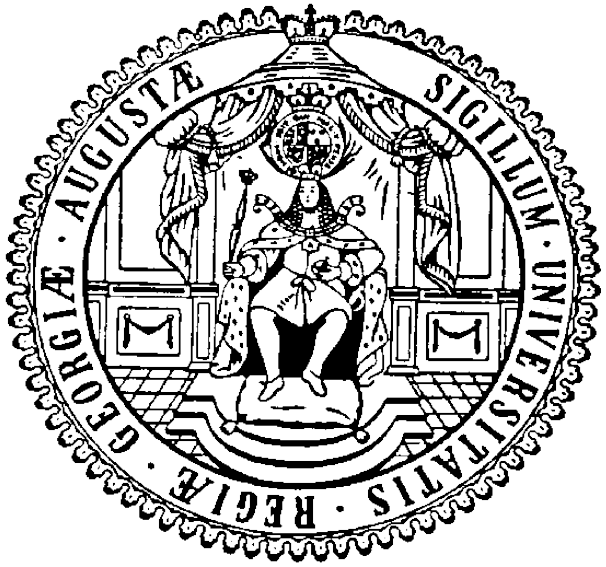
# Indodiversity: Analyzing biodiversity effects on rubber and oil palm plots in Jambi, Indonesia





**Module:** Data Analysis with R in Agricultural Economics

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**Master program:** Development Economics

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**Abstract**

Biodiversity loss due to transformation of tropical rainforest into utilizable land is one of the most relevant environmental topics of our time. An overall trend of reducing biodiversity at small-scale farm level sustained by the newest round of our dataset points into this direction. Our dataset combines agricultural, economic and ecological problem sets, as it analyzes species richness on rubber and oil palm plots in Jambi, Indonesia. One of the world's regions that is the most affected by tropical land-use change. Further analysis is needed to draw more substantial conclusions from the data.

**Keywords:** *Rubber, palm oil, Jambi, Indonesia, small-scale farming, species richness, lowland rainforest transformation*

# 1 Introduction

# 2 Main part

## 2.1 Literature insight and problem set

## 2.2 Data structure

Table 1: Data extract

| household ID | Number of species |
|---|---|
| 687 | 26 |
| 681 | 24 |
| 678 | 30 |
| 676 | 26 |
| 675 | 21 |
| 672 | 28 |
| 670 | 26 |
| 667 | 45 |
| 664 | 24 |
| 658 | 34 |

Figure1: Density of species reported per wave

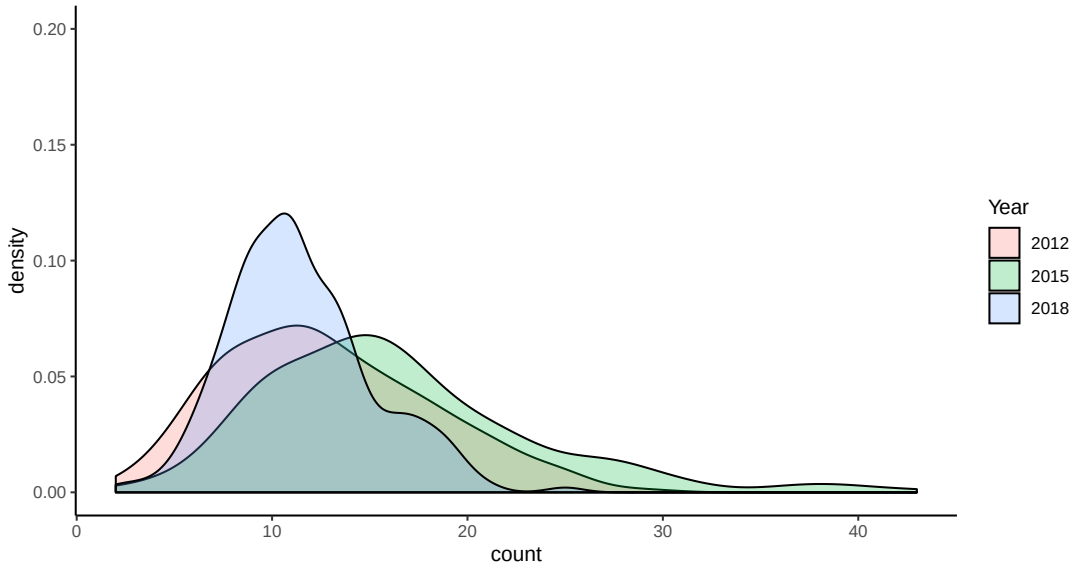
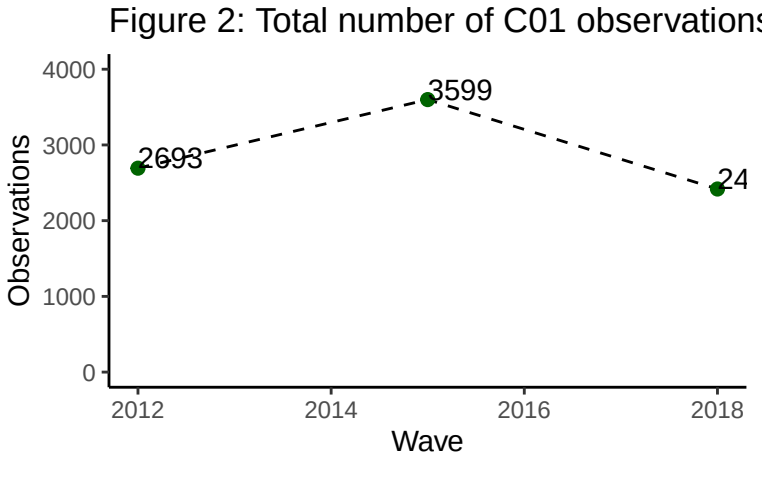



