# Mapping the rainfall distribution for irrigation planning in dry season at pineapple plantation, Lampung Province, Indonesia (Study case at Great Giant Pineapple Co. Ltd.)

**P Cahyono[1], N K Astuti[1], Purwito[1] and A Rahmat[2]**

[1]Department of Research and Development, Great Giant Pineapple Company, Jl. Raya Arah Menggala Km 77, Terbanggi Besar, Lampung Tengah, Terbanggi Besar, Central Lampung Regency, Lampung 34163 Indonesia
[2]The United Graduate School of Agricultural Science, Gifu University, 1-1 Yanagido, Gifu, Gifu Prefecture 501-1193, Japan

**Abstract.** One of the problems caused by climate change is unpredictable of the dry season. Understanding when the dry season will start is very important to planning the irrigation schedule especially on large plantation**.** Data of rainfall for 30 years in Lampung, especially in Pineapple Plantation show that dry month occurs from June to October. If in two *decadals (ten days period)* rainfall less than 100 mm then it is predicted that next decadal will be dry season. Great Giant Pineapple Co. Ltd. has 32,000 hectares plantation area and located in three regencies at Lampung Province, Indonesia with varies rainfall between regions within a plantation. Therefore, monitoring the rainfall distribution by using ombrometer installed at 10 representative location points can be used to determine irrigation period at the beginning of dry season. Mapping method using the server program and data source is from 10 monitoring rainfall stations installed at the observed points. Preparation of rainfall distribution mapping is important to know the beginning of the dry season and thus planning the irrigation. The results show that 2nd decadal of April is indicated as the starting time of dry season, which is similar with Indonesian government for climate agency's result.

## 1. Introduction

Pineapple (*Ananas comosus* Merr.) is one of the commodity with large planting area and high production in Indonesia. This makes pineapple become the important economic plants in the tropic area [1,2]. Great Giant Pineapple Co. Ltd. (GGP) is the biggest pineapple exporter in Indonesia [3], with the total plantation area around 32,000 hectares with effective pineapple planting area approx. 20,000 hectares. GGP has a large area and belongs to the different regencies at Lampung Province. Climate change and global warming, in many ways, have adverse effects on the environment and humankind [4,5]. One of the indications of climate change is increases in the earth surface temperature in global scale [5] extreme weather condition and also changing in the precipitation pattern. Indonesia have dry season which is irrigation activities is needed to growing plant. Irrigation on pineapple plant is very important because it affects the growth and production [3].

The limitation of equipment in a large plantation area and unpredicted when the dry season will start caused by climate change, makes irrigation management and planning become very vital to support good production. Priority scale must be considered due to the large area with heterogeneous climatic condition. Moreover, the global climate change nowadays also influences the shifting of wet and dry season [6]. Mapping the distribution of rainfall will be important as base information to make

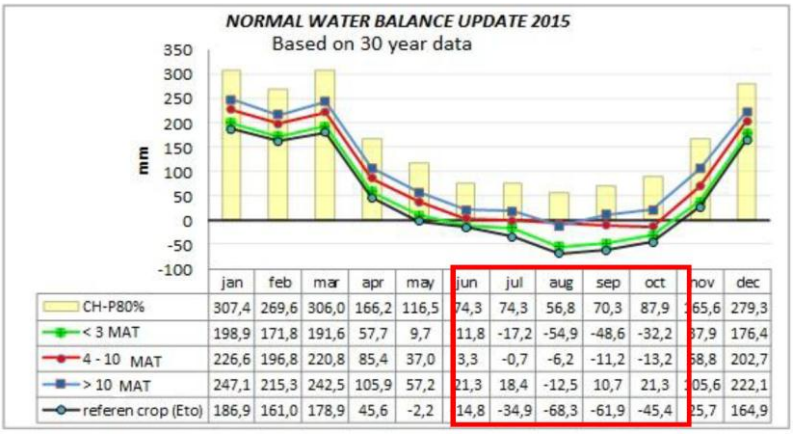
a decision on irrigation scheduling and to understand when dry season starts especially under global climate change issue recently.

