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SOLAR RESOURCE AND POTENTIAL OF PHOTOVOLTAIC ELECTRICITY GENERATION IN CAMEROON : PV GIS APPROACH

Agriculture

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ABSTRACT

The estimation of PV potential generation of a 1 kW_p grid-connected PV system has been conducted in 59 localities of Cameroon with the online application "PV GIS". This investigation was made for a fixed PV generator with solar modules mounted: Horizontally, at optimum angle of inclination and at 90 °C. The results show that the highest values of PV generation potential are obtained with solar modules mounted at the optimum angle of inclination (1136.3-1566 kWh/kW_p). These values are greater than those of EU countries (470-1390). Global horizontal irradiation (GHI) values are(1673.1-2368 KWh/m^2) with conversion rate of GHI into PV electricity of (68.44-69.35%).The optimum angle of inclination is between 6and15 ° C, the national average is about10.89°C.Thefive localities with the highest PV generation potential are: Mokolo,Kousseri, Yagoua, Mora in the Far-North Region and Baham in the West Region.

KEYWORDS

Global horizontal solar irradiation, Photovoltaic electricity generation potential, Solar modules, Orientation and inclination of solar modules.

1. Introduction

Located in Central Africa, Cameroon stretches from the Gulf of Guinea to Lake Chad, between 1°40' and 13° north latitude; 8°30' and 16°10' East longitude. Triangular in shape, the country has an area of 475,444km^2, 1250 km long across the North-South and 860 km East-West axis. The country is bounded to the South by Congo, Gabon, and the Atlantic Ocean; to the West by Nigeria; to the North by Lake Chad and to the East by Chad (with a long coastline of 402 km) and Central Africa Republic [1]. Two great climatic zones are observed: South zone, rainy, humid with temperatures averaging19°C, lying between latitudes 5°C and 2°C North and the northern semi-arid zone, dry, with temperatures averaging 28°C, lying between latitudes 5°C and 13°C North [2]. The country is about 20 million inhabitants, with an annual population growth rate of 2.7% [3]. The solar resource is high within the country with daily irradiation estimated at 5.56 kWh/m^2/day in the cities of Bamenda, Bertoua, Yaounde, Douala and Ngaoundere [1]. The national average of Global Horizontal Irradiation (GHI) is 5.8 kWh/m^2/day [4].This solar potential (fig.1) remains undeveloped. The annual direct normal irradiation is <500Wh/m^2 in forest areas and >1700Wh/m^2in the northern regions.

Interest in PV has evolved exponentially in several countries in recent decades, it has risen from 30% in 1997 to 85% in the sector worldwide [5]. The calculation of PV generation potential of current PV technologies is the basic step in the analysis of future scenarios of energy supply and the implementation of legal framework and financial support to the expanding PV industry [6, 7].

The aim of this study is to contribute in the evaluation of the PV potential generation of grid-connected PV systems for the development and implementation of policies and programs in renewable energy in general and especially solar PV.

2. Data and Methodology

Data were collected in 59 localities (58 departments in the country) for 1 kW_p grid-connected system with online application “PV GIS” in 2015. PV GIS (Photovoltaic Geographical Information System) is an interactive web application developed by the European Commission for the acquisition of local solar radiation maps and performance evaluation of photovoltaic systems. The satellite data covers the Mediterranean, Africa and South East Asia. This web-interface is organized into three separate applications:

- Acquisition of solar radiation maps and climate related data;
- Estimation of the daily variation of the global irradiation;
- Estimation of the potential of solar power generation.

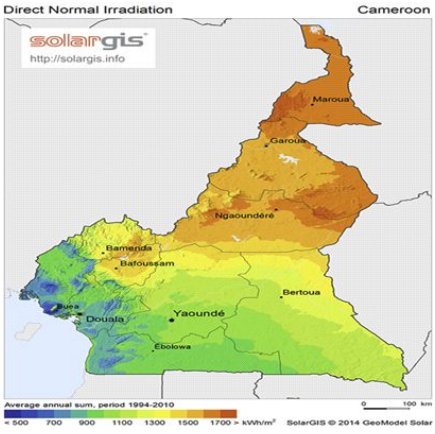


Fig.1. Direct Normal Irradiation in Cameroon [8] (Solar GIS, 2014)

The application calculates daily Global Horizontal Irradiation (GHI), PV generation potential and the angle of inclination or optimum orientation angle to reach maximum annual yield of the system [7, 9, 10, 11, 12]. In this study, monthly data of Global Horizontal Irradiation (GHI) and PV generation potential of 1 kW_pgrid-connected PV system were combined to obtain annual data for each locality as [7,10]. Thus for each PV module position (horizontal, at the optimum inclination angle and vertical), maximum values, average, minimum and standard deviation of the distribution, as well as the optimum angle of inclination have been determined by data processing in Excel 2007. Localities have been classified according to the yearly PV generation potential and the rate of transformation of the global horizontal irradiation into PV electricity.

3. Results

See (appendix 0) for the full names and codes of the 59 localities (locations). In the graphs some localities names do not appear, but are represented by a vertical-line.

3.1. Global Horizontal Irradiation (GHI)

a) Solar modules mounted horizontally

Thenationalaverage annual value of GHI received by modulesisto about 2022.38 kWh/m^2.The maximum value of the overallradiationarrivingonhorizontallyinstalled modulesis2299 kWh/m^2, observed in Kousseri (Far-NorthRegion), the minimum value (1658.6 kWh/m^2), is observed in Mundemba (South-West Region) with the standard deviation of 186.24. The Regionswith the highest GHI are: Far-North, North, Adamaoua, North-West and West with values of GHI significantly above the national average (Fig. 6a).

It can be seen (Fig.7a)that the monthly GHI is always above150 kWh/m^2 for all the northern Regions (Far-North, North and Adamaoua). Apart certain localities of South-West Regions, the monthly sunshine is greater than100kWh/m^2 throughout the territory.

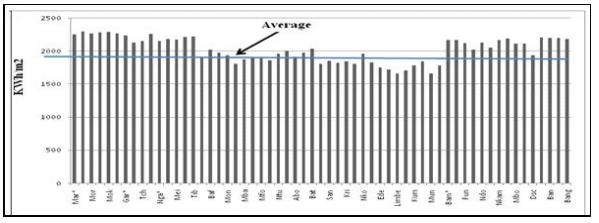
b) Solar modules mounted at the optimum angle of inclination

The mean annual global irradiation received by modules mounted at the optimum angle of inclination is2049.83 kWh/m^2.Themaximum and minimum are 2368 kWh/m^2; 1673.1 kWh/m^2 respectively with standard deviation of 195.96 (Fig. 6b). This value of GHI is above the national average in the localities of the northern Regions, North-West, West (except Dschang) and some localities of Center Region (Bafia) and East Region (Bertoua and Batouri).

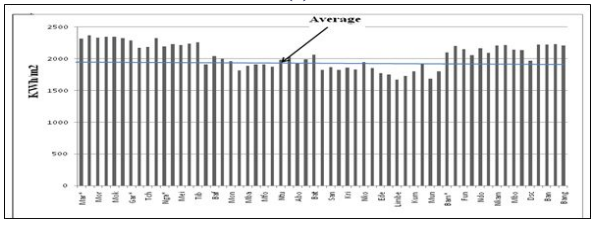
Apart from some localities of the Littoral Region (Douala and Edea) and the South-West Region (Limbe and Mundemba), all other localities receive a monthly global irradiation above 100 kWh/m^2(Fig. 7b).

C) Solar modules mounted at 90°C

The average annual GHI °is 839.14 KWh/m^2. The maximum and minimum are 1007.4kWh/m^{2}and707.5 kWh/m^{2}respectivelywith a standard deviation of 84.49 (Fig.6c). Within the country (Fig. 7c), the months with high GHI are December, January, February; those with intermediate GHI are October, March and Septemberandthe others with lowGHI are April, May, June, July and August.