Table 1 shows some examples of how many different species were usually reported per plot. We see that the range is usually from 5 to 15 species. This data is from the last round of 2018. In order to make the reported numbers comparable, Figure 1 provides us a comparison of the densities of the number of species reported. As it can be seen, the peak of the distributions are slightly above a species count of 11. Although the 2015 wave has its peak at 15 species per plot. Furthermore, the 2018 wave has a higher peak which means that the numbers of species reported are distributed closer to

its peak of 10. While in 2012, 7.5% of the observations took a value around 11, in 2018 it was more than 10%.

Despite the minor differences of the densities of the data collection, the three distributions are quite comparable. That becomes even clearer when considering the large darkblue area which is covered by all three density graphs. Now, after having performed the first glimpse at the data, we can thus state that there are no severe inconsistencies.

### 2.2.1 before




### after

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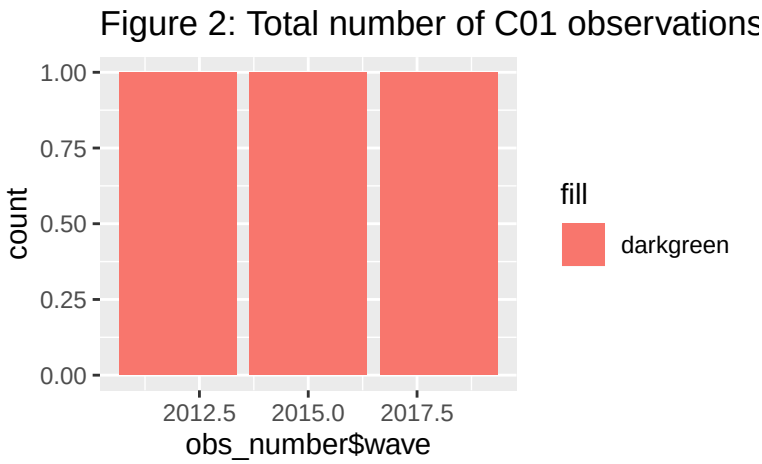



Figure 2 shows us the total number of observations in the data set. The number of observations is increasing in 2015 with respect to 2012 and decreases again in 2018.
### before

Table 2: Total number of species per wave

| Wave | Species |
|---|---|
| 2012 | 536 |
| 2015 | 1476 |

| Wave | Species |
|---|---|
| 2018 | 399 |
| ### aft | er |

Table 3: Total number of species per wave

| Wave | Species |
|---|---|
| 2012 | 536 |
| 2015 | 873 |
| 2018 | 399 |

## 2.3 Methodology

Beyond descriptive statistics which are presented in this paper, a more analytical approach is the use of biodiversity measures. For our C01 dataset the use of species richness indices such as the Simpson and the Shannon Index are the most appropriate. The formula of the Shannon index is as follows:

$$H = -\sum_{i=1}^{s} p_i \ln p_i \tag{1}$$

Where $s$ is the total number of species - in our case, we apply the total number of species found in each round. $p$ is the proportion - as long as the formula is applied at plot level - of the species $i$ found in one plot over all species. This proportion is then multiplied by the natural logarithm of the same. The index accounts for both abundance and evenness of the species found and the outcome of this index in one plot is comparable to the one of another plot in the same round.