## 2. Methods

The experiment was conducted in Great Giant Pineapple plantation, Central Lampung, Indonesia. The coordinate of Great Giant Pineapple is 4°49'07"S latitude and 105°13'13"E longitude, with elevation 46 meters above sea level. Precipitation data were collected from 10 locations (Div II, Div III, Div IV, Div V, Div VI, PG2, Lab PG3, R&D, Kijung, Lakop). Observation time was April 2017 (*decadal* 1 (1-10 April), *decadal* 2 (11-20 April), and *decadal* 3 (21-30 April) and supported with 30 years climatological data from meteorology station belongs to the company. *Decadal* (Dasarian) is 10 days period used by Indonesian government for climate determination.

## 3. Results and discussions

Figure 1 shows the water of pineapple in a different age of plant. Water balance shows the availability of water for a year which calculate the factors affect water availability (input and output), for the months of water deficit and surplus. Figure 1 and Table 1 show that pineapple plantation had water surplus in January - May, and November - December. This means that the surplus months occur for 7 months, whereas water deficit occurs for 5 months duration, from June to October with the peak in August.




| | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CH-P80% | 307,4 | 269,6 | 306,0 | 166,2 | 116,5 | 74,3 | 74,3 | 56,8 | 70,3 | 87,9 | 165,6 | 279,3 |
| < 3 MAT | 198,9 | 171,8 | 191,6 | 57,7 | 9,7 | 11,8 | -17,2 | -54,9 | -48,6 | -32,2 | 37,9 | 176,4 |
| 4 - 10 MAT | 226,6 | 196,8 | 220,8 | 85,4 | 37,0 | 3,3 | -0,7 | -6,2 | -11,2 | -13,2 | 68,8 | 202,7 |
| > 10 MAT | 247,1 | 215,3 | 242,5 | 105,9 | 57,2 | 21,3 | 18,4 | -12,5 | 10,7 | 21,3 | 105,6 | 222,1 |
| referen crop (Eto) | 186,9 | 161,0 | 178,9 | 45,6 | -2,2 | 14,8 | -34,9 | -68,3 | -61,9 | -45,4 | 25,7 | 164,9 |