(a)



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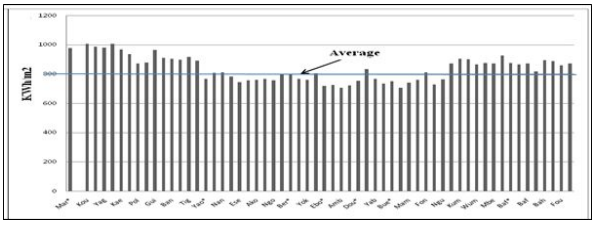
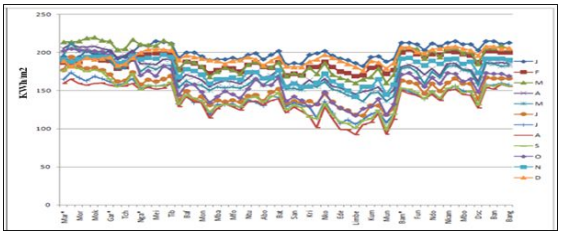
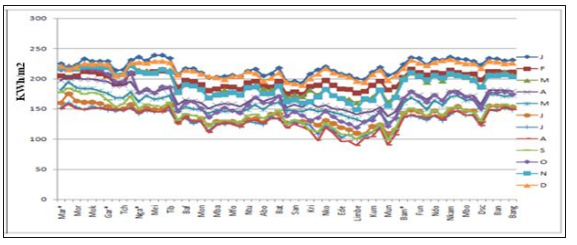


(c)

Fig.6. Yearly sum of Global Horizontal Irradiation(GHI) in kWh/m2 receives by a 1kWp system in 59 localities of Cameroon with solar modules mounted: (a) horizontally; (b) at the optimum angle; (c) vertically.



(a)



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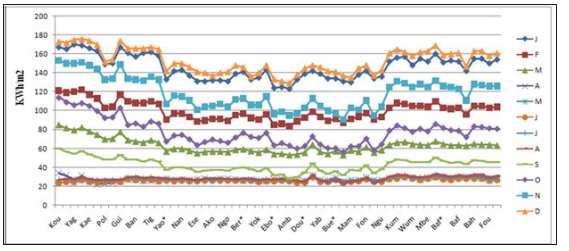


(c)

Fig.7. Monthly sum of GHI with modules mounted: (a) horizontally; (b) at the optimum angle; (c) vertically

3.2. PV generation potential

a) Solar modules horizontally mounted

The national yearly average PV electricity generation potential (kWh/kW$_p$) is 1376.14. The maximum value (1532 kWh) is observed in the locality of Mokolo (Far-North Region) and the minimum value (1127.4 kWh) in Limbe (South-west Region). The standard deviation of the distribution is 123.45 kWh. In general, high potential sites are in the northern (Far-North, North and Adamaoua), North-Westand West Regions with a potential greater than the national average. All other sites are potentially more or less below the national average. South-west region is the one who has the lowest national potential (Fig. 2a).

For the monthly PV generation potential it can be observed that only the northern regions have monthly PV potential of more than100 kWh/kW$_p$ during 12 months of the year. In the Far-North and North regions, the most favourable months for electricity production are March, June and October, while the least favourable months are March and April. In Center, South, East, Littoral and South-West Regions, the most favourable months for PV electricity generation are December, January, February and unfavourable months are April, September and October. In the West and North-West regions, the most favourable months are October, December and March, while the unfavorable ones areApril, June, and September (Fig. 3a).

b) Solar modules mounted at optimum angle of inclination

Thenational yearly average PV generation potential is 1391.67 kWh/kW$_p$. The maximum value 1566 kWh, is observed in Mokolo, the minimum value 1136.3 kWh in Limbe. The standard deviation is 127.19 (Fig.2b). The northern Regions, North-West and West Regions (except Dschang), have a PV generation potential significantly higher than the national average.

For monthly PV generation potential (Fig. 3b), only northern Regions possess a higher potential up to100 kWh/kWp during 12 months within the year. The favourable and unfavourable months of the others Regions are similar to those in horizontally mounted modules (as explained above in section a).

The Average optimum angle of inclination in all locations within the year is to about 10.89°C. The maximum is 15°C, the minimum6°Cand the standard deviation is 2.21°C (Fig.4). The northern Regions, South-West and North-Westpresent the greatest angles of inclination in general.

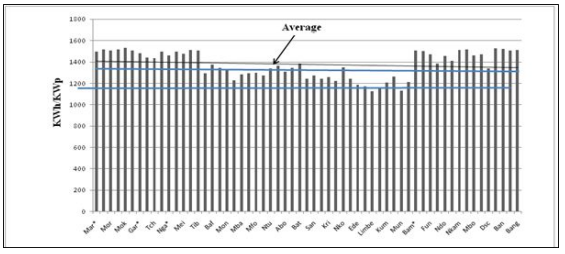
c) Solar modules mounted at 90°C

The average annual PV generation potential isto about 560.02 kWh/kW_p. The maximum value is667.6 kWh; the minimum is 469.1 kWh with the standard deviation of 56.21kWh (Fig. 2c).

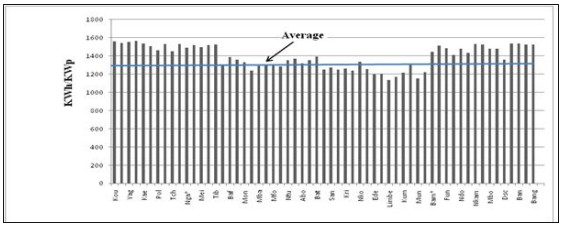
According to (Fig. 3c) classification of the months into three categories within the country can be made: the months with high PV generation potential (December, January, February);the months with average potential (October, March and September) and the months with low potential(April, May, June, July and August).

d) Classification of sites

With modules mounted at optimum inclination angle, it appears that the first five high PV generation potential sites are: Mokolo (1st), Kousseri (2nd), Yagoua (3rd), Mora (4th) in the Far-North Region and Baham (5th) in the West Region. The sites with the least PV generation potential in decreasing order are: Buea (South-West Region), Edea (Littoral Region), Mamfe, Mundemba, Limbe (South-WestRegion Fig.5).



(a)



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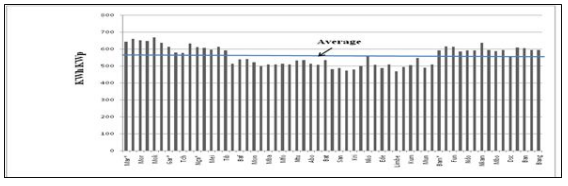
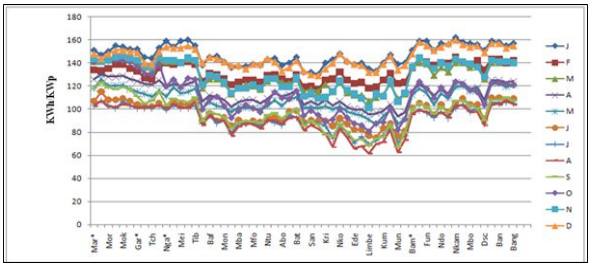


(c)

Fig.2. Yearly sum of PV electricity generation ptential for a 1kWp system in 59 localities of Cameroon (kWh/kWp) with solar modules mounted: (a) horizontally; (b) at the optimum angle; (c) Vertically.

(a)



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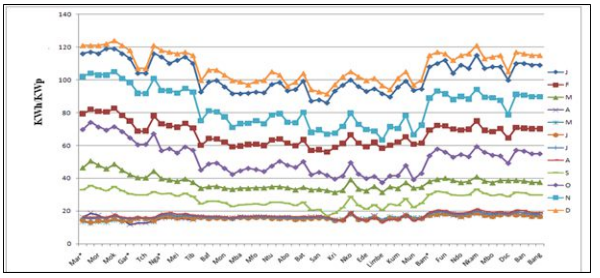

(c)

Fig.3. Monthly sum of PV electricity generation potential for a 1kWp system in 59 localities in Cameroon (kWh/kWp) with solar modules mounted: (a) horizontally; (b) at the optimum angle; (c) Vertically.

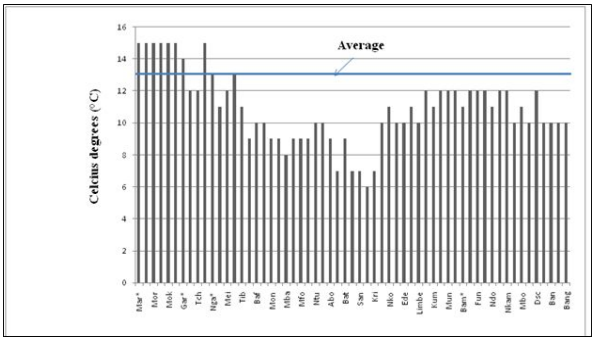

Fig.4. Optimum inclination angle (the angle at which the module receives the largest amount of total yearly global irradiation) for a South facing PV modules.

