SUPPORTING INFORMATION

**Quantifying Future Annual Fluxes of Polychlorinated Dibenzo-P-Dioxin and Polychlorinated Dibenzofuran Emissions from Sugarcane Burning in Indonesia via Grey Model**

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**Table S1. Sugarcane area and production 2016 – 2022.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Province** | **2016** | **2017** | **2018** |
| **Area (Ha)** | **Production (Ton)** | **Area (Ha)** | **Production (Ton)** | **Area (Ha)** | **Production (Ton)** |
| 1 | Aceh | - | - | - | - | - | - |
| 2 | North Sumatra | 7758 | 29679 | 6103 | 17930 | 6305 | 17023 |
| 3 | West Sumatra | - | - | - | - | - | - |
| 4 | Riau | - | - | - | - | - | - |
| 5 | Jambi | - | - | - | - | - | - |
| 6 | South Sumatra | 22251 | 102033 | 18643 | 81001 | 23128 | 101135 |
| 7 | Bengkulu | - | - | - | - | - | - |
| 8 | Lampung | 124632 | 756546 | 123362 | 694800 | 118974 | 642630 |
| 9 | Bangka Belitung Island | - | - | - | - | - | - |
| 10 | Riau Island | - | - | - | - | - | - |
| 11 | D.K.I Jakarta | - | - | - | - | - | - |
| 12 | West Jawa | 21453 | 88806 | 19900 | 81885 | 10962 | 43713 |
| 13 | Central Jawa | 47104 | 210248 | 39659 | 150315 | 43528 | 201037 |
| 14 | D.I. Yogyakarta | 7274 | 31778 | 2230 | 3490 | 2639 | 10418 |
| 15 | East Jawa | 207146 | 1231726 | 217923 | 1250986 | 184858 | 1065965 |
| 16 | Banten | - | - | - | - | - | - |
| 17 | Bali | - | - | - | - | - | - |
| 18 | West Nusa Tenggara | - | - | 1686 | 7339 | 2056 | 1348 |
| 19 | East Nusa Tenggara | - | - | - | - | - | - |
| 20 | West Kalimantan | - | - | - | - | - | - |
| 21 | Central Kalimantan | - | - | - | - | - | - |
| 22 | South Kalimantan | - | - | - | - | - | - |
| 23 | East Kalimantan | - | - | - | - | - | - |
| 24 | North Sulawesi | - | - | - | - | - | - |
| 25 | Central Sulawesi | - | - | - | - | - | - |
| 26 | Sulawesi Selatan | 10481 | 34908 | 11348 | 43366 | 8541 | 44663 |
| 27 | Southeast Sulawesi | - | - | - | - | - | - |
| 28 | Gorontalo | 7720 | 49148 | 6496 | 31930 | 13856 | 43016 |
| 29 | West Sulawesi | - | - | - | - | - | - |
| 30 | Maluku | - | - | - | - | - | - |
| 31 | North Maluku | - | - | - | - | - | - |
| 32 | West Papua | - | - | - | - | - | - |
| 33 | Papua | - | - | - | - | - | - |
|   | **Indonesia** | **455819** | **2534872** | **447350** | **2363042** | **414846** | **2170948** |

