The Clean Paper

WHAT THE PAPER SAYS · WHAT IT DOESN'T · WHY IT MATTERS

Mining mine qofa caalaa bosona qulqulleessa — forest loss extraction naannoo dhokataa

Qorannoon Nature mine clusters 16,627 sub-Saharan Africa keessatti, mining dense forests keessa 2001–2020 direct deforestation naannoo 187,000 hectares uume jedha; garuu story guddaan offsite dha. Unmined areas waliin wal-bira qabamee, waggaa kudhan booda mine 1 km keessatti deforestation 0–100 scale irratti points 8 ol ture, effect 20 km hanga hafe. Average irratti direct mine hectare tokko waggaa shan keessatti offsite forest loss hectares 33.9 dabalataa waliin wal qabate. Kun energy transition badaa jechuu miti; mineral supply chains geography fi forest costs pit caalaa guddaa qabaachuu agarsiisa.

Written by Laura Nesso · Cross-checked by Lucio Vaglio · Edited by Michele Renda · Figures by Laura Nesso and Nova Vela · AI-assisted, human-reviewed

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Footprint jechuun boolla qofa miti

Bakki albuudaa tokko bifa ifaa qaba. Pit, tailings pond, spoil heap, road bosona keessa murame. Isaan mallattoolee satellite argu fi regulator daangaa itti kaasu danda'u.

Garuu extraction lafa naannoo isaa illee jijjiira. Namoonni dhufu. Roads bosona bira ga'uu salphisu. Settlements guddatu. Agriculture bal'ata. Bakki albuudaa kaartaa irratti scar qofa miti; giddugala of gravity haaraa ta'uu danda'a.

Barruu Nature tokko garaagarummaa kana sub-Saharan Africa guutuu irratti lakkoofsaan kaa'a. Barreessitoonni bosona dense keessatti 2001–2020 kallattii albuuda-baasuun-ka'e deforestation tilmaamu; achiis places similar amma hin mined ta'in waliin wal-bira qabanii mine naannoo bosona dhabamuu dabalataa hammam akka mul'atu gaafatu. Xumura isaanii salphaa fi nama hin gammachiisne: kallattii bal'ina bakka albuudaa kutaa mul'atu qofa.

Landsat natural-color image tokko Ghana Ashanti gold belt keessatti bal'aa fi artisanal gold-Albuuda baasuun scars agarsiisa. Qorannoon as irratti dubbannu Albuuda baasuun-related bosona dhabamuu bal'ina bakka albuudaa mataa isaa irraa hammam fagaatee akka deemu gaafata.

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Kun climate fi biodiversity politics'f bu'aa faayidaa qabu dha, sababni isaas yaada lama frame tokko keessatti eega. Ammayyaa infrastructure fi anniisaa transition albuudota barbaadu. Garuu albuudota bakka duwwaa irraa hin dhufan. Gaaffiin qulqulluun slogan "Albuuda baasuun gaarii moo badaa" miti; guutuu baasii bosonaa amanamaan safaramaa jiraa?

Barreessitoonni maal godhan

qorannoon continent-scale forest fi land-fayyadama daataa causal-inference qophii waliin walitti makata. Barreessitoonni forested bal'inoota sub-Saharan Africa keessatti 2001–2020 **mine clusters 16,627** kaartaa godhan. bosona dhabamuu gosa lama adda baasan.

Tokkoffaan **kallattii albuuda-baasuun-ka'e deforestation** dha: bal'ina bakka albuudaa keessatti clearing, pits, tailings ponds, spoil heaps, shafts fi amaloota Albuuda baasuun operations waliin kallattiin wal qabatan dabalatee.

Lammaffaan **offsite deforestation** dha: mine naannoo bosona dhabamuu, pit mataa isaa miti, garuu hundeessuu bakka albuudaa irraa ancillary sochii — agriculture, settlements, roads fi access biroo — ka'uu danda'u.