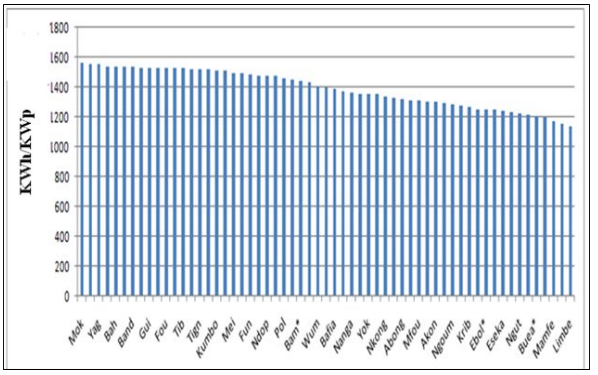

Fig.5. Ranking of localities according to the yearly PV potential generation at the optimum inclination angle.

3.3. Conversion rate of GHI into PV electricity

The average rate of conversion of GHI in PV solar electricity with solar modules inclined at the optimum angle is to about 67.92% per m^2. Its maximum value (69.35%) is observed in the locality of Nkambe (South-West Region), while its minimum value (68.44%) is observed in Kousseri (Far-North Region) the locality receiving the greatest value of solar irradiation(Fig.8).

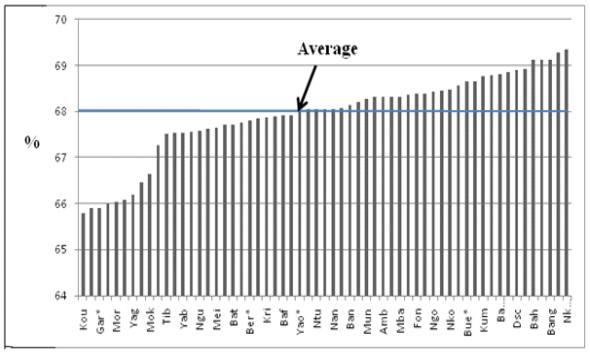

Fig.8. Conversion rate (% per m^2) of GHI receives by modules into PV electricity in 59 localities of Cameroon (Solar modules mounted at optimum angle of inclination).

4. Discussion and conclusion

The PV generation potential is higher with modules mounted at the optimum angle of inclination in comparison with the other two arrangements (horizontal and vertical).The difference is to about1. 11% with the modules mountedhorizontallyand59.75% with modules mounted at 90°C.ThePVgeneration potential varies (Fig. 9) in function of the angle of inclination. It is observable that the yearly PV generation potential curves (at optimum inclination angle and horizontally mounted) are superposed while there is a considerable gap between the PV generation curve of modules mounted at90 ° C.

PV generation potential of Cameroon per installed kilowatt peak (1127-1532 kWh) with horizontally mounted modules is greater than the one of the European Union countries(470-1390 KWh) as estimated by [7, 10]. The values of standard deviation of PV potential generation (123.45) for the horizontally mounted modules and(127.19) at optimum inclination angle, indicates that this potential is variably distributed throughout the territory. It varies depending on the positions of the localities (latitude, longitude, altitude), seasons of the year (climate), the inclination of the modules. For the whole territory, the most favorable month for PV electricity generation are the months from December to February, which are the dry season months with high degree of sunlight throughout the country.

The average annual PV potential (1391.67 kWh/kWp) with modules mounted at the optimum angle, represent0.0013% of the annual electricity consumption in Cameroon (103TWh) as said by [13]. Theoretically, to satisfy15%of the national energy consumption (businesses and services) [14], it will require a PV generator installation capacity of approximately12 MW_p. Such generator would require installation of PV modules on an area of about11.4 hectares if $1kW_p$requires surface of about $9.5m^2$[15]. Thus to meet1% of needs, it should be installed a capacity of$0.8KW_p$ covering an area of approximately 0.76 hectare of modules.

The results show that PV generation potential is proportional to the GHI. Kousseri possesses the greatest national GHI, but is ranking at the second place of the PVgeneration potential after Mokolo (the second highest GHI). This is also observable in some localities of the South-West. The maximum GHI is reached at the optimum inclination angle. Approximately67.89% of the radiation received by the modules are transformed into electricity (30% losses).The curves(Fig.10) of GHI received by solar modules mounted at the horizontal and at the optimum angle of inclination are superposed showing a considerable gap between them and the one of modules at 90°C.These results show that the angle of inclination should be close to the horizontal in the country for optimal PV electricity generation. When going from the horizontal position at the optimum angle of inclination PV generation potential increases (about 1%). But when reaches the vertical position (90 ° C), this potential decreases drastically (60% losses compared to the optimal angle of inclination). This study suggests that when deviating from the optimum angle to greater angles the PV generation potential decreases. Then within the country, it is preferable to mount the solar modules horizontally, instead of arranging them at any angle different from the optimum angle.

The conversion rate of the overall GHI increases with the altitude. In fact, the northern Region localities with greatest GHI (Kousseri and Mokolo) have the lowest conversion rate. The localities of West and North-West Region, located on the high mountains have the highest conversion rate.

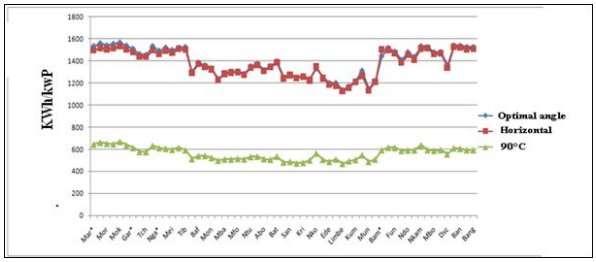

Fig.9. Comparative graphs of yearly PV potential generation of 1KWp system in function of solar modules inclination in 59 localities of Cameroon

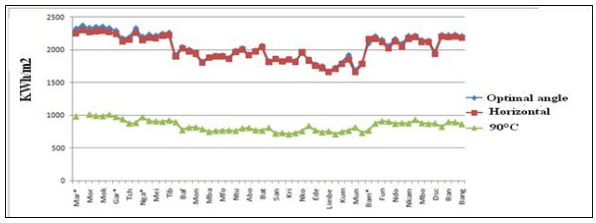

Fig.10. Comparative graphs of yearly GHI received by 1KWp system in function of solar modules inclination in 59 localities of Cameroon

