SUPLEMENTARY MATERIAL

Supplement 1: travel scenario tables

Walking & Motorized scenario

Class	Label	Label (English)	Speed (km/h)	Mode
11	Forets denses	Dense forest	1.5	WALKING
12	Forets riveraines	Riparian forest	1.5	WALKING
13	Forets claires, savanes boisées	Open forest, wooded savannah	1.5	WALKING
14	Savane arborée, arbustive	Sparsely wooded savannah	1.5	WALKING
16	Plantations	Plantations	3	WALKING
17	Fourrées	Thickets	3	WALKING
21	Cultures et Jachères	Cultivated and fallow lands	3	WALKING
22	Cultures sans arbres	Cultivated lands without trees	3	WALKING
32	Savanes herbeuses	Grassy savannah	3	WALKING
41	Agglomérations et infra, plantations urbaines	Agglomerations and infrastructure, urban plantations	3	WALKING
61	Sols nus, roches, carrières, plage	Open soil, rocky terrain, quarries, beach	3	WALKING
1000	Pistes rurales	Rural tracks	15	MOTORIZED
1002	Routes bitumées rurales	Primary rural asphalted roads	80	MOTORIZED
1003	Routes secondaires rurales	Secondary rural roads	40	MOTORIZED
1004	Pistes urbaines	Urban tracks	10	MOTORIZED
1005	Routes bitumées urbaines	Primary urban asphalted roads	30	MOTORIZED
1006	Routes secondaires urbaines	Secondary urban roads	20	MOTORIZED

Motorcycle-taxi scenario

class	label	Label (English)	Speed (km/h)	mode
11	Forets denses	Dense forest	8	MOTORIZED
12	Forets riveraines	Riparian forest	8	MOTORIZED
13	Forets claires, savanes boisées	Open forest, wooded savannah	8	MOTORIZED
14	Savane arborée, arbustive	Sparsely wooded savannah	8	MOTORIZED
16	Plantations	Plantations	10	MOTORIZED
17	Fourrées	Thickets	8	MOTORIZED

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21	Cultures et Jachères	Cultivated and fallow lands	10	MOTORIZED
22	Cultures sans arbres	Cultivated lands without trees	10	MOTORIZED
32	Savanes herbeuses	Grassy savannah	12	MOTORIZED
41	Agglomérations et infra, plantations urbaines	Agglomerations and infrastructure, urban plantations	7	MOTORIZED
61	Sols nus, roches, carrières, plage	Open soil, rocky terrain, quarries, beach	7	MOTORIZED
1000	Pistes	Rural tracks	15	MOTORIZED
1002	Routes bitumées	Primary rural asphalted roads	40	MOTORIZED
1003	Routes secondaires	Secondary rural roads	20	MOTORIZED
1004	Pistes urbaines	Urban tracks	10	MOTORIZED
1005	Routes bitumées urbaines	Primary urban asphalted roads	30	MOTORIZED
1006	Routes secondaires urbaines	Secondary urban roads	15	MOTORIZED

Walking scenario

class	label	Label (English)	Speed (km/h)	mode
11	Forets denses	Dense forest	1.5	WALKING
12	Forets riveraines	Riparian forest	1.5	WALKING
13	Forets claires, savanes boisées	Open forest, wooded savannah	1.5	WALKING
14	Savane arborée, arbustive	Sparsely wooded savannah	1.5	WALKING
16	Plantations	Plantations	3	WALKING
17	Fourrées	Thickets	3	WALKING
21	Cultures et Jachères	Cultivated and fallow lands	3	WALKING
22	Cultures sans arbres	Cultivated lands without trees	3	WALKING
32	Savanes herbeuses	Grassy savannah	3	WALKING
41	Agglomérations et infra, plantations urbaines	Agglomerations and infrastructure, urban plantations	3	WALKING
61	Sols nus, roches, carrières, plage	Open soil, rocky terrain, quarries, beache	3	WALKING
1000	Pistes	Rural tracks	4	WALKING
1002	Routes bitumées	Primary rural asphalted roads	4	WALKING

1003	Routes secondaires	Secondary rural roads	4	WALKING
1004	Pistes urbaines	Urban tracks	4	WALKING
1005	Routes bitumées urbaines	Primary urban asphalted roads	4	WALKING
1006	Routes secondaires urbaines	Secondary urban roads	4	WALKING

Supplement 2: Preparation of input geospatial data

All following geospatial data sets were prepared using QGIS ver. 3.2.0. After finalization, each of them was changed to raster format (if needed) at 100m resolution, and projected in the WGS84 Universal Transverse Mercator (zone 31N) coordinate reference system.

Road network (vector)
We used the road network created by the *Direction de la Cartographie nationale et du cadastre* of Togo. In 2015, GIS experts from the national Togolese Institute for Statistics, Economic and Demographic studies (INSEED), in collaboration with technicians from the National Ministry of Public Works and Transportation, re-categorized this road data set into three hierarchical categories: asphalted roads, secondary roads, and tracks (see figure 1B).

Barriers to movement (vector)
Water bodies were considered as barriers to terrestrial movements, unless a road segment crosses over, which is assumed to be a bridge. Rivers were recoded into two categories by the INSEED GIS experts, distinguishing permanent and seasonal rivers. We used both categories as barriers to movement in our accessibility models, reflecting our conservative approach of considering a maximum of potential barriers.