**Figure 1**. Monthly water balance of pineapple in a different age of the plant.

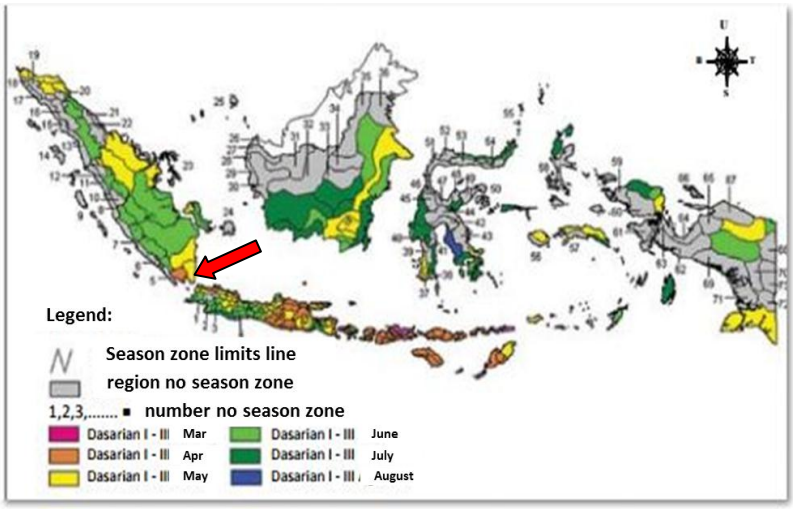



**Figure 2**. Map of the average starting time of dry season based on 30 years data (BMKG, 2011).

**Table 1**. Pineapple water requirement.

| Month | Evaporation | | Pineapple water requirement | | | |
|---|---|---|---|---|---|---|
| | | | *Crop factor* = 0,5 (small plant) | | *Crop factor* = 0,3 (big plant) | |
| | mm/mth | mm/day | mm/mth | mm/day | mm/mth | mm/day |
| Jan | 100.0 | 3.2 | 48.4 | 1.6 | 29.0 | 1.0 |
| Feb | 95.0 | 3.4 | 50.5 | 1.7 | 30.3 | 1.0 |
| Mar | 98.8 | 3.2 | 47.8 | 1.6 | 28.7 | 1.0 |
| Apr | 106.6 | 3.6 | 53.3 | 1.8 | 32.0 | 1.1 |
| **May** | **111.8** | **3.6** | **54.1** | **1.8** | **32.5** | **1.1** |
| **Jun** | **109.1** | **3.6** | **54.6** | **1.8** | **32.7** | **1.1** |
| **Jul** | **117.5** | **3.8** | **56.9** | **1.9** | **34.1** | **1.1** |
| **Aug** | **139.7** | **4.5** | **67.6** | **2.3** | **40.6** | **1.4** |
| **Sep** | **146.0** | **4.9** | **73.0** | **2.4** | **43.8** | **1.5** |
| **Oct** | **143.3** | **4.6** | **69.3** | **2.3** | **41.6** | **1.4** |
| Nov | 109.0 | 3.6 | 54.5 | 1.8 | 32.7 | 1.1 |
| Dec | 108.9 | 3.5 | 52.7 | 1.8 | 31.6 | 1.1 |

The movement of season starting time can easily indicated by the change of the precipitation pattern. Figure 2 shows that Province of Lampung has two different starting time of the dry season: around April and May, respectively. According to Figure 3,the starting time of the dry season moved forward 1-2 *decadal* in Lampung Province. The rainfall distribution maps during April in the plantation which refers to Figure 2 are presented in Figure 5.