APPENDIX 0. Full names, codes and geographical coordinates of the 59 localities

Maroua (Mar* 10°33'49"N, 14°19' 34"E, 400m), Kousseri (Kou12°5'13", 15°0'53" E, 295 m), Mora (Mor 11°2'33" N, 14°8'34" E, 462 m),Yagoua (Yag10°20'49" N, 15°14'13" E, 327 m), Mokolo (Mok 10°44'32" N, 13°48'15" E, 808 m), Kaélé (Kae 10°6'40" N, 14°26'35" E, 378 m), Garoua (Gar* 10°6'40" N, 14°26'35" E, 378 m), Poli (Pol 8°27'48" N, 13°14'38" E, 486 m), Tcholliré(Tch 8°23'51" N, 14°10'21" E, 371 m), Guider (Gui 9°55'32" N, 13°56'36" E, 344 m), Ngaoundere (Nga* 7°20'17" N, 13°34'0" E, 1094 m.), Banyo (Ban 6°45'11" N, 11°48'17" E, 1081 m), Meiganga (Mei 6°30'33" N, 14°17'35" E, 966 m), Tignère (Tig 7°21'35" N, 12°39'42" E, 1102 m), Tibati (Tib 6°25'18" N, 12°37'23" E, 861 m), Yaoundé (Yao*3°50'52" N, 11°30'7" E, 711 m), Bafia (Baf 4°45'16" N, 11°13'26" E, 492 m), Nanga-Eboko (Nan 4°40'26" N, 12°22'30" E, 614 m), Monatélé (Mon 4°16'31" N, 11°15'59" E, 399 m), Eséka (Ese 4°16'31" N, 11°15'59" E, 399 m), Mbalmayo (Mba 3°30'51" N, 11°30'27" E, 638 m), Akonolinga (Ako 3°46'57" N, 12°14'56" E, 651 m), Mfou (Mfo 3°57'56" N, 11°55'49" E, 759 m), Ngoumou (Ngo 3°35'38" N, 11°18'22" E, 681m), Ntui (Ntu 4°26'47" N, 11°37'27" E, 531 m), Bertoua (Ber*4°34'45" N, 13°40'36" E, 663 m), Abong-Mbang (Abo3°58'39" N, 13°10'47" E, 672 m), Yokadouma (Yok 3°31'55" N, 15°2'59" E, 524 m.), Batouri (Bat4°26'7" N, 14°21'42" E, 620 m), Ebolowa (Ebo*2°55'34" N, 11°9'21" E, 587 m.), Sangmélima (San 2°55'34" N, 11°9'21" E, 587 m.), Ambam (Amb 2°22'53" N, 11°15'59" E, 604 m), Kribi (Kri : 2°56'26" N, 9°54'36" E, 14 m.), Douala (Dou* 4°3'3" N, 9°46'4" E, 35 m), Nkongsamba (Nko 4°58'26" N, 9°56'7" E, 962 m),Yabassi (Yab 4°29'46" N, 9°58'17" E, 144 m), Edea (Ede 3°47'43" N, 10°8'12" E, 44 m), Buea (Bue*4°8'53" N, 9°14'43" E, 839 m), Limbe (Lim 4°8'53" N, 9°14'43" E, 839 m), Mamfe (Mam 5°45'4" N, 9°18'52" E, 89 m), Kumba (Kum 4°37'59" N, 9°26'42" E, 235 m.), Fontem (Fon 5°29'6" N, 9°51'45" E, 733 m.), Mundemba (Mun 4°58'24" N, 8°54'28" E, 143 m), Nguti (Ngu5°20'13" N, 9°25'2" E, 226 m), Bamenda (Bam* 5°57'46" N, 10°9'32" E, 1274 m), Kumbo (Kum 6°13'28" N, 10°40'33" E, 1671 m.), Fundong (Fun 6°16'55" N, 10°17'6" E, 1559 m), Wum (Wum 6°23'18" N, 10°4'30" E, 1074 m), Ndop (Ndo 5°59'38" N, 10°26'42" E, 1174 m.), Mbengwi (Mbe 6°0'45" N, 10°1'9" E, 1261 m), Nkambe (Nka 6°34'59" N, 10°41'44" E, 1717 m.), Bafoussam (Baf* 5°28'50" N, 10°25'42" E, 1381 m), Mbouda (Mbo 5°37'24" N, 10°15'15" E, 1385 m.), Bafang (Baf 5°9'36" N, 10°11'13" E, 1192 m), Dschang (Dsc 5°26'45" N, 10°2'49" E, 1334 m), Baham (Bah5°20'9" N, 10°23'34" E, 1594 m.), Bandjoun (Ban 5°22'2" N, 10°25'1" E,1510 m), Bangangté (Bang 5°8'39" N, 10°31'26" E, 1316 m)*Regional head quater

APPENDIX 1. PV POTENTIAL GENERATION (KWh/KWp) WITH SOLAR MODULES MOUNTED HORIZONTALLY

	Mar*	Kou	Mor	Yag	Mok	Kae	Gar*	Pol	Tch	Gui	Nga*	Ban	Mei	Tig	Tib	Yao*	Baf	Nan	Mon
J	132	128	132	137	135	134	135	132	131	134	143	141	144	146	142	130	135	136	132
F	124	122	124	128	128	125	124	120	120	125	131	132	132	133	132	119	125	125	122
M	138	139	140	141	144	139	138	134	133	139	139	140	138	143	140	118	126	125	122
A	131	134	132	133	134	131	129	125	125	130	123	125	123	128	127	110	115	113	111
M	128	136	130	130	131	128	124	120	119	126	118	125	121	125	125	105	112	109	107
J	118	127	120	119	120	118	114	110	110	116	109	114	112	114	117	94,9	103	95,5	98,6
J	112	116	112	110	115	112	109	108	109	112	107	109	108	110	110	92	99,6	92,4	94,7
A	107	111	107	107	109	109	106	106	106	108	105	107	105	107	110	88,8	97,6	92,9	92,4
S	118	122	120	117	120	118	111	105	108	116	104	109	107	108	110	90,4	98,4	95,9	93,8
O	134	134	134	135	135	134	131	126	126	132	116	121	116	124	122	98,7	107	108	101
N	127	125	127	129	130	129	129	126	125	129	130	132	130	133	132	116	121	120	117
D	128	124	128	130	131	130	131	126	125	130	137	139	137	139	137	130	133	133	132
Yearly sum	**1497**	**1518**	**1506**	**1516**	**1532**	**1507**	**1481**	**1438**	**1437**	**1497**	**1462**	**1494**	**1473**	**1510**	**1504**	**1292, 8**	**1372, 6**	**1345, 7**	**1323, 5**
Maximum	**1532**																		
Average	**1376. 14746**																		
Minimum	**1127. 4**																		
SD	**123,4 59086**																		

APPENDIX 1. NEXT

	Ese	Mba	Ako	Mfo	Ngo	Ntu	Ber*	Abo	Yok	Bat	Ebo*	San	Amb	Kri	Dou*	Nko	Yab	Ede
J	128	129	129	131	130	133	134	130	133	136	125	126	125	134	133	137	131	129
F	116	119	121	121	119	123	125	122	120	124	115	117	115	122	121	127	120	117
M	113	117	121	119	117	123	126	123	121	125	115	117	115	121	115	126	114	112
A	105	109	111	110	108	112	118	114	115	119	105	109	106	110	106	113	104	103
M	102	106	106	106	105	108	114	108	113	116	105	106	104	107	105	112	104	101
J	90,2	94,7	93,2	95,2	93,6	98,5	99,1	94	102	105	92,6	94,3	92,8	94,1	91,1	102	92,9	87,6
J	81,8	91,3	91,2	92,6	88,9	95,1	92,8	90,2	98,6	97	89,8	92,9	90,5	88,6	78,3	94,9	83,6	73,9
A	78,4	87	90,5	89	85,6	92,9	93	89,7	94	95,3	83,2	88	84,3	80,1	69	89,8	77,9	67,6
S	83,2	88,9	90,5	89,9	88,4	95,5	97,4	92,6	97,1	101	85,9	90,1	87,4	78,6	76,8	91,7	81,2	73,9
O	91,2	97,7	102	99,3	96,3	104	113	108	107	114	93,5	97,7	94,3	88,3	89,6	102	91,4	86,3
N	109	113	113	115	113	119	119	113	114	120	107	109	106	106	109	119	110	107
D	129	129	126	130	130	133	131	125	129	132	125	124	124	128	130	136	131	128
Yearly sum	**1226,8**	**1281,6**	**1294,4**	**1298**	**1274,8**	**1337**	**1362,3**	**1309,5**	**1343,7**	**1384,3**	**1242**	**1271**	**1244,3**	**1257,7**	**1223,8**	**1350,4**	**1241**	**1186,3**

APPENDIX 1. END

	Bue*	Limbe	Mam	Kum	Fon	Mun	Ngu	Bam*	Kum	Fun	Wum	Ndo	Mbe	Nkam	Baf*	Mbo	Baf	Dsc	Bah	Ban	Fou	Bang
J	129	126	123	130	133	128	129	147	145	145	139	144	142	147	147	145	145	139	147	147	143	146
F	116	114	113	120	122	116	118	136	136	134	130	133	133	138	135	132	136	127	137	137	133	136
M	110	107	109	112	121	108	113	140	139	138	128	135	131	139	139	135	136	126	140	140	140	139
A	101	98,3	99,5	102	105	96,7	101	125	125	123	115	121	116	127	127	121	123	111	129	128	126	127
M	98,8	95,9	92,5	100	102	92,7	97,5	125	127	122	110	121	115	127	128	122	124	109	130	129	126	128
J	86,3	81,5	80,9	89,8	90,7	81,4	87,2	115	114	112	102	111	105	113	117	112	112	97,4	118	117	116	116
J	77,9	72,9	77,2	82,1	85,9	74,8	82,3	108	106	103	97,7	103	97,7	108	110	104	106	92,2	111	111	112	111
A	67,9	63	72	74,1	82,9	63,8	76,6	105	103	101	97,1	101	96	107	107	101	101	88,8	108	107	110	108
S	73,6	69,3	75,7	77,3	85,5	67,7	81	107	107	103	96,2	103	97,6	108	108	103	102	91,1	110	109	110	108
O	84,1	79,8	86,3	87,6	95,8	80,5	90,3	119	121	116	107	115	110	121	120	115	113	102	121	120	119	118
N	102	96,7	106	105	113	99,1	108	134	134	131	125	130	127	133	133	130	128	120	133	133	132	132
D	126	123	120	128	128	123	126	144	143	140	137	140	141	144	143	141	142	136	144	144	140	142
Yearly sum	**1172, 6**	**1127, 4**	**1155, 1**	**1207, 9**	**1264, 8**	**1131, 7**	**1209, 9**	**1505**	**1500**	**1468**	**1384**	**1457**	**1411, 3**	**1512**	**1514**	**1461**	**1468**	**1339, 5**	**1528**	**1522**	**1507**	**1511**

