The *Metroxylon Sagu* Habitat Suitability
(Present and Future Climate Conditions)

Introduction:

Metroxylon sagu (MS) or sago palm belong to the *Calamoideae* subfamily in *Arecaceae* family. It is native to the tropical islands of southern Japan. Nowadays, the main occurrences of *MS* are in southern and pacific Asia. This palm is cultivated for its starch used in food industry and for its leaflets/dried petioles used in building industry.

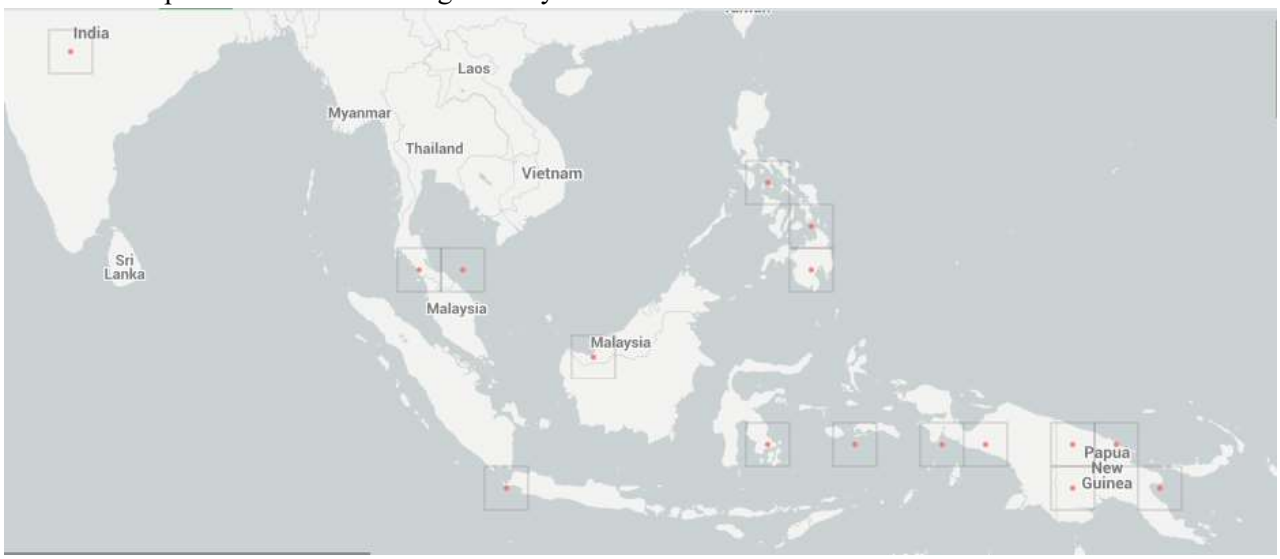

***Figure 1**: Present MS distribution from GBIF*
(https://www.gbif.org/occurrence/map?has_coordinate=true&has_geospatial_issue=false&taxon_key=273378)

Methodology:

The *MS* distribution modelling have been obtained by Maxent (Maximum model entropy) software. Inputs are two main settings:

- Specie occurrences: table with 34 coordinates (latitudes and longitudes from GBIF)
- Present and Future climate Variables (2050) selection

Climate variables were downloaded from worldclim.org, with a resolution of 5 arc minutes. To avoid correlations, four of them have been selected through Rstudio program:

- Bio1: Annual mean Temperature
- Bio6: Min temperature of coldest month
- Bio12: Annual precipitation
- Bio15: Precipitation Seasonality (coefficient of variation)

Sago palm requires very bright light. It develops in wet conditions and lowland tropical climates. Its optimal growth is in areas where annual daytime temperatures are within the range 25 – 36 °c and where the mean annual precipitation is in the range 3,000-4,500 mm. Therefore Bio1/Bio6 and Bio12/Bio15 provide data on temperatures and precipitations respectively.