The formula of the Simpson index is similar:

$$D = \frac{1}{\sum_{i=1}^{s} p_i^2} \tag{2}$$

The main difference regarding the interpretation of both indices is that the Simpson Index takes the dominance of one species on a plot into account. If there is a frequency of 2000 of one plant and four more plants of one each in a plot, the Simpson Index will yield a considerably low index of species richness. Whereas six evenly distributed plants of 500 each would yield a higher Simpson Index.

The Shannon Index is a rather general measure of plant richness and takes rather the total number of species that is reported per plot into account. The higher the number of species - the higher the index. For the sake of comparableness I decided that for the mapping I will use the Shannon index. The mapping will be discussed in the following part.

## 2.4 Discussion of the findings

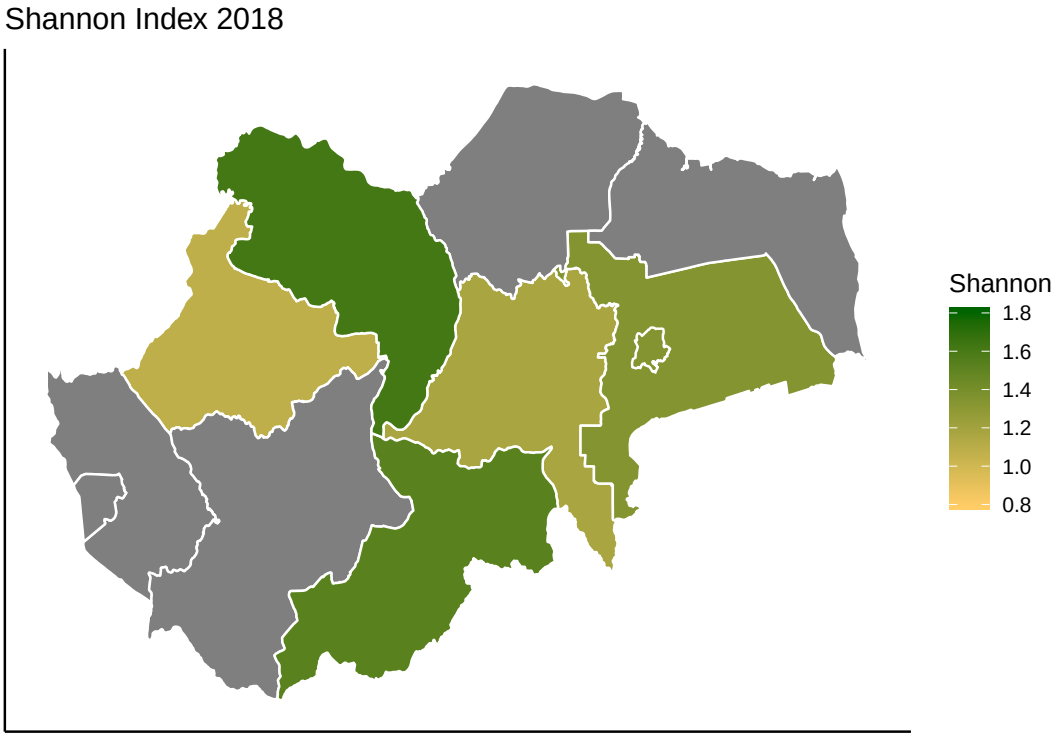
### 2.4.1 Invasives

Table 4: The most frequent species

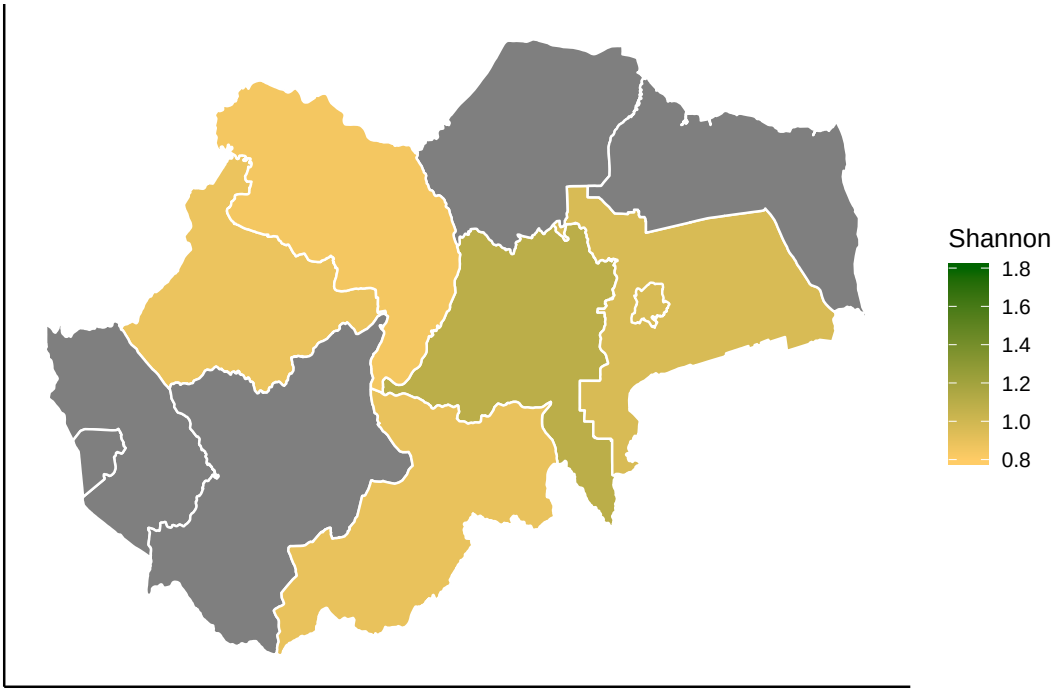
| Species name | Total frequency | Invasive species |
|---|---|---|
| Cyrtococcum patens | 35229 | no |
| Clidemia hirta | 11132 | yes |
| Centotheca lappacea | 10288 | no |
| Asystasia gangetica | 9140 | yes |
| Axonopus compressus | 8498 | no |
| Ottochloa nodosa | 8299 | no |
| Scleria ciliaris | 6699 | no |
| Leptaspis urceolata | 6592 | no |
| Legazpia polygonoides | 3924 | no |
| Dicranopteris linearis | 3811 | yes |