Kutaa lammaffaa tilmaamuuf barreessitoonni difference-in-differences bu'uura fayyadaman. Afaan salphaan, Albuuda baasuun jalqabu dura fi booda mine naannoo bosona dhabamuu, places similar garuu amma hin mined ta'in naannoo bosona dhabamuu waliin wal-bira qaban. Achiis mine gid-dugala irraa concentric fageenyawwan ilaalu: 1 km keessatti, 1–5 km, 5–10 km fi 10–20 km.

Qophii kun barbaachisaa dha, sababni isaas barruun mine bira bosona dhabamuu qofa lakkaa'aa hin jiru. hundeessuu bakka albuudaa irraa **additional dhabamuu** counterfactual trend unmined bal'inoota waliin wal-bira qabamee tilmaamame godhu yaala.

Maal argatan

Kallattii albuuda baasuun bosona dhabamsiisuu guddaa ture. Dense bosonoota sub-Saharan Africa keessatti barreessitoonni 2001–2020 **187,070 hectares** kallattii Albuuda baasuun-induced deforestation tilmaamu. Democratic Republic of the Congo, Ghana fi Côte d'Ivoire walitti **45%** kallattii dhabamuu kanaa qabaatan.

Dhabamuu naannoo footprint caalaa guddaa ture. Bakki albuudaa tokko erga established ta'ee booda, 1 km keessatti cumulative deforestation waggaa kudhan booda unmined bal'inoota caalaa **0–100 safartuu irratti qabxiilee 8 ol** ture. Kun deforestation saffisa absolute gap dha, 8% walbira qabamee daballii miti. Dhiibbaa fageenya waliin dadhabaa ta'e, garuu hin badne: waggaa kudhan booda qorannoon gaps dabalataa 1–5 km irratti 3.6 qabxiilee, 5–10 km irratti 1.9, 10–20 km irratti 1.1 tilmaama.

Lakkoofsi kun time-specific dha: dhiibbaawwan waggaa kudhan, immediate dhabamuuwwan miti.

Offsite/kallattii reeshiyoo nama ajaa'ibsiisa. Shallaggii adda keessatti, bal'ina bakka albuudaa'n hectare tokko kallattiin ifaa godhu hundaaf, waggaa shan keessatti offsite **33.9 hectares** bosona cufaa dabalataa bade jedhanii giddugaleessa tilmaamu. Offsite dhabamuu dabalataa keessaa baay'een agricultural expansion hundeessuu bakka albuudaa'n triggered ta'e waliin wal qabate; settlement expansion illee barbaachisaa, roads share xiqqaa.

Lakkoofsi kunis time-specific dha: reeshiyoo waggaa shan. Ten-year 0-to-100-safartuu dhiibbaawwan waliin walitti makuun hin qabu.

Dhiibbaa bakka hunda tokko miti. qorannoon DRC irratti concern cimaa gabaasa, sababni isaas kallattii Albuuda baasuun footprint guddaa fi offsite dhabamuu dabalataa guddaa walitti qaba. Biyyoonni biroon walbira qabamee offsite rukuttaawwan ol'aanaa, kallattii footprints xiqqaa qabu. Commodity sadarkaa irratti, cobalt fi copper mines — albuudota batteries, electrical infrastructure fi anniisaa transition'f ijoo — total additional deforestation qorannoo tilmaamota keessatti ol'aanaa turan.

Maaliif offsite kutaan barbaachisaa dha

Environmental assessment yeroo baay'ee kallattii project daangaa irraa jalqaba. Kun hubatamuu danda'a. Pit mul'ata, permit perimeter qaba, dhaabbata infrastructure ijaaru ibsuu danda'a.

Garuu bosonoota legal boundaries qofaaf deebii hin kennan. Access fi incentives irratti deebii kennu. Mine roads, hojjettoota, money, settlements fi demand food fiduu danda'a. Kun bosona naannoo lafa ifaa gochuun salphaa, bu'a qabeessa yookaan barbaachisaa ta'e godhuu danda'a.

Kanaaf yaadni paperichaa cimaan lakkoofsa tokko miti. Garaagarummaa **kallattii** fi **triggered** dhabamuu dha.

