminently informal patterns and passes through different steps. In the first step, the mediator is an influential farmer of the tertiary block, who may or may not be the canal chief. Most of conflicts are settled at this level. If no agreement could be reached, an influential person at the village level is contacted. The village chief can either take a decision himself (five villages) or call upon someone he judges to be more competent on the matter, such as the water bailiff, to whom he lends his authority (two villages). A study about optimal water management and conflict resolution was done in a Middle East water project by Fisher et.al. 2002 and revealed that a model that has been developed is called ‘‘WAS’’ for ‘‘Water Allocation System’’ is a model for the Israeli-Jordanian-Palestinian region. Such models can assist the formation of water policies, taking into account user-supplied values and constraints. They provide powerful tools for the system-wide cost-benefit analysis of infrastructure.

Local awareness of the scarce water conditions has allowed the people of NPLM to face this challenge with wisdom. *Aia adat* (water resources controlled and regulated by custom) is one of their strategies to distribute the water. Indigenous knowledge of water resources creates planting time accordance to the fluctuation micro-climate as shown in graph 1 below.

They have to maintain the schedule in order to water all the land fairly. They are maintaining the work together as well. There is a meeting among farmers before cultivation time begins. The meeting is to discuss when, each piece of land is to be cultivated or harvested, and to whom the work should designated. Rice is normally cultivated in *tahun* *gadang* and takes fourteen months for cultivation. The crop rotation is based on *tahun gadang*; rice planted as monoculture, with no intercropping occurring (14 months with 3 times the rice harvest). The crops were rotated every third year, for example, Rice-Peanuts-Corn or Peanuts-Rice-Corn. They are aware that rotation makes increase in soil fertility.

A similar study was done by David (2011) revealed that those villages with higher biodiversity is due to the awareness of their local people. The loss of a traditional farming system is the most common situation; the highest local biodiversity is related to the local wisdom in using their natural resources. Related studies about food insecurity explain that people tend to spread the risk of food insecurity by increasing revenue, either from agricultural activities (collected forest products), excluding farming, or other activities (Niehof, 2010). But in this area, people tend to face their food insecurity by finding the problem (in this case water scarcity) and solve it communally.

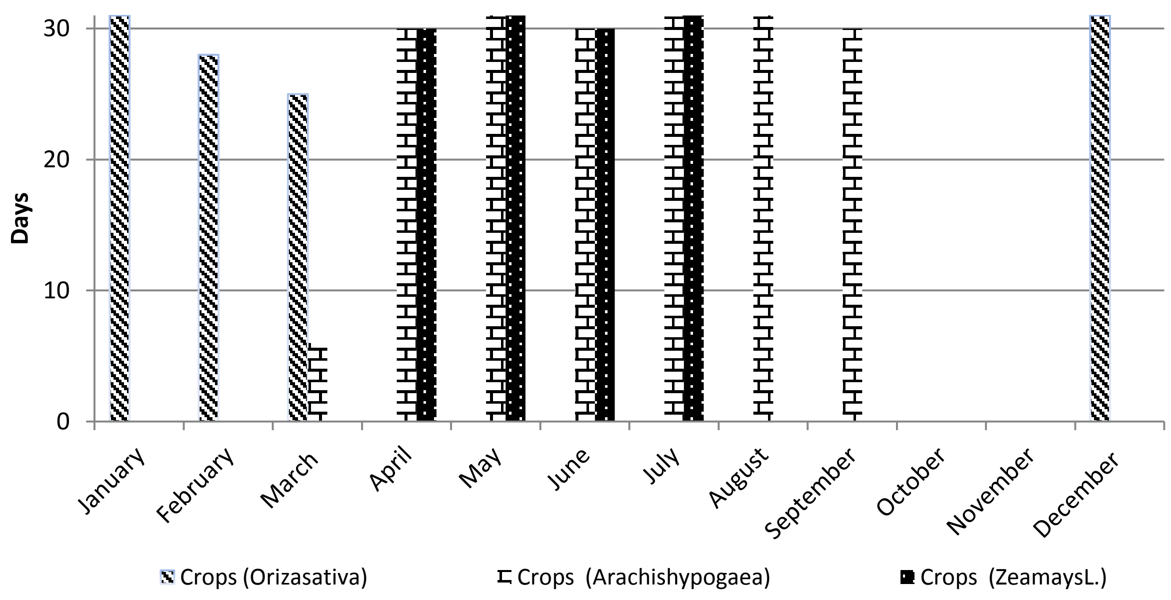

Figure. 1 Crops rotation in *Nagari Padang Laweh Malalo (Appendix with clear illustration)*