### 2.4.2 Mapping

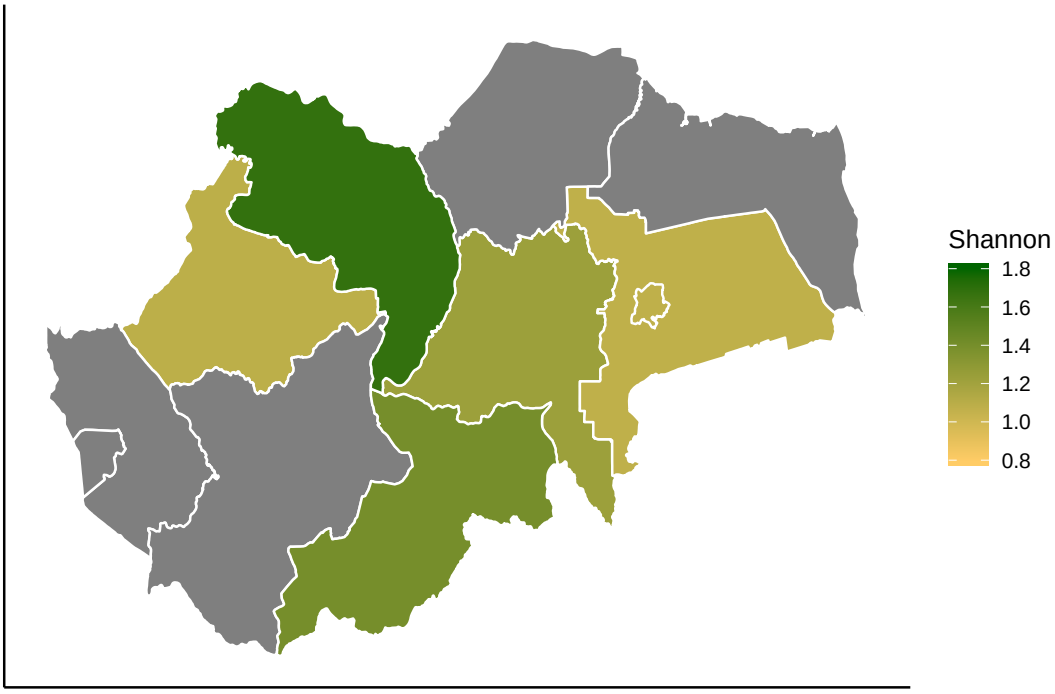
#### 2.4.2.1 before



Shannon Index 2015

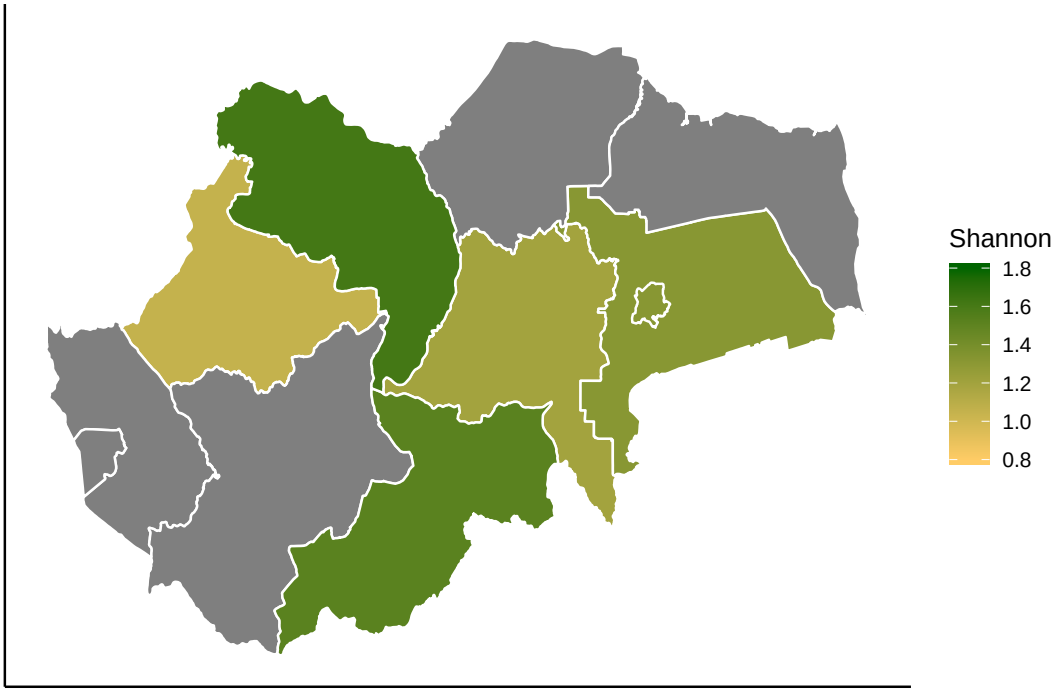



Shannon Index 2012