Model Output:

The present distribution of *MS* is modelled in North and South America, in Europe, in South Australia and in South Asia. For the future distribution, there are little changes in the distribution pattern. Suitability of some areas decrease, for instance in Australia extremely suitable areas (in green) become less suitable (yellow) in 2050.

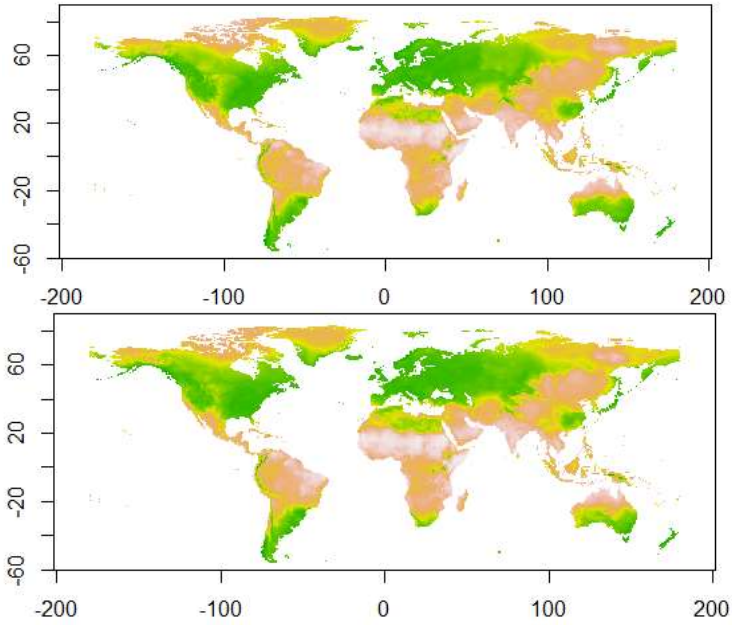

***Figure 2**: Current habitat suitability modelled with Worldclim data for MS*

Colour range: White (less suitable areas) to green (extremely suitable areas)

***Figure 3**: Future habitat suitability (2050) modelled with Worldclim data for MS*

Colour range: White (less suitable areas) to green (extremely suitable areas)

Model performance was estimated using AUC. It appears to be useful model but not reliable model, AUC= 0,746 rather than 0, 5 (random prediction).

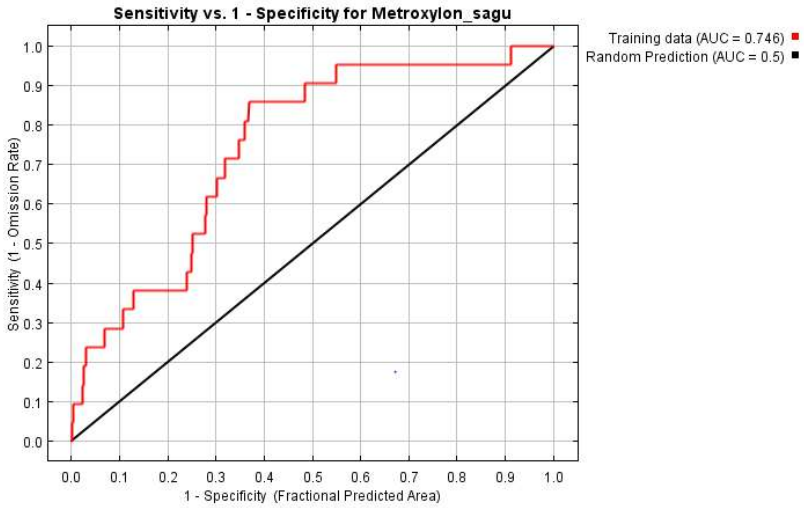

***Figure 4**: Graph showing the Area under Curve (AUC).*

From the climatic variable importance table, the main driver in the distribution pattern is precipitation Seasonality (Bio15).

