Litter Fall Production in West-African Forests and Plantations

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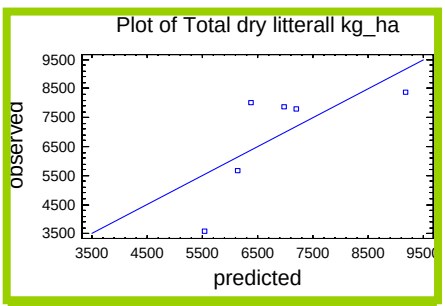
Abstract

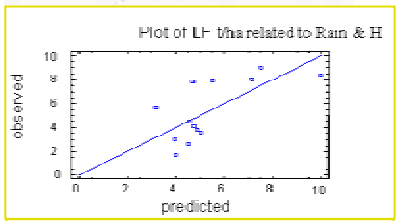
To predict litter fall annual quantity of forest and plantation in Benin, West-Africa, vegetation stand parameters like biomass were measured. The biological stand parameters, however, will not change as strongly as variation of litter fall over time and across regions in Benin, where unimodal and bimodal Guinean Coast climate rainfall regimes dominate differently in North and South. For predicting regionally more generalized and temporal dynamics of litter fall, climate change should be taken into account.
Moreover, the micro-site conditions like soil characters vary throughout the regions in Benin could contribute to more precise prediction of litter fall.

Material & Methods

Litter fall amounts of 6 sites in forest and plantations along the whole North, Middle and South Ouémè River Basin (10°N, 2°E—6°N, 2°E), were collected in a monthly interval for a whole year. Additionally, the litter fall data of other 6 sites within the same project IMPETUS in Benin were used. The biological stand parameters like Diameter at Breast Height--DBH, Basal Area—BA, Height of tree—H, Planting Density—PD were measured in situ. The soil samples in the same 6 sites were taken and analyzed in Germany. Climate parameters like 20 years average annual and monthly precipitation amount (1985-2004), number of rainy days, were supplied by Mr. Malte Diederich from the same project.
The statistic program Statgraphics Plus 5.1 was used in 3 steps for analyses:
1. Time series analyses of 12 sampling sites for: monthly litter fall quantities (**LFm**) vs. average monthly precipitation quantities (**Pm**).
2. Multiple regressions with 12 sites data was done.
2. Simple regression analyses with stand, site and climate parameters of the 6 sites.
3. Multiple regression analyses with 6 sites data for seeking prediction model of litter fall.



LF = 163.629*DBH + 3.8467*Pa
Model-3: R-squared = 97.1873 %
R-squared (adjusted for d.f.) = 96.4841%
Confidence level = 99%



LF = 0.00117854*Pa + 0.00484474*H
Model-2: R-squared = 91.1035 percent
R-squared (adjusted for d.f.) = 90.2948%
Confidence level = 99%

Table1 Litter fall data across 12 sites in Benin as related to different ecological parameters

Serial Nr.	LF t/ha	Precipitation mm	H cm	Veco m³/ha	N-Lat.	E-long.	Elev.
Boranglf	5.67	1137	380	37985	7.20	2.06	183
lafolf	7.88	1185	845	84516	6.98	2.13	87
latelf	8.37	1185	1767	176747	6.98	2.17	69
pofolf	8.00	1214	1176	117579	6.97	2.68	104
nfolf	7.81	1160	688	68831	9.76	2.35	317
nmglf	3.58	1160	760	76000	9.79	2.71	394
sefolf	9.02	1283	1245	124490	9.70	1.67	439
sefalf	1.72	1283	514	51350	9.70	1.67	439
secashlf	4.55	1283	633	63330	9.70	1.67	439
dfolf	4.10	1250	670	67020	9.02	1.94	384
dfalf	3.02	1250	514	51350	9.02	1.94	384
dcashlf	2.65	1250	633	63330	9.02	1.94	384
dorlf	3.78	1250	700	70000	9.02	1.94	384

Table 2 Litter fall across 6 sites in Benin as related to important soil and growth characteristics

Serial Nr.	LF kg/ha	Rain mm	DBH cm/tree	Sum BA m²/ha	Height cm	PD	Vbio m³/ha	N-Lat.	E-long.	Elev.	Soil C %
Boranlf	5675	1137	11	11	380	215	1	7.20	2.06	183	0.56
lafolf	7878	1185	15	20	845	344	6	6.98	2.13	87	2.49
latelf	8371	1185	28	62	1767	944	103	6.98	2.17	69	1.25
pofolf	7998	1214	10	111	1176	589	77	6.97	2.68	104	1.34
nfolf	7807	1160	17	39	688	656	18	9.76	2.35	317	0.91
nmglf	3583	1160	7	8	760	100	1	9.79	2.71	394	2.73

Results and Discussions

- Over all the 12 sites, 2 variables "Monthly litter fall quantity vs. Monthly precipitation" showed a moderately strong relationship with a correlation coefficient equals -0.505822 at the 99% confidence level.
- Multiple regressions for 12 sites to determine the annual total litter fall quantity (LF): annual Precipitation (Pa), Height or Latitude along could fit relative strongly LF. 2 or 3 parameters combined yielded some better models.
- When comparing with other site and climate parameters, the biological stand parameters like bio-volume (Vbio-m3/ha), DBH could fit and explain the LF and its variation better than climate parameter like Pa.
- Multiple regression for 6 sites to determine the LF: Generally, multiple regression with more possibility to select different parameters yielded better models.
- Annual litter fall quantity LF were more easier to predict than monthly litter fall quantity LFm.

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