Supply chain bal'ina bakka albuudaa qofa lakkaa'e, land-fayyadama jijjiirama extraction'n uume gadi xiqqeessuu danda'a. Environmental rukuttaa assessment lease daangaa irratti dhaabbate, bosona dhabamuu project sun carraan isaa guddaa gochuuf gargaare darbuu danda'a. Product renewable anniisaa deeggaru jechuun "ifaa" jedhamee market godhame illee maateriyaalii chain isaa ofumaan ifaa hin ta'u.

Kun maal *hin* mirkaneessu

- Anniisaa transition badaa dha jechuu **hin agarsiisu**. Ammayyaa infrastructure, energy-transition albuudota dabalatee, land-fayyadama costs guddaa qabaachuu danda'u agarsiisa.
- Mine hundi kallattii hectare tokkoof sirrii 33.9 hectares offsite dhabamuu uuma jechuu miti. giddugaleessa mine clusters hedduu irraa, project tokko tilmaama miti.
- Tree tokko tokko mine bira bade mine sanuma irraa murame jechuu hin mirkaneessu. Quasi-experimental qophii garee uummataa safartuu additional dhabamuu tilmaama.
- nama dhuunfaa dhaabbilee, permits yookaan buyers irratti responsibility hin ramadu; project-level tracing barbaada.
- Albuuda baasuun rukuttaawwan hunda hin haguugu. Water pollution, labor haalawwan, biodiversity fragmentation, rights conflicts fi hawaasummaa displacement ijoo safartuu forest-dhabamuu kana alatti jiru.
- World guutuu hin haguugu. Dense bosonoota sub-Saharan Africa irratti xiyyeeffata.

Ragaan hammam cimaa dha?

Direct-deforestation tilmaama irratti ragaa continental safartuu keessatti cimaa dha. qorannoon maxxanfame land-fayyadama fi forest-cover kuusaa daataa fayyadamuun bosona dhabamuu Albuuda baasuun amaloota waliin kallattii associated adda baasa.

Offsite additional dhabamuu irratti ragaa substantial dha, garuu model-based. Difference-in-differences observational daataa irraa sababa-qabeessa dhiibbaawwan tilmaamuuf qophaa'e, tasaa yaaliiwwan impossible yeroo ta'e. Barreessitoonni heterogeneity-jabaataa malleen haaraa fi alternative estimators robustness qoru. Gaarii practice dha.

Garuu bu'aa safartuu sirriitti dubbifamuu qaba. barruun Albuuda baasuun establishment qorannoo sirna guutuu keessatti bal'ina bakka albuudaa alatti additional deforestation waliin wal qabata jechuun ragaa jabaataa dha. Tree tokko tokko satellite irratti "mine irraa murame" jechuun confession miti.

Dubbisuu ummataaf banaa faayidaa qabu panic yookaan dismissal miti; safartuu discipline dha: Albuuda baasuun landscape tokko bana yoo ta'e, rukuttaa assessment fence alatti ilaalu qaba.

Maaliif barbaachisaa dha

"Clean anniisaa" jechuun maateriyaalii world dhoksuu danda'a. Solar panels, batteries, transmission sararoota, electric vehicles fi daataa centers hundi mined maateriyaalota barbaadu. Maateriyaalota keessaa muraasni bosonoota fi biodiversity waliigalaa barbaachisummaa qaban irraa dhufu.

Kun decarbonization dogoggora godha jechuu miti. Alternative — fossil-fuel dependence itti fufuu — land, air, water fi climate costs gurguddaa mataa isaa qaba. Garuu transition fossil sirna caalaa ifaa ta'uu danda'a, akka default ifaa ta'ee osoo hin taane.

Gatiin barruu kanaa geography dhokataa ignore gochuu rakkisa. Inni: pit qofa hin lakkaa'in. Forest jijjiiramoota pit naannoo lakkaa'i. Roads, farms fi settlements extraction booda dhufan lakkaa'i. Off-site deforestation environmental rukuttaa assessments, no-net-dhabamuu himannoowwan fi zero-deforestation supply chains keessatti galchi, jedha.