Variable	Percent contribution	Permutation importance
bio15	62.8	65
bio1	18.1	9.3
bio6	12.2	16.9
bio12	6.9	8.9

***Figure 5:** Percent contribution of Climatic variables.*

Response to future scenario:

For the response to future scenario 2050, world map shows that the suitable habitat for *MS* is wider than its actual occurrence. This is probably due to the facts that only climatic variables are used and small occurrences are input to create this future scenario.

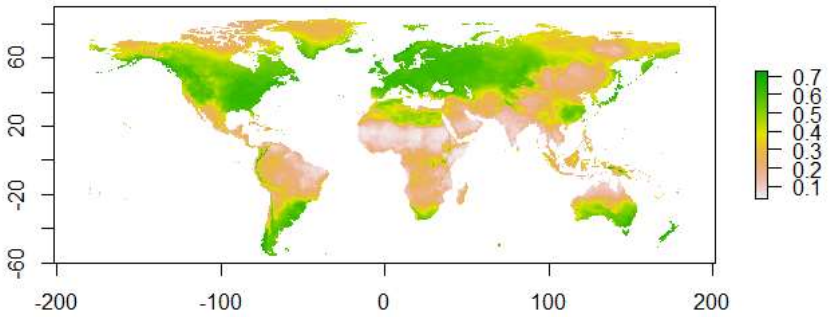

Figure 6: *Future habitat suitability modelled with Worldclim data for MS*

Colour range: White (less suitable areas) to green (extremely suitable areas

In 2050, Southern Asia (India and Thailand) might be less suitable than pacific Asia (Sumatra, Malaysia, Papua and New Guinea) for the *MS* growth.

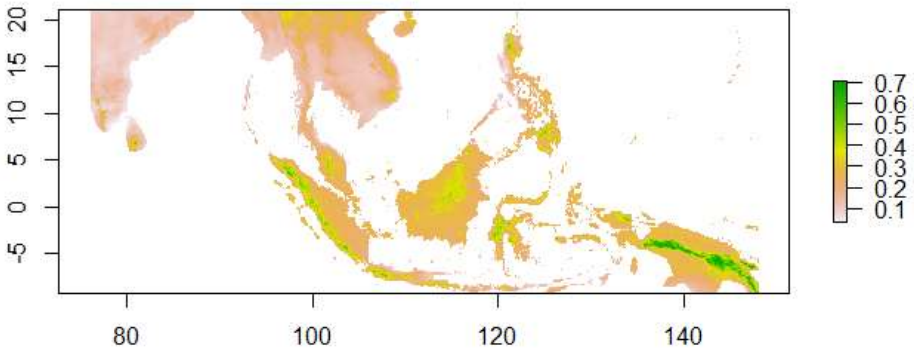

Figure 7: *Future habitat suitability modelled with Worldclim data for MS*

Zoom on MS occurrence area future habitat

Biological interpretation:

Bio15 is a measure of the variation in monthly precipitation totals over the course of the year, minor decrease in Bio15 means a large decrease in precipitations. *MS* grows in wet conditions, therefore the precipitation seasonality has a bigger influence on the model (63%). Temperature is an important parameter for *MS* development. Indeed, it is considered to be drought resistant but not freeze tolerant, that is why percent contribution of bio1 and bio6 are 18% and 12% respectively.

The suitable habitat change slightly between present and future models. Probably, it is because other factors like accessibility and biotic conditions (soil properties, species competition…) are more important than climatic variables in distribution pattern of *MS*.

Finally, the quality of the model might be improve with:

- More georeferenced occurrences input
- Climatic variables input which are more relevant for *MS* (example : as it is not freeze tolerant, focus on climatic variables which measure the coldest temperatures)
- Addition of biotic parameters and accessibility

References:

Food and Agriculture Organization, ECOCROP, Data sheet: Metroxylon sagu, (http://ecocrop.fao.org/ecocrop/srv/en/dataSheet?id=1466)