# Impacts of Climatic Behavior Changes in the Terroir Elements of Uji Tea Cultivation

Fitrio Ashardiono, Ritsumeikan University, Japan

## The Asian Conference on Sustainability, Energy & the Environment 2014 Official Conference Proceedings 0706

### Abstract

Current on-going changes in the behavior of climatic conditions are very much evident with continuous increase in the degree of intensity. These conditions are very alarming for the agriculture industries especially those, which are utilizing unique *terroir* condition of a certain area for their production. Through these changes, the most affected *terroir* elements are climatic factor followed by soil factor, which can be clearly seen in Uji Area green tea cultivation. As the oldest and most famous green tea producing region in Japan, Uji Tea reputation have been built through its *terroir* characteristic and their long-running traditional agriculture knowledge. Changes on the climatic factors have directly affected the timing for leaf bud break thus changed the timing for harvest. Not only changing the period of cultivation process, damages caused by frost, drought, heavy rain and temperature extremities have directly affected the quality and quantity of the tea production. Observation and surveys conducted in Uji showed that it is necessary to develop new cultivation methods, which is based on a climate change adaptation framework. Through the application of this framework, Uji tea farmers would be able to pro-actively adapt with the on-going changes and ensuring the sustainability of Uji area as a tea-growing region.

Keywords: Climate Change, Tea Cultivation, Terroir, Traditional Agriculture Knowledge

# iafor

The International Academic Forum www.iafor.org

# 1. Uji Tea – Uji-cha

The term of Uji Tea might not be familiar for most people, only those who have a preference in drinking Japanese Green Tea would probably have heard this word. Even so what is commonly understand about Japanese green tea would be *matcha* or *sen-cha*. Based on the definition by Kyoto Tea Cooperative (2006) (Kyoto Prefecture, 2012), Uji Tea is a definition of tea products which are grown in four prefectures: Kyoto, Nara, Shiga and Mie; and processed inside Kyoto Prefecture by a tea manufacturer which based in Kyoto Prefecture. Although this definition has become rather wide, originally the term of Uji Tea is for tea products which are grown and processed in Uji Area in Kyoto Prefecture.

Uji Tea as a trademark and a geographical indication of tea products are widely known inside Japan as it is the mark of high quality teas. Although there are several tea growing regions in Japan such as Shizuoka and Kagoshima, in terms of matcha and *gyokuro* production, these two tea types which are produced in Uji Area are regarded as the benchmark for highest quality tea. Among Japanese tea ceremony instructors and practicioners, it is a tradition to use the best quality matcha, which is of course those which are produced in Uji Area. Similarly gyokuro tea is traditionally served as delicacy to guest during formal meetings as well as other formal occasions.









Fig. 2. Uji Tea Logo

## 2. Tea Cultivation in Uji Area

Uji Area also known as Uji City is located in the south of Kyoto City with population of 191,213 as 2014, and a land area of 67.55 km<sup>2</sup>. As mentioned previously Uji Area is the most well-known green tea producing region in Japan, with tea cultivation history dating back to 1191 AD. As one of the main reason why the definition of Uji Tea becomes so wide, Uji Area alone only have 81.6 Ha of tea fields whereas to ensure enough production volume, tea leaves from neighboring prefectures are brought inside to Uji Area for processing.

Despite the outsourcing method used by tea manufacturers, the tea farmers in Uji Area retains traditional cultivation methods which relies heavily on manual labor during cultivation process as well as tea harvest. Tea farmers in Uji Area use traditional covering methods in the tea cultivation process, which knowledge of this practice have been passed down through generations of tea farmers.

In this unique method, tea bushes are covered with sunlight blocking materials at the moment of first bud break, which the sunlight intensity is reduced up to 98 percent in three weeks period prior harvesting. Covering materials used in this method are traditionally using woven reeds and straws, although other artificial material like black vinyl sheet is also used. This method contributes directly to the character of Uji Tea flavor and taste. Because of this complex and resource consuming cultivation method, tea harvest in Uji Area can only be conducted once a year.





Fig. 3. Covering method using black vinyl sheet (a); traditional covering method using woven reeds and straws (b) (c) (d); tea bushes under covering method (e); tea harvesting (f)

### 3. Impacts of Climate Change

Current on-going changes in the climatic conditions have been directly affecting the agriculture and forestry industries, whereas the effects are evident in the tea cultivation especially because tea plants are sensitive towards climatic changes (Ashardiono, 2014). Based on observations climatic changes in Uji Area are: 1) sudden drop in temperature during Spring season; 2) higher temperature during fall season; 3) changes in quantity and period of rainy season; 4) longer period of drought; 5) diminishing morning fog; 5) diminishing characteristic of high quality tea.