APPENDIX 2. GHI (KWh/m^2) AT HORIZONTAL

	Mar*	Kou	Mor	Yag	Mok	Kae	Gar*	Pol	Tch	Gui	Nga*	Ban	Mei	Tig	Tib	Yao*	Baf	Nan	Mon
J	195	188	194	202	198	198	202	192	194	200	210	209	215	214	212	193	200	200	195
F	187	183	187	194	193	190	189	179	181	191	197	197	199	200	199	178	188	186	181
M	214	214	215	219	220	216	215	204	205	217	211	210	209	216	212	177	189	187	182
A	205	211	207	207	208	205	203	194	196	203	185	185	184	191	191	162	171	168	164
M	197	212	202	201	201	197	191	179	180	195	175	182	178	183	183	154	163	158	157
J	177	194	181	179	180	177	171	162	163	174	158	164	162	165	169	137	149	138	142
J	165	174	167	163	169	166	162	157	160	166	153	156	156	157	159	133	144	134	137
A	159	165	159	157	159	160	157	155	156	159	151	154	152	153	160	129	142	135	134
S	176	183	179	175	177	175	165	155	159	172	151	157	156	156	161	132	144	140	137
O	202	205	203	203	202	201	197	186	187	198	170	176	169	182	178	144	157	158	148

N	191	188	191	194	194	194	194	186	188	195	191	193	192	197	194	168	178	176	171	
D	189	182	187	193	191	192	194	183	185	193	200	204	204	204	203	190	196	194	192	
Yearly sum	**2257**	**2299**	**2272**	**2287**	**2292**	**2271**	**2240**	**2132**	**2154**	**2263**	**2152**	**2187**	**2176**	**2218**	**2221**	**1897**	**2021**	**1974**	**1940**	
Maximum	**2022.38814**																			
Average	**2022.38814**																			
Minimum	**1658.6**																			
SD	**186.248673**																			

APPENDIX 2. NEXT

	Ese	**Mba**	**Ako**	**Mfo**	**Ngo**	**Ntu**	**Ber***	**Abo**	**Yok**	**Bat**	**Ebo***	**San**	**Amb**	**Kri**	**Dou***	**Nko**	**Yab**	**Ede**
J	190	191	191	193	191	197	199	191	197	202	184	186	185	197	199	202	196	192
F	173	177	180	179	175	184	187	181	180	187	170	172	170	181	181	188	181	175
M	168	175	180	177	172	184	188	182	181	187	169	173	170	180	172	186	171	167
A	155	160	163	162	159	166	175	167	170	177	155	161	156	164	158	166	156	154
M	150	155	154	155	153	158	166	157	165	170	152	153	151	157	155	162	152	149
J	131	137	135	137	135	143	144	136	148	152	133	136	134	136	132	146	135	127
J	118	132	132	133	128	138	135	130	143	141	129	134	131	129	114	136	121	107
A	114	126	132	129	124	135	136	131	137	139	121	128	123	117	101	129	114	98,8
S	122	130	132	131	129	140	142	135	142	147	125	131	128	115	113	133	119	109
O	134	142	149	145	140	152	165	157	157	167	136	142	137	129	132	148	134	127
N	159	165	165	167	164	174	174	166	167	177	155	159	155	155	160	172	162	157
D	190	189	185	189	190	194	191	183	189	194	182	181	181	188	191	197	193	189
Yearl sum	**1804**	**1879**	**1898**	**1897**	**1860**	**1965**	**2002**	**1916**	**1976**	**2040**	**1811**	**1856**	**1821**	**1848**	**1808**	**1965**	**1834**	**1751,8**

APPENDIX 2. END

	Bue*	**Limbe**	**Mam**	**Kum**	**Fon**	**Mun**	**Ngu**	**Bam***	**Kum**	**Fun**	**Wum**	**Ndo**	**Mbe**	**Nkam**	**Baf***	**Mbo**	**Baf**	**Dsc**	**Bah**	**Ban**	**Fou**	**Bang**
J	190	186	182	194	195	188	191	213	213	211	203	212	208	213	215	211	211	203	215	215	211	213
F	173	169	170	180	181	172	177	200	204	198	195	198	197	202	201	198	196	187	202	202	200	200
M	164	160	165	168	179	160	171	206	207	205	192	203	194	205	206	199	201	185	206	206	209	205
A	150	146	149	151	155	143	151	181	184	180	171	179	170	185	186	178	177	162	187	186	187	185
M	144	141	136	147	148	136	143	179	181	175	159	175	167	182	183	177	175	157	186	185	182	183
J	124	118	117	130	130	118	126	163	161	159	146	159	149	160	166	159	159	139	167	166	166	166
J	112	106	112	119	123	108	119	152	149	145	139	148	139	151	156	150	148	131	158	157	160	158
A	98,5	92	105	108	120	92,8	112	150	146	144	139	145	137	150	152	145	144	127	154	152	158	155
S	107	101	111	113	124	98,8	119	153	152	148	139	149	140	153	156	147	149	131	157	156	159	156
O	123	117	126	129	139	118	132	171	173	166	155	167	159	173	172	162	165	148	173	172	172	169
N	150	142	155	155	165	145	158	192	193	188	183	189	185	191	192	185	188	173	192	192	192	190
D	185	181	176	189	187	179	186	207	207	201	199	204	205	207	208	205	203	196	208	208	205	206
Yearly sum	**1720,5**	**1659**	**1704**	**1783**	**1846**	**1658,6**	**1785**	**2167**	**2170**	**2120**	**2020**	**2128**	**2050**	**2172**	**2193**	**2116**	**2116**	**1939**	**2205**	**2197**	**2201**	**2186**

APPENDIX 3. PV GENERATION POTENTIAL (KWh/KWp) AT OPTIMUN INCLINATION ANGLE

	Mar*	**Kou**	**Mor**	**Yag**	**Mok**	**Kae**	**Gar***	**Pol**	**Tch**	**Gui**	**Nga***	**Ban**	**Mei**	**Tig**	**Tib**	**Yao***	**Baf**	**Nan**	**Mon**
J	151	147	150	155	154	152	152	145	144	153	159	154	159	160	155	138	145	146	141
F	134	133	135	139	139	135	133	127	126	136	140	139	140	141	139	124	131	130	126
M	141	142	143	144	146	142	140	136	134	142	141	141	140	143	142	118	126	126	122
A	126	130	128	128	129	126	124	122	121	125	119	122	120	122	124	107	112	110	108
M	118	126	120	120	121	117	115	113	111	116	111	119	114	115	118	101	106	103	102
J	107	115	108	108	109	107	104	102	102	105	101	107	104	104	108	89,7	96,4	89,9	92,8
J	103	107	103	101	106	103	101	101	101	103	99,5	103	101	101	103	87,6	94,1	87,8	90
A	103	107	102	102	104	103	101	102	102	103	101	104	101	101	106	86,2	94,3	90,1	89,6
S	118	123	119	117	119	117	111	105	107	115	103	109	107	106	110	89,7	97,6	95,4	93,1
O	141	143	142	143	142	141	137	131	130	139	120	126	119	127	126	100	109	111	103
N	143	141	142	145	146	144	142	137	136	145	142	142	140	144	142	121	129	128	123
D	148	144	148	151	151	150	149	140	139	150	154	153	153	155	152	140	145	144	141
Yearly sum	**1533**	**1558**	**1540**	**1553**	**1566**	**1537**	**1509**	**1461**	**1453**	**1532**	**1490,5**	**1519**	**1498**	**1519**	**1525**	**1302,2**	**1385,4**	**1361,2**	**1331,5**
Maximum	**1566**																		
Average	**1391.67966**																		
Minimum	**1136.3**																		
SD	**127.191071**																		