Kun "green albuudota gaarii" yookaan "green albuudota badaa" caalaa seenaa ga'eessa dha. Maateriyaalii basis transition consequences qaba; supply chain ofii isaa ifaa jechuun dura consequences sun mul'ataa ta'uu qabu.

Cuunfaa gabaabaa

Qorannoon Nature dense bosonoota sub-Saharan Africa keessatti 2001–2020 mine clusters 16,627 analyze godhe. Pits, tailings ponds fi spoil heaps fakkaatan irraa **187,070 hectares** kallattii albuuda-

baasuun-ka'e deforestation tilmaama. Difference-in-differences bu'uura fayyadamuun, mine naannoo unmined bal'inoota waliin wal-bira qabamee additional deforestation illee tilmaama: waggaa kudhan booda cumulative deforestation 1 km keessatti **0–100 safartuu irratti qabxiilee 8 ol** ture, dhiibbaa 20 km hanga hafe. Shallaggii waggaa-shan adda keessatti kallattii Albuuda baasuun deforestation hectare tokko giddugaleessa **33.9 hectares** additional offsite dense-bosona dhabamuu waliin wal qabate, baay'inaan agricultural expansion fi settlements irraa. Cobalt fi copper mines total additional deforestation ol'aanaa qorannoo keessatti qabaatan. Bu'aan anniisaa transition badaa jechuu miti; mineral supply chains land-fayyadama costs bal'ina bakka albuudaa alatti dheeratan qabaachuu agarsiisa.

Sakatta'a ifaa

barruun maal agarsiisa: Dense bosonoota sub-Saharan Africa keessatti Albuuda baasuun kallattii bosona dhabamuu guddaa uume; hundeessuu bakka albuudaa booda mine naannoo unmined bal'inoota caalaa additional deforestation mul'ate; offsite dhabamuu kallattii footprint baay'ee caaluu danda'a; energy-transition albuudota muraasni kuusaa daataa kana keessatti total additional deforestation ol'aanaa waliin wal qabatan.

Wanti amansiisaa garuu hin mirkanoofne: nama dhuunfaa mines hedduun permit footprint isaanii caalaa offsite rukuttaa guddaa qabu; environmental rukuttaa assessments fi supply-chain rules cimaa dhabamuu muraasa hir'isuu danda'u; tropical Albuuda baasuun naannoowwan biroo keessatti hidden offsite dhiibbaawwan wal fakkaataa jiraachuu danda'u.

Wanti hin agarsiifne: Albuuda baasuun hundi equally damaging dha; nearby bosona dhabamuu tokko tokko mine addaa irraa dhufe; anniisaa transition badaa dha; project-level tracing malee nama dhuunfaa dhaabbilee/buyers responsible dha; bosona dhabamuu Albuuda baasuun hawaa-summaa/environmental cost qofa dha.

Daangaa ijoo: Observational sababa-qabeessa inference, akka carraatti ramadame ragaa miti; continent-scale tilmaamota, project-level attribution miti; dense bosonoota sub-Saharan Africa qofa; dhiibbaawwan daataa qulqullina, mine detection fi moodeela yaadota bu'uuraa irratti hirkatu.

Dubbisaan waliigalaa hammam amanuu qaba? Kallattii Albuuda baasuun deforestation qorannoo naannoo keessatti substantial ta'uu irratti amantaa guddaa. hundeessuu bakka albuudaa garee uummataa safartuu irratti offsite deforestation dabalataa waliin wal qabachuu irratti gaarii. giddugaleessa 33.9:1 reeshiyoo Bakki albuudaa tokko irratti kallattiin hojiirra oolchuu irratti gadi-aanaa. Stance sirrii: mineral supply chains barbaachisaa ta'uu danda'u, garuu pit alatti accounting amanamaa barbaadu.

Maddoota

Nature (2026)
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White Rose Research Online — published version
https://eprints.whiterose.ac.uk/id/eprint/241799/

Processed outputs and analysis code — GitHub
https://github.com/OMorton/AFR_MiningForestLoss

Post-deforestation land-use dataset — Zenodo
https://doi.org/10.5281/zenodo.11065705