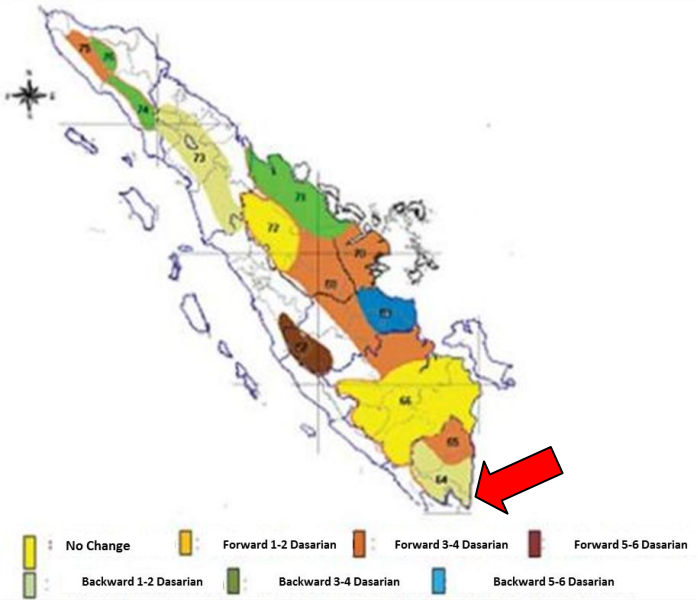
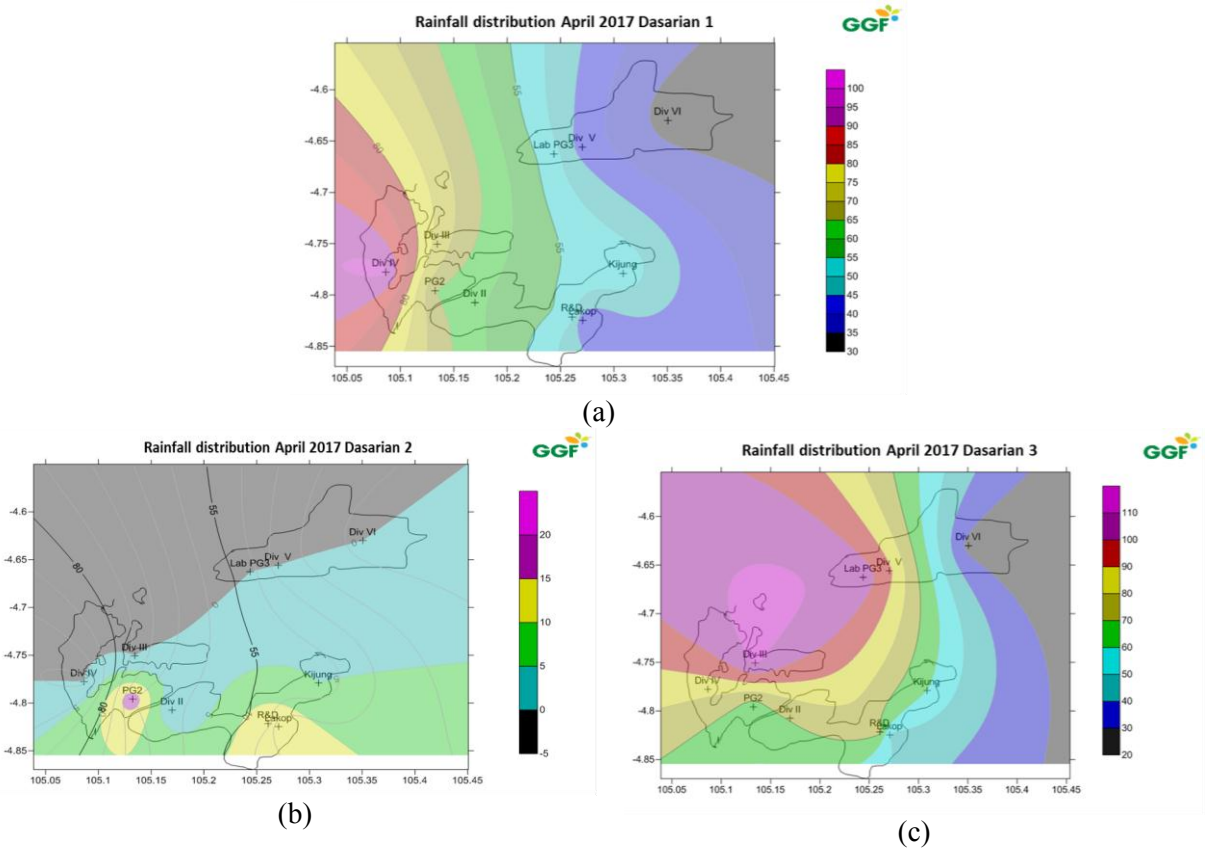



**Figure 3**. Movement of starting time of dry season based on 30 years data (BMKG 2011).

The provision of irrigation on a very large pineapple plantations is not the same between one location and another location. Therefore, on this 32,000 ha plantation, 10 rainfall monitoring stations were installed in representative points.

Figure 5 shows that mapping the rainfall distribution from *decadal* to *decadal* obtained there were still enough rain in the first *decadal* of April at all stations (more than 50 mm / *decadal*). Then the

second *decadal* shows a drastic drop of rainfall, where all stations indicated the accumulated rainfall data were very low (less than 50 mm / *decadal*). *Therefore, decadal* 2 of April is indicated as the beginning of dry season.




(a) (b) (c)

**Figure 4**. Mapping of rainfall distribution in pineapple plantation April (a) *Decadal* 1, (b) *Decadal* 2, and (c) *Decadal* 7.

## 4. Conclusion

In the pineapple plantation of Lampung Province, Indonesia, water surplus occurred for 7 months and water deficit occurs for 5 months (June to October) with the deficit peak is in August . $2^{nd}$ *decadal* of April is indicated as the starting time of the dry season. By this results, the anticipation of climate change impact on water deficit on pineapple plantation can be determined

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