APPENDIX 3. NEXT

	Ese	**Mba**	**Ako**	**Mfo**	**Ngo**	**Ntu**	**Ber***	**Abo**	**Yok**	**Bat**	**Ebo***	**San**	**Amb**	**Kri**	**Dou***	**Nko**	**Yab**	**Ede**
J	136	137	137	139	138	143	144	138	140	145	132	132	130	140	143	148	141	139
F	121	123	125	125	123	129	130	126	124	130	119	120	117	125	126	132	125	122
M	113	118	121	120	117	124	127	123	122	126	115	117	115	121	115	123	114	112
A	102	106	108	108	105	109	114	111	113	116	104	107	104	108	103	107	102	100
M	97,7	102	101	101	100	103	108	103	109	110	101	102	101	103	99,6	103	98,3	96,2
J	85,6	90,1	88,1	89,9	88,5	92,2	92,8	89	97,8	98,6	88,7	90,1	89,6	89,8	85,4	91,9	87,1	82,3

J	78,7	87,4	86,9	88,2	84,8	90	88,1	86	94,9	92,4	86,6	89,4	87,8	85,3	74,5	86,1	79,4	70,5
A	76,9	84,7	87,8	86,4	83,2	89,9	90,1	87,1	92,1	92,7	81,6	86,1	82,9	78,4	67	82,9	75,4	65,7
S	83	88,4	89,7	89,3	87,7	94,8	96,6	91,8	96,9	100	85,5	89,5	87	78,2	76,2	87,3	80,5	73,4
O	92,7	98,8	104	101	97,7	106	115	110	109	116	94,6	98,9	95,2	89,3	91,2	100	92,9	87,8
N	114	118	118	121	118	126	126	119	119	127	111	113	109	110	115	124	116	113
D	138	138	135	139	139	144	141	133	136	142	133	130	129	135	140	148	142	139
Yearly sum	**1238,6**	**1291,4**	**1301,5**	**1307,8**	**1281,9**	**1350,9**	**1372,6**	**1316,9**	**1353,7**	**1395,7**	**1252**	**1275**	**1247,5**	**1263**	**1235,9**	**1333,2**	**1253,6**	**1200,9**

APPENDIX 3. END

	Bue*	Limbe	Mam	Kum	Fon	Mun	Ngu	Bam*	Kum	Fun	Wum	Ndo	Mbe	Nkam	Baf*	Mbo	Baf	Dsc	Bah	Ban	Fou	Bang
J	140	135	133	140	147	139	140	151	159	159	151	157	156	162	158	157	156	151	159	158	155	157
F	123	118	119	125	131	122	123	136	144	141	138	140	140	145	141	139	142	134	143	143	140	142
M	112	107	110	112	122	109	113	137	140	139	129	136	132	140	140	136	137	126	140	140	141	140
A	99,5	95,4	96,5	98,3	104	93,9	97,5	115	121	118	112	117	112	123	123	117	119	108	125	125	123	124
M	94,4	90,9	87	94,1	99,4	87,6	91,2	112	118	114	104	114	109	119	120	115	117	103	122	122	119	121
J	82,1	76,7	75,2	83,5	87,1	76,2	80,6	101	105	103	95,1	104	97,3	105	109	104	104	91,2	110	110	108	109
J	76,1	69,5	72,5	77,3	83,5	70,9	77	95,9	99,1	96,7	92,4	97,5	92,1	101	104	98	99,8	87,4	105	105	106	105
A	67,7	61,3	69,5	71,5	81,9	62,3	73,4	95,9	98,8	97,4	94,3	97,2	92,7	103	103	97,3	97,6	85,9	104	104	107	104
S	74,1	68,6	74,5	76,4	86,5	67,5	79,8	100	105	102	95,8	102	97	107	107	103	101	90,1	108	108	110	107
O	86,2	80,9	87,8	88,9	100	82,4	91,6	115	124	118	110	119	113	124	122	117	115	104	123	123	122	121
N	109	101	113	111	124	106	114	136	144	140	135	140	137	143	141	139	136	128	142	141	141	140
D	138	132	132	139	146	134	138	148	158	155	151	154	157	160	156	154	155	149	157	157	153	155
Yearly sum	**1202,1**	**1136,3**	**1170**	**1217**	**1312,4**	**1150,8**	**1219,1**	**1442,8**	**1515,9**	**1483,1**	**1407,6**	**1477,7**	**1435,1**	**1532**	**1524**	**1476,3**	**1479,4**	**1357,6**	**1538**	**1536**	**1525**	**1525**

APPENDIX 4. OPTIMUM INCLINATION ANGLE

	Mar*	Kou	Mor	Yag	Mok	Kae	Gar*	Pol	Tch	Gui	Nga*	Ban	Mei	Tig	Tib	Yao*	Baf	Nan
Angle in °c	15	15	15	15	15	15	14	12	12	15	13	11	12	13	11	9	10	10

Mon	Ese	Mba	Ako	Mfo	Ngo	Ntu	Ber*	Abo	Yok	Bat	Ebo*	San	Amb	Kri	Dou*	Nko	Yab	Ede	Bue*	Limbe
9	9	8	9	9	9	10	10	9	7	9	7	7	6	7	10	11	10	10	11	10

Mam	Kum	Fon	Mun	Ngu	Bam*	Kum	Fun	Wum	Ndo	Mbe	Nkam	Baf*	Mbo	Baf	Dsc	Bah	Ban	Fou	Bang
12	11	12	12	12	11	12	12	12	11	12	12	10	11	10	12	10	10	10	10

APPENDIX 5. PV GENERATION POTENTIAL (KWh/KWp) AT 90°C

	Mar*	Kou	Mor	Yag	Mok	Kae	Gar*	Pol	Tch	Gui	Nga*	Ban	Mei	Tig	Tib	Yao*	Baf	Nan	Mon
J	116	117	116	119	119	116	113	104	104	116	114	110	112	114	110	92,6	98,7	99,6	95,7
F	79,3	82	80,8	80,5	82,6	78,3	74,9	68,7	68,8	78	73,1	72	71,1	73,4	70,6	60	64,3	64	61,9
M	46,3	50,4	47,9	45,7	48,5	44,8	42,1	40,3	40,2	44,2	39,7	39	38,1	39,5	37,5	33,9	34,8	35	33,9
A	16,3	18,6	17,5	15,3	17,9	14,8	11,8	12,6	12,6	14,1	15,6	16	15,5	15,2	14,7	16,4	15,6	15,8	15,5
M	13,6	12,6	13,4	13,3	14,6	13,5	13,8	15,6	15,2	13,6	16,9	16,6	16,2	16,4	15,7	16,6	16	16,3	15,9
J	14,2	13	14	13,9	15,2	14	14	15,6	15,2	14	16,6	16,4	15,7	16,3	15,2	15,8	15,2	15,5	15,2
J	15,8	15,4	15,8	15,7	17	15,6	15,2	15,8	15,6	15,5	17,6	18	16,9	17,6	16,8	16,4	16	16,1	15,9
A	16,4	16,1	16,4	16,2	17,6	16,2	15,8	16,2	15,9	16,2	18,4	18,8	17,9	18,4	17,5	17	16,6	16,8	16,5
S	32,9	35,4	33,7	32,4	34,7	32,2	30,4	29,7	29,6	31,7	30,5	30,6	29,2	30,6	28,8	24,4	25,9	26	25
O	69,8	74,2	71,3	69,4	71,5	68,5	64,7	60,5	60,7	67,2	56,9	58,1	55,5	59,2	57,2	45,1	48,8	49,3	46,1
N	102	104	103	103	105	101	98,5	91,9	91,8	101	93,7	93,5	92	94,9	92,6	75,3	81,2	80,6	77,6
D	121	121	121	122	124	121	118	107	107	121	118	117	116	117	115	99,8	106	106	103
Yearly sum	**643,6**	**659,7**	**650,8**	**646,4**	**667,6**	**635,9**	**612,2**	**577,9**	**576,6**	**632,5**	**611**	**606**	**596,1**	**612,5**	**591,6**	**513,3**	**539,1**	**541**	**522,2**
Maximum	**667,6**																		
Average	**560,025424**																		
Minimum	**469,1**																		
SD	**56,2137687**																		