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No** | **Province** | **2019** | **2020** | **2021** | **2022** |
| ***Area* (Ha)** | ***Production* (Ton)** | ***Area* (Ha)** | ***Production* (Ton)** | ***Area* (Ha)** | ***Production* (Ton)** | ***Area* (Ha)** | ***Production* (Ton)** |
| 1 | Aceh | - | - | - | - | - | - | - | - |
| 2 | North Sumatra | 6818 | 15882 | 5526 | 14317 | 6091 | 20519 | 8022 | 27645 |
| 3 | West Sumatra | - | - | - | - | - | - | - | - |
| 4 | Riau | - | - | - | - | - | - | - | - |
| 5 | Jambi | - | - | - | - | - | - | - | - |
| 6 | South Sumatra | 23007 | 90422 | 27550 | 91806 | 31912 | 109693 | 31788 | 112418 |
| 7 | Bengkulu | - | - | - | - | - | - | - | - |
| 8 | Lampung | 129482 | 742123 | 131658 | 729021 | 136224 | 781085 | 142566 | 721547 |
| 9 | Bangka Belitung Island | - | - | - | - | - | - | - | - |
| 10 | Riau Island | - | - | - | - | - | - | - | - |
| 11 | D.K.I Jakarta | - | - | - | - | - | - | - | - |
| 12 | West Jawa | 10135 | 32488 | 9889 | 39492 | 12070 | 47372 | 14467 | 60953 |
| 13 | Central Jawa | 41687 | 182738 | 31973 | 127018 | 46845 | 216549 | 53797 | 242266 |
| 14 | D.I. Yogyakarta | 3009 | 9423 | 2964 | 11035 | 2809 | 8336 | 1885 | 5510 |
| 15 | East Jawa | 176871 | 1050874 | 188589 | 1003162 | 182261 | 1034675 | 209578 | 1139151 |
| 16 | Banten | - | - | - | - | - | - | - | - |
| 17 | Bali | - | - | - | - | - | - | - | - |
| 18 | West Nusa Tenggara | 665 | 2487 | 654 | 1635 | 2138 | 7467 | 2763 | 11737 |
| 19 | East Nusa Tenggara | - | - | - | - | 1491 | 5733 | 1734 | 1777 |
| 20 | West Kalimantan | - | - | - | - | - | - | - | - |
| 21 | Central Kalimantan | - | - | - | - | - | - | - | - |
| 22 | South Kalimantan | - | - | - | - | - | - | - | - |
| 23 | East Kalimantan | - | - | - | - | - | - | - | - |
| 24 | North Sulawesi | - | - | - | - | - | - | - | - |
| 25 | Central Sulawesi | - | - | - | - | - | - | - | - |
| 26 | Sulawesi Selatan | 12312 | 46535 | 11842 | 55251 | 13559 | 47712 | 13045 | 25427 |
| 27 | Southeast Sulawesi | - | - | - | - | 4593 | 18015 | 1272 | 1844 |
| 28 | Gorontalo | 9068 | 54079 | 8352 | 50668 | 9015 | 51175 | 9091 | 52373 |
| 29 | West Sulawesi | - | - | - | - | - | - | - | - |
| 30 | Maluku | - | - | - | - | - | - | - | - |
| 31 | North Maluku | - | - | - | - | - | - | - | - |
| 32 | West Papua | - | - | - | - | - | - | - | - |
| 33 | Papua | - | - | - | - | - | - | - | - |
|   | **Indonesia** | **413054** | **2227051** | **418996** | **2123405** | **449008** | **2348331** | **490008** | **2402648** |

**Table S2. Activity Rate in Sugarcane Crop Residue Burning in 2016 – 2022.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Province** | **2016** | **2017** | **2018** |
| **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** | **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** | **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** |
| 1 | Aceh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | North Sumatra | 8865 | 0 | 0 | 5356 | 0 | 0 | 5085 | 0 | 8865 |
| 3 | West Sumatra | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | Riau | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | Jambi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | South Sumatra | 30477 | 0 | 0 | 24195 | 0 | 0 | 30209 | 0 | 30477 |
| 7 | Bengkulu | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Lampung | 225981 | 0 | 0 | 207538 | 0 | 0 | 191954 | 0 | 225981 |
| 9 | Bangka Belitung Island | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Riau Island | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | D.K.I Jakarta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | West Jawa | 26526 | 0 | 0 | 24459 | 0 | 0 | 13057 | 0 | 26526 |
| 13 | Central Jawa | 62801 | 0 | 0 | 44899 | 0 | 0 | 60050 | 0 | 62801 |
| 14 | D.I. Yogyakarta | 9492 | 0 | 0 | 1042 | 0 | 0 | 3112 | 0 | 9492 |
| 15 | East Jawa | 367918 | 0 | 0 | 373671 | 0 | 0 | 318405 | 0 | 367918 |
| 16 | Banten | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | Bali | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | West Nusa Tenggara | 0 | 0 | 0 | 2192 | 0 | 0 | 403 | 0 | 0 |
| 19 | East Nusa Tenggara | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | West Kalimantan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | Central Kalimantan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | South Kalimantan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | East Kalimantan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | North Sulawesi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | Central Sulawesi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | Sulawesi Selatan | 10427 | 0 | 0 | 12953 | 0 | 0 | 13341 | 0 | 10427 |
| 27 | Southeast Sulawesi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | Gorontalo | 14681 | 0 | 0 | 9538 | 0 | 0 | 12849 | 0 | 14681 |
| 29 | West Sulawesi | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | Maluku | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | North Maluku | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | West Papua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | Papua | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|   | **Indonesia** | **1516355** | **2.57** | **1.64** | **1413704** | **2.462206** | **1.57** | **1298948** | **2.376** | **1.52** |