According to the survey, traditional water resource management of people at NPLM provides sustainability of rice production based on *tahun gadang* calenders. The daily household food intake revealed that they eat rice (n= 53) 2-3 times a day. Protein intake is from fish (n=17), egg (n=7), meat (n= 16) and other (including eel) (n=13). Vegetables intake are from cucumber (n=13), cassava leaf (n=32) and jackfruit (n=8). Fruit daily intake are from banana (n=25), papaya (n=24) and watermelon (n=4). Local Health Center reported, the nutritional status of this area is classified as well nourished. Up to now, there is no case of child malnutrition.

Figure 2 (a) Shadow of the rain area phenomena, (b) small creek to watering the farmland

Conclusion

The study revealed that farmers are practicing indigenous knowledge regarding their topographical disadvantageous. They created *aia adat* regulation to watering their land fairly, bringing benefit in terms food security. The above findings may be helpful for other farmers as well as researcher to learn from the wisdom and techniques. The study may help the improvement of livelihood of the rural farmers of this district. These traditional knowledge based practices of this area are low cost and more profitable for farmer under water scarcity.

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Appendix

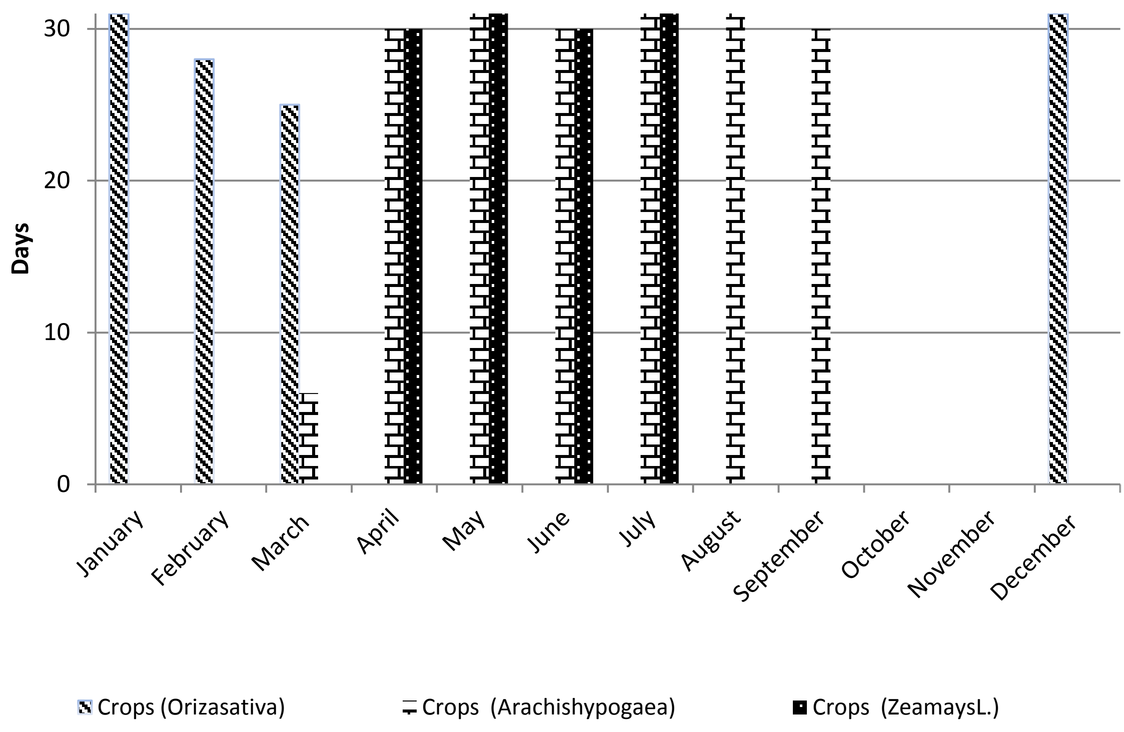

Figure. 1. Crops rotation in *Nagari Padang Laweh Malalo*

Figure 2: (a) Shadow of the rain area phenomena, (b) small creek to watering the farmland

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