APPENDIX 5. NEXT

	Ese	Mba	Ako	Mfo	Ngo	Ntu	Ber*	Abo	Yok	Bat	Ebo*	San	Amb	Kri	Dou*	Nko	Yab	Ede
J	91,5	91,5	91,8	92,5	92,1	97,2	98,4	93,3	94,1	99,2	87	87,7	85,9	93,2	96,7	99,9	95,9	92,9
F	59,2	59,6	60,6	60,7	59,9	63,3	63,9	61,4	59,8	63,4	56,9	57,4	56	58,8	61,2	66,5	61,4	59,1
M	33,2	33,8	33,8	34,1	34,1	34,7	34,7	34,2	32,9	34,4	32,9	33,2	32,5	31,3	32,6	39,1	33,4	32,3
A	15,9	16,5	16,1	16,4	16,5	15,9	15,3	15,9	15,2	15	16,4	16,4	16,4	14,6	14,8	18,7	15,2	15,1
M	15,9	16,5	16,3	16,6	16,5	16,2	15,7	16,2	15,2	15,3	16,2	16,4	16,2	14,6	14,9	18,9	15,3	15
J	15,1	15,8	15,5	15,8	15,8	15,4	15,2	15,5	14,6	14,8	15,4	15,5	15,4	13,9	14,2	18	14,5	14,3
J	15,4	16,3	16,1	16,4	16,3	16,1	16	16	15,5	15,9	15,9	16,2	15,9	14,3	14,4	18,8	15,1	14,2
A	15,8	16,9	16,8	17	16,9	16,7	16,7	16,8	16,3	16,6	16,4	16,9	16,5	14,8	14,2	19,1	15,2	14,2
S	22,7	23,8	24,1	24,4	23,8	25,4	25,4	24,8	23,3	25,3	20,5	21	17,1	18,7	22	28,9	23,3	21,3
O	42,4	44,6	46,1	45,4	44,2	47,5	50,4	48	46,7	50,2	42,2	43,7	41,9	39,6	41,4	49,6	42,6	39,9
N	71	73,4	73,6	75,2	73,3	78,7	79,5	74,3	73,9	80,2	68	69,6	66,9	67,5	71,8	79,8	73	69,8
D	99,6	98,9	97	99,2	99,8	105	103	96,2	98,7	104	94,1	92,8	91,4	97,1	102	105	102	99,6
Yearly sum	**497,7**	**507,6**	**507,8**	**513,7**	**509,2**	**532,1**	**534,2**	**512,6**	**506,2**	**534,3**	**481,9**	**486,8**	**472,1**	**478,4**	**500,2**	**562,3**	**506,9**	**487,7**

APPENDIX 5. END

	Bue*	Limbe	Mam	Kum	Fon	Mun	Ngu	Bam*	Kum	Fun	Wum	Ndo	Mbe	Nkam	Baf*	Mbo	Baf	Dsc	Bah	Ban	Fou	Bang
J	94,5	91,5	89,5	95,5	99,2	93,5	94,4	108	110	112	104	109	107	115	107	108	108	99,8	110	110	109	109
F	61,8	58,2	60	61,9	65,2	60,7	61,3	69,3	72,1	71,8	69,9	69,4	69,8	74,9	69,1	68,4	70,2	64,6	70,9	70,4	70,1	70,1
M	35	31,4	34,7	33,7	37,3	34	34,5	38	39,2	40	38,7	37,4	37,9	40,8	38,2	37,2	38,6	38,5	38,7	38,3	37,5	37,5
A	17	14,6	15,4	15,5	17,4	15,6	15,6	17,3	17,6	18	17,1	16,3	17,5	18,3	17,3	16,8	17,7	18,1	17,7	17,5	16,7	16,7
M	17	14,5	16,6	15,6	17,8	15,9	16,1	17,6	18	18,6	18,7	16,8	17,8	18,9	17,6	17,1	17,9	18,5	18	17,7	16,9	16,9
J	16	13,7	15,5	14,8	17	14,9	15,2	17,1	17,9	18,2	17,7	16,4	17,3	18,7	17,2	16,6	17,4	17,7	17,6	17,4	16,4	16,4
J	16,1	13,7	15	15,1	17,3	14,8	15,4	18,4	19,6	19,4	18,2	17,8	18,4	20,3	18,8	18,1	18,7	18,2	19,4	19,1	18	18
A	15,7	13,3	14,8	15	17,6	14	15,4	19,1	20,4	20,1	18,6	18,6	19,1	21,1	19,7	18,9	19,5	18,6	20,4	20,1	19	19
S	23,7	20,7	24,2	23,4	27,4	22,2	24,6	29,9	31,8	31,4	29,8	29,4	29,8	33,3	30,6	29,3	30	28,8	31,4	31	29,6	29,6
O	41,1	37,4	41,5	41,6	47,8	39,2	43	53,8	57,9	56	52,9	54,5	53,2	59,4	55,9	54,1	53,7	49,2	57,2	56,6	55	55
N	68,9	63,5	71,5	70,4	78,3	66,6	72,5	89	93,4	91,6	88,1	90	88,4	94,2	89,5	89,1	87,6	78,9	91,2	90,7	89,9	89,9
D	101	96,6	94,1	101	105	96,9	99,9	115	117	116	112	115	116	121	113	114	115	105	117	116	115	115
Yearly sum	**507,8**	**469,1**	**492,8**	**503,5**	**547,3**	**488,3**	**507,9**	**592,5**	**614,9**	**613,1**	**585,7**	**590,6**	**592,2**	**635,9**	**593,9**	**587,6**	**594,3**	**555,9**	**609,5**	**604,8**	**593,1**	**593,1**

APPENDIX 6. GHI (KWh/m^2) AT 90°C

	Mar*		Kou	Mor	Yag	Mok	Kae	Gar*	Pol	Tch	Gui	Nga*	Ban	Mei	Tig	Tib	Yao*	Baf	Nan	Mon
J	165	J	167	165	170	169	166	163	149	150	167	161	157	161	162	158	133	142	143	137
F	118	F	121	119	120	122	117	113	103	104	117	110	108	108	110	107	90,7	97,3	96,8	93,6
M	79,5	M	84,6	81,3	79,2	81,9	77,7	74,3	69,5	70,1	77,3	68,6	67,1	65,9	68,4	65,6	56,6	59,3	59,3	57,3
A	28,8	A	33,7	30,9	27	31	26,2	21,8	22,6	23	25	26,8	26,6	26,2	25,8	24,9	27,3	26,3	26,7	26,2
M	24,8	M	23,5	24,7	24,2	26,4	24,7	24,5	25,4	25,6	24,7	28,1	27,2	27,1	27,1	26,1	27,6	26,6	27,3	26,6
J	25,1	J	23,7	25	24,5	26,6	24,7	24,4	24,9	25,1	24,7	27,4	26,5	26,2	26,8	25,3	26,1	25,5	26,1	25,3
J	27,1	J	26,8	27,3	26,9	28,8	26,7	26,1	26,3	26,3	26,5	29	29,2	28,2	28,9	27,9	27,3	27	27,3	26,5
A	27,6	A	27,3	27,8	27,4	29,5	27,4	26,8	27,3	27,1	27,3	29,7	30,2	29,2	29,7	28,8	28,1	27,9	28,1	27,5
S	55,2	S	59,8	56,7	54,3	57,2	53,9	50,6	48,1	48,5	52,9	47,9	47,9	46,1	48,2	46	37,5	40,3	40,3	38,7
O	107	O	114	109	106	108	105	99,7	92,3	93	103	84,7	86,4	82,9	88,5	86,1	67,2	73,5	74,2	69,5
N	149	N	153	150	150	151	148	144	133	134	149	134	133	132	136	133	107	116	115	111
D	173	D	173	172	175	176	174	170	152	154	174	166	166	166	167	165	142	150	150	146
Yearly sum	**980,1**		**1007,4**	**988,7**	**984,5**	**1007,4**	**971,3**	**938,2**	**873,4**	**880,7**	**968,4**	**913,2**	**905,1**	**898,8**	**918,4**	**893,7**	**770,4**	**811,7**	**814,1**	**785,2**
Maximum	**1007,4**																			
Average	**839,147458**																			
Minimum	**707,5**																			
SD	**84,497591**																			