(Source: Kyoto Prefecture Tea Industry Research, 2013)

Note: 1: January; 2: February; 3: March; 4: April; 5: May; a: beginning; b: mid; c: late

Fig. 4. Recorded Average Temperature (°C) between January to May (2002-2007) (a); Recorded Average Temperature (°C) between January to May (2008-2013) (b)

As seen in fig. 4, fluctuations of average temperature are clearly recorded in the year 2002 to 2013. The recorded fluctuations that happened between the year 2002 to 2007 was not as erratic as the fluctuations that happened between 2008 to 2013. Beginning in this term refer to the first ten days of the month, while mid refer to the second ten days, and late refer to the last ten days.



(Source: Kyoto Prefecture Tea Industry Research, 2013)

Fig. 5. Tea Productivity in Uji Area 2002-2013

Observation of these data showed how much changing climatic behavior have been affecting the tea cultivation process in Uji Area. These changes might or might not directly affected the tea harvest yield, but sudden climatic fluctuations will inevitably change the leaf physical composition which automatically affect the quality of the tea harvest. As a continuation of the previous research (Ashardiono & Cassim, 2014), further analysis showed that crucial period for Uji Tea cultivation happened between mid of February to beginning of May.

As a method to further understand the climate change effect towards Uji Tea cultivation, social surveys and observations are conducted on several tea farmers and their tea plantations between late 2013 to early 2014. Currently as there are 113 active tea farmers in Uji Area, whereas this number is actually bigger than what it represent. In each tea farmer's household, at least two to three individual are registered as tea farmer, thus this means the actual number of active tea farmers are only half or one third of the registered number. Through preliminary research, there are 15 tea farmers which cooperated in the social surveys and observations. Although the number is small, each respondent is most likely representing at least two tea farmers from their household, therefore the actual number of respondents would be around 30 farmers.

Interviews are conducted using semi structure method in which it was guided by seven main questions. The questions are structured into: 1) Demographic Information; 2) Agriculture Knowledge; 3) *Terroir* Comprehension; 4) Opinion on Climate Change; 5) Seasonal Cultivation Process; 6) Utilization of Precision Agriculture; and 7) Socio-Economic and Environmental Issues.

On the respondent's age group from 15 farmers, there are 4 farmers in the age group 30-39 years; 9 farmers in the age group 40-49 years; 1 farmers in the age group 50-59 years; and 1 farmers in the age group 60-69 years. Among them 78 percent possess tea cultivation experience for more than 20 years, while 22 percent possess 15 to 20 years of experience. This number correlates with questions about *terroir* comprehension whereas 77 percent of the respondents received knowledge on tea cultivation from their family, while the remaining 23 percent acquired cultivation knowledge through self-experience as well as information from fellow tea farmers. From this data it can be concluded that evidently there are traditional agriculture knowledge passed inter-generations among tea farmers community in Uji Area.



Fig. 6. Climate Change Effects on Uji Area Tea Cultivation

Regarding the questions about climate change effect towards tea cultivation, as seen in fig. 6 generally there are five recorded effects which are drought, frost, excessive rainfall, high temperature and low temperature. Among these events all of the respondents showed their concern especially on longer period of drought and rapid temperature fluctuations whether it is a sudden drop or a sudden climb. These events are seriously affecting not only the harvest yield, but also compromising the quality of harvest.

In response with the climatic changes, the respondents have indicated that there are several changes in the cultivation process such as: early harvesting, late deep soil treatment, early covering, summer covering, and utilization of watering system as well as frost fan. Traditionally, tea farmers in Uji Area previously did not use any watering system, until recently when drought period have become longer and harsher.

Around 69 percent of the respondents rely on external information sources such as television, radio and internet to acquire information on climatic condition, while remaining 31 percent utilized climate measurement equipment such as ordinary thermometer as well as more advanced monitoring station. Developing from the previous question, on the question about precision agriculture system, 62 percent of the respondent did not use any kinds of precision system, while 38 percent are somewhat utilizing the system to a certain extent. The respondents seem to have strong affinity toward soil condition as 54 percent answered that they would like to utilize precision agriculture system for soil management. The remaining answers consist of 23 percent showed their interest in climate control, 8 percent in leaf analysis and 15 percent answered that they are not interested in precision agriculture system.

On the topics on economic and social issues, 77 percent responded that it has becoming more difficult to maintain their household economic condition only with tea cultivation, whereas 23 percent of the respondents are processing and selling their own tea products because for these respondents it is not possible to support their family only with tea cultivation. On a broader discussion it is revealed that out of the current immediate issues faced by the tea farmers in Uji Area, 48 percent is about low sales value of harvested tea leaves, 36 percent on increasing expenses for tea cultivation and 16 percent is on successor problem of the tea plantation.