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|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Province** | **2019** | **2020** | **2021** |
| **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** | **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** | **Qs (ton/yr)** | **BL (kg/m2)** | **Bb (Kg/m2)** |
| 1 | Aceh | 4277 | 0.08 | 0.05 | 6129 | 0.10 | 0.06 | 8258 | 0.10 | 0.07 |
| 2 | North Sumatra | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 3 | West Sumatra | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 4 | Riau | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 5 | Jambi | 27423 | 0.10 | 0.06 | 32765 | 0.10 | 0.07 | 33579 | 0.11 | 0.07 |
| 6 | South Sumatra | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 7 | Bengkulu | 217760 | 0.17 | 0.11 | 233311 | 0.17 | 0.11 | 215527 | 0.15 | 0.10 |
| 8 | Lampung | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 9 | Bangka Belitung Island | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 10 | Riau Island | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 11 | D.K.I Jakarta | 11796 | 0.12 | 0.08 | 14150 | 0.12 | 0.08 | 18207 | 0.13 | 0.08 |
| 12 | West Jawa | 37940 | 0.12 | 0.08 | 64683 | 0.14 | 0.09 | 72365 | 0.13 | 0.09 |
| 13 | Central Jawa | 3296 | 0.11 | 0.07 | 2490 | 0.09 | 0.06 | 1646 | 0.09 | 0.06 |
| 14 | D.I. Yogyakarta | 299646 | 0.16 | 0.10 | 309059 | 0.17 | 0.11 | 340266 | 0.16 | 0.10 |
| 15 | East Jawa | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 16 | Banten | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 17 | Bali | 488 | 0.07 | 0.05 | 2230 | 0.10 | 0.07 | 3506 | 0.13 | 0.08 |
| 18 | West Nusa Tenggara | 0 | 0.00 | 0.00 | 1712 | 0.11 | 0.07 | 531 | 0.03 | 0.02 |
| 19 | East Nusa Tenggara | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 20 | West Kalimantan | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 21 | Central Kalimantan | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 22 | South Kalimantan | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 23 | East Kalimantan | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 24 | North Sulawesi | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 25 | Central Sulawesi | 16504 | 0.14 | 0.09 | 14252 | 0.11 | 0.07 | 7595 | 0.06 | 0.04 |
| 26 | Sulawesi Selatan | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 27 | Southeast Sulawesi | 15135 | 0.18 | 0.12 | 15286 | 0.17 | 0.11 | 15644 | 0.17 | 0.11 |
| 28 | Gorontalo | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 29 | West Sulawesi | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 30 | Maluku | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 31 | North Maluku | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 32 | West Papua | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 33 | Papua | 636284 | 1.25 | 0.80 | 698089 | 1.38 | 0.88 | 719145 | 1.26 | 0.80 |
|   | **Indonesia** | **1270548** | **2.49** | **1.59** | **1394158** | **2.76** | **1.77** | **1436269** | **2.52** | **1.61** |