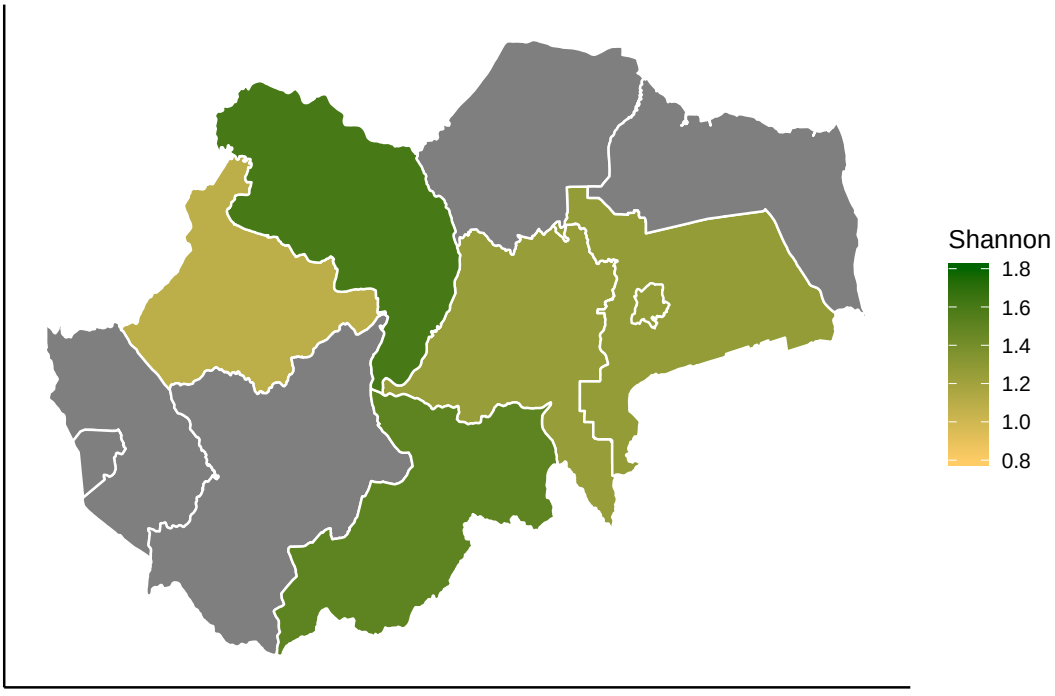


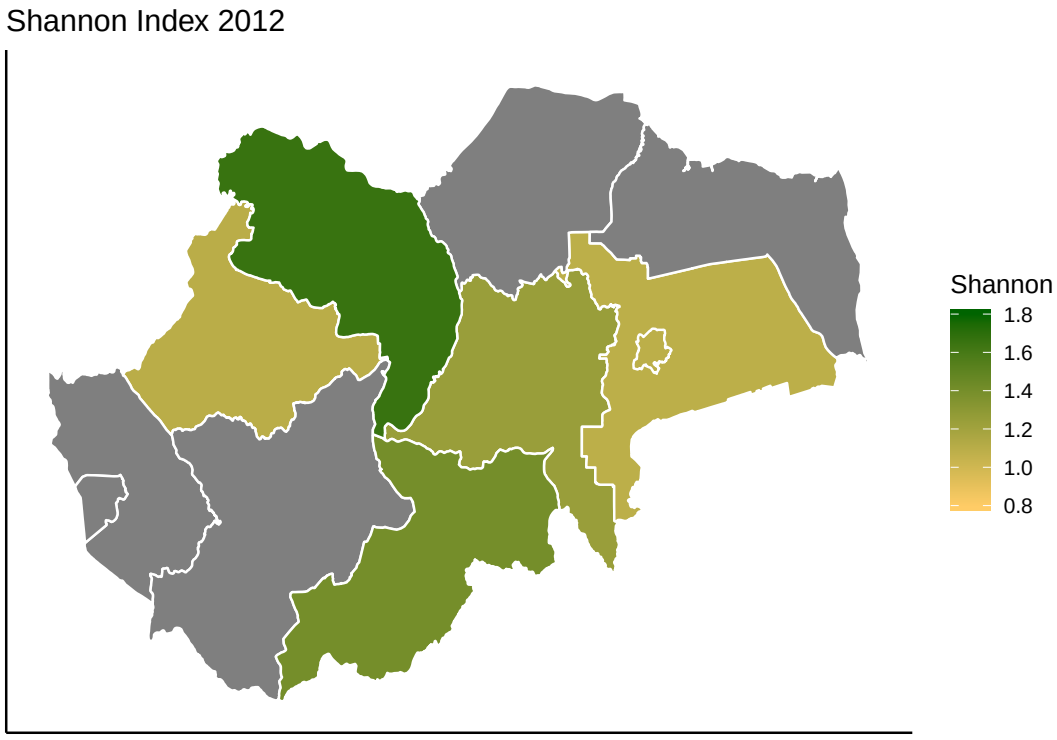

#### 2.4.2.2 after

Shannon Index 2018




Shannon Index 2015






# 3 Conclusion