With the continuing trend of decreasing sales value, some of the tea farmers especially those who have sons, particularly late teens are beginning to show their

concern on the sustainability of the tea cultivation production in Uji Area. Their concern are mostly focused on how to attract the younger generation to continue the tradition of tea cultivation, because at this rate continuation of the tradition is in danger as most of the younger generation will choose to have different job instead continuing their family work.

## 4. Conclusion and Further Discussion

As mentioned previously although climate change effects are evident, not all of the tea farmers are fully concern about the possible outcome that might happened in the near future. In summary they understand the latent danger if they did not immediately take action to adapt with the rapid changes. Nevertheless as the result of social survey showed, they are more concern about the current economic as well as social situations of Uji Area.

As mentioned in the previous research, in order to swiftly adapt with the on-going climate change, as well as to maintain the economic and environmental sustainability of a climate change affected tea cultivation region, utilization of precision agriculture system is needed as a data gathering tool and to create new agriculture methods (Ashardiono, 2014).

Through analysis of the current Uji Area situation, utilization of precision agriculture system to some extent might further burden the economic condition of the tea farmers, which currently already struggling. Nonetheless by utilizing precision agriculture system, tea farmers would be able to receive many benefits such as detail measurement and monitoring data which is very useful for the traceability elements of their products. Traceability system allows the tea farmers to expand the market of their products as it provide all the necessary information that consumers needed, which in some sense a safe assurance for the tea products.



Fig. 7. Tea Cultivation Process in Uji Area

Secondly, utilization of precision agriculture system which is based on traditional agriculture knowledge will further refine the already practiced cultivation system,

thus creating new intervention methods to ensure the quality and quantity of the tea harvest. As seen in fig. 7 tea farmers could focus and conduct intervention during any of the critical phase during tea cultivation process. These methods which utilized precision technology will help young farmers to better understand the conditions of tea cultivation process.

Further use of the precision system will lead to identification and utilization of important bio-climatic indicators which are useful in selection of land and cultivars as well as prediction of tea harvest quantity and quality (Ashardiono & Cassim, 2014). In summary through utilization of precision agriculture system, the sustainability of Uji Area as a tea growing region can be ensured both from economic as well as social perspectives.

#### References

- Ashardiono, F. (2014). Climate Change Adaptation for Agro-Forestry: Sustainability and Potentials in the Tea Industry. *Policy Science*, 21 (2), 99-113.
- Ashardiono, F., & Cassim, M. (2014). Climate Change Adaptation for Agro-Forestry Industries: Sustainability Challenges in Uji Tea Cultivation. *Procedia Environmental Sciences*, 20, 823-831.
- Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 1251-1262.
- De Costa, W. J. (2008). Climate change in Sri Lanka: myth or reality? Evidence from long term meteorogical data. *Journal of the National Science Foundation of Sri Lanka* (36), 63-88.
- Holland, T., & Smit, B. (2010). Climate Change and the Wine Industry: Current Research Themes and New Directions. *Journal of Wine Research*, 21 (2-3), 125-136.
- Jones, G. V. (2005). Climate change in the western United States grape growing regions. *Acta Holticulturae*, 689, 41-60.
- Jones, G. V., & Davis, R. E. (2000). Climate influences on grapevine phenology, grape composition, and wine production and quality for Bordeaux, France. *American Journal of Enology and Viticulture*, *51* (3), 249-261.
- Jones, G. V., & Webb, L. B. (2010). Climate Change, Viticulture, and Wine: Challenges and Opportunities. *Journal of Wine Research*, 21 (2-3), 103-106.
- Kyoto Prefecture Government. (2012). *Tea Industry Statistic in Kyoto Prefecture* (in Japanese).
- Kyoto Prefecture Tea Industry Research Center. (2013). Annual Cultivation Growth Data (in Japanese).
- MacFarlane, A., & MacFarlane, I. (2009). The Empire of Tea. Overlook Press.
- Parry, M., & Carter, T. (1998). *Climate impact and Adaptation Assessment: a Guide* to the IPCC Approach. London: Earthscan Publications.
- Robson, C. (2011). Real World Research (3rd ed.). Wiley-Blackwell.
- Schipper, E. F., & Burton, I. (Eds.). (2009). *The Earthscan Reader on Adaptation to Climate Change*. London: Earthscan Publication.
- van Leeuwen, C., & Seguin, G. (2006). The Concept of Terroir in Viticulture. *Journal of Wine Research*, 17 (1), 1–10.
- Vezzoli, C., & Manzini, E. (2008). *Design For Environmental Sustainability*. London: Springer.
- Wijeratne, M. A. (1996). Vulnerability of Sri Lanka Tea Production to Global Climate Change. *Water, Air, and Soil Pollution*, 92, 87-94.