APPENDIX 6. NEXT

	Ese	Mba	Ako	Mfo	Ngo	Ntu	Ber*	Abo	Yok	Bat	Ebo*	San	Amb	Kri	Dou*	Nko	Yab	Ede
J	131	131	132	132	131	139	141	133	135	143	124	125	123	133	139	142	139	134
F	88,6	89,8	91,5	91,2	89,5	95,4	96,8	92,3	90,6	96,3	85,1	86,2	84	89,1	92,7	98,9	93,4	89,5
M	54,8	56	56,6	56,5	55,9	58,4	58,9	57,1	55,4	58,4	53,8	54,3	52,9	53,3	55,2	63,9	56,3	54,1
A	26,7	27,3	26,9	27,3	27,4	26,7	25,8	26,6	25,6	25,5	27,1	27,1	27,2	25,2	25,5	30,9	26	25,8
M	26,7	27,4	27,3	27,5	27,5	27,1	26,5	27,1	25,7	26	26,9	27,2	27	25,3	25,6	31	26,1	25,8
J	25,4	26,1	25,9	26,1	26	25,8	25,8	26	24,6	25,2	25,5	25,8	25,7	24,2	24,4	29,7	24,8	24,5
J	26	27,4	27	27,4	27,2	27,1	27,2	27,1	26,3	27	26,8	27,1	26,8	25,4	24,8	30,9	25,6	24,5
A	26,5	28,1	28	28,2	27,9	27,9	28,1	28	27,3	27,9	27,3	28	27,7	25,8	24,3	31,5	25,8	24,3
S	35,1	36,5	37,2	37,3	36,4	39,5	39,8	38,2	36	39,6	31,9	32,6	27,7	29,8	34,3	43,8	36,3	33,1
O	63,3	66,6	69,3	67,8	65,9	71,5	76,3	72,2	71	76,4	63,1	65,5	62,9	59,7	62,4	72,6	64	60,1
N	101	104	105	107	104	112	113	106	106	115	96,4	98,9	95,1	96,7	103	113	105	100
D	141	140	137	140	141	148	146	136	140	148	133	131	129	138	145	148	146	142
Yearly sum	**746,1**	**760,2**	**763,7**	**768,3**	**759,7**	**798,4**	**805,2**	**769,6**	**763,5**	**808,3**	**720,9**	**728,7**	**709**	**725,5**	**756,2**	**836,2**	**768,3**	**737,7**

APPENDIX 6. END

	Bue*	Limbe	Mam	Kum	Fon	Mun	Ngu	Bam*	Kum	Fun	Wum	Ndo	Mbe	Nkam	Baf*	Mbo	Baf	Dsc	Bah	Ban	Fou	Bang
J	134	131	130	138	142	134	136	152	156	157	148	155	152	160	151	153	152	142	155	155	150	154
F	91,2	87,7	91,2	93,8	97,5	90,6	93,3	103	108	107	105	105	104	110	103	102	103	96,1	105	105	103	104
M	56,8	52,7	57,8	56,3	61,1	55,6	57,9	63,7	66	66,7	64,3	63,8	63,3	67,4	64,2	62,9	63,4	62,6	64,6	64,1	63,6	62,9
A	28,5	25	26,1	26,5	28,6	26,2	26,4	28,1	28,6	29,4	28,5	26,9	28,5	29,5	28,2	27,5	28,7	29,6	28,8	28,5	26,1	27,2
M	28,2	25	26,4	26,5	28,9	26,3	26,5	28,3	28,5	29,7	29,1	27	28,7	30,4	28,2	27,4	28,8	29,8	28,7	28,4	26,5	27,3
J	26,6	23,4	24,6	25,1	27,3	24,6	25	27,6	28,1	29,4	28,2	26,6	27,8	29,6	27,6	26,8	28	28,4	28,2	27,8	25,8	26,6
J	27,2	23,8	25	25,6	28,4	24,7	25,7	29,4	31,1	30,9	29,3	28,8	29,4	31,9	30,3	29	30,5	29,6	31,2	30,7	28,2	29,3
A	26,2	23	24,9	25,5	28,8	23,7	25,7	30,5	32,2	31,8	30,2	29,9	30,5	33	31,5	30,2	31,6	30,2	32,6	32,2	29,5	30,9
S	35,9	32,1	37,4	36,3	41,9	34,1	38,2	45,6	48,1	47,6	45,4	45,2	45,3	50	46,5	44,8	45,4	43,6	47,5	46,9	45,3	45,2
O	60	56	61,9	62,1	70,1	58	64,2	78,8	84,3	81,4	77,5	80,7	77,9	85,8	81,7	79,3	78,6	71,9	83,3	82,7	81,2	80,7
N	96,7	90,8	103	101	111	94,8	104	125	131	129	125	128	125	132	126	125	123	111	128	127	126	126
D	141	137	135	145	148	137	143	161	165	162	158	162	163	169	159	160	161	147	163	163	158	161
Yearly sum	752,3	707,5	743,3	761,7	813,6	729,6	765,9	873	906,9	901,9	868,5	878,9	875,4	928,6	877,2	867,9	874	821,8	895,9	891,3	863,2	875,1

APPENDIX 7. CONVERSION RATE OF GHI INTO PV ELECTRICITY AT OPTIMUM INCLINATION ANGLE

Locality	GHI	PV potential	Conversion rate								
Kou	2368	1558	65,7939189	Baf	2040	1385,4	67,9117647	Kum	2204	1515,9	68,7794918
Gui	2325	1532	65,8924731	Limbe	1673,1	1136,3	67,9158448	Mbo	2146	1476,3	68,7931034
Gar*	2290	1509	65,8951965	Yao*	1914	1302,2	68,0355277	Bam*	2097	1442,8	68,803052
Kae	2329	1537	65,9939888	Ese	1820	1238,6	68,0549451	Baf*	2213	1524	68,865793
Mor	2332	1540	66,0377358	Ntu	1985	1350,9	68,0554156	Dsc	1970	1357,6	68,9137056
Mar*	2320	1533	66,0775862	Yok	1989	1353,7	68,0593263	Fun	2152	1483,1	68,9172862
Yag	2346	1553	66,1977835	Nan	2000	1361,2	68,06	Bah	2225	1538	69,1235955
Tch	2186	1453	66,4684355	Ako	1912	1301,5	68,0700837	Ban	2222	1536	69,1269127
Mok	2350	1566	66,6382979	Ban	2229	1519	68,1471512	Bang	2206	1525	69,1296464
Pol	2172	1461	67,2651934	Abo	1931	1316,9	68,197825	Baf	2135	1479,4	69,29274
Tib	2259	1525	67,5077468	Mun	1685,4	1150,8	68,2805269	Nkam	2209	1532	69,3526483
Kum	1802	1217	67,536071	Ndo	2163	1477,7	68,3171521			**Average**	**67,9229002**
Yab	1856	1253,6	67,5431034	Amb	1826	1247,5	68,3187295			**SD**	**0,91936557**
Dou*	1829,6	1235,9	67,5502842	San	1866	1275	68,3279743				
Ngu	1804	1219,1	67,5776053	Mba	1890	1291,4	68,3280423				
Ede	1775,7	1200,9	67,6296672	Mfo	1913	1307,8	68,3638265				
Mei	2214	1498	67,6603433	Fon	1919	1312,4	68,3897863				
Mam	1728	1170	67,7083333	Wum	2058	1407,6	68,3965015				
Bat	2061	1395,7	67,7195536	Ngo	1873	1281,9	68,4410037				
Tig	2242	1519	67,7520071	Fou	2228	1525	68,4470377				
Ber*	2024	1372,6	67,8162055	Nko	1947	1333,2	68,4745763				
Nga*	2197	1490,5	67,8425125	Ebo*	1826	1252	68,5651698				
Kri	1861	1263	67,8667383	Bue*	1750,8	1202,1	68,6600411				
Mon	1961	1331,5	67,8990311	Mbe	2090	1435,1	68,6650718				

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