Land cover (raster)
The land cover data set at 100m resolution was provided by INSEED. We assumed that different land cover categories can influence travel speed (e.g., travel is slower in a dense forest than in an open area), each of these land cover categories can be given a distinct travel speed in the travel scenario. The landcover category representing bodies of water was extracted from the landcover and used as an additional barrier to movement. Using the "Merge land cover" tool in AccessMod, the land cover raster was merged with the road network and the various barriers to movement, in order to obtain the final "merged land cover" on which travel models are applied. For the merging process, roads were stacked above the barriers, so that any existing road passing over a barrier was considered passable.

Population density (raster)
Population densities were derived from the Worldpop data set[1]. This data set is at 3-arc second resolution (90m at the equator) and is appropriate for our analyses as the modelling technique to obtain it uses a detailed settlement mapping and links these settlements with gazetteer population numbers, considering that the vast majority of people live within a settlement. The remaining unaccounted-for population is then distributed using a weighted landcover grid in function of the probability of being populated, and the total population estimates are adjusted to UN estimates[2]. We used the UN-adjusted 2013 and 2018 Worldpop data sets for Togo. The data set was aggregated to 100m resolution.

A final correction step consisted in correcting for the population falling in pixels that were assigned a barrier status in the merged landcover data set, because this population is not considered by the accessibility analysis and is left unaccounted for. To correct for that, we extracted the population in each barrier pixel and dispatched it uniformly within the surface of the prefecture area the pixel belongs to. This way the population in each prefecture was correctly represented, even if a large number of barrier pixels are found. This step was done in AccessMod using the « Adjust population distribution" module.

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Supplement 3: Table of percentage of population living within 2-hour travel time to the nearest EmONC facility, per prefecture, with uncertainty intervals within brackets, and for the walking & motorized and the motorcycle-taxi scenarios

	Walking & Motorized Scenario		Motorized only Scenario		Walking only Scenario	
Prefectures	*1-hour*	*2-hour*	*1-hour*	*2-hour*	*1-hour*	*2-hour*
Agoenyive	100 [99.6 - 100]	100 [100 - 100]	100 [100 - 100]	100 [100 - 100]	68.4 [53.2 - 80.3]	99.6 [95.5 - 99.9]
Agou	73.4 [59.9 - 83.5]	99.7 [96.3 - 99.9]	69.3 [57.8 - 78.7]	99.9 [94.4 - 100]	13.0 [9.9 - 15.9]	27.9 [21.9 - 34.1]
Akebou	46.7 [31.7 - 61.5]	93.4 [84.3 - 96.3]	42.9 [23.7 - 55.9]	92.3 [75.3 - 100]	0.9 [0.6 - 1.4]	4.8 [2.7 - 6.9]
Amou	67.3 [55.3 - 76.3]	92.2 [86.5 - 95.4]	74.4 [64.9 - 83.5]	99.3 [94.4 - 100]	8.8 [6 - 12.2]	26.9 [19.6 - 34.4]
Anie	41.5 [35.5 - 48.0]	74.0 [61.2 - 88.3]	41.6 [37.2 - 44.7]	61.6 [52.3 - 71.3]	15.4 [11.8 - 18.6]	27.8 [23.9 - 31.5]
Assoli	56.5 [41.2 - 67.3]	90.5 [82.2 - 94.7]	77.7 [65.1 - 85.3]	99.6 [95.5 - 100]	9.8 [6.6 - 13.2]	25.5 [19.8 - 31.2]
Ave	76.3 [66.8 - 82.5]	94.8 [89.9 - 97.3]	85.2 [75.6 - 93.3]	100 [99.9 - 100]	17.5 [12.8 - 21.6]	37.8 [29.4 - 45.4]
Bas-Mono	88.3 [82.2 - 92.0]	98.6 [96.4 - 99.4]	98.9 [94.9 - 99.6]	99.6 [99.6 - 99.6]	45.3 [33.9 - 54.2]	78.8 [68.0 - 86.3]
Bassar	57.5 [46.9 - 67.1]	87.2 [80.4 - 90.8]	64.5 [54.2 - 71.7]	92.8 [84.4 - 97.0]	12.5 [9.0 - 15.8]	24.3 [20.1 - 28.9]
Binah	85.9 [77.3 - 91.6]	97.9 [96.6 - 98.6]	85.4 [77.7 - 90.5]	100 [97.3 - 100]	28 [20.6 - 36.6]	61.1 [53.2 - 66.8]
Blitta	81.4 [72.7 - 87.5]	97.1 [94.4 - 98.2]	84.3 [78.8 - 89.8]	98.3 [95.0 - 99.9]	31.7 [21.6 - 41.8]	64.1 [57.2 - 66.3]
Cinkasse	99.3 [93.5 - 99.6]	99.9 [99.9 - 99.9]	94.5 [67.9 - 100]	100 [100 - 100]	10.7 [9.1 - 12.2]	18.1 [15.2 - 21.6]
Dankpen	48.3 [37.2 - 57.4]	83.3 [71.7 - 90.5]	42.2 [32.7 - 52.0]	83.3 [69.1 - 93.4]	9.8 [7.6 - 11.5]	16.8 [14.2 - 19.8]
Danyi	76.8 [64.9 - 85.9]	98.1 [94.8 - 99.2]	92.5 [81.1 - 97.2]	100 [100 - 100]	8.8 [6.6 - 11.3]	23.5 [16.9 - 32.0]
Doufelgou	53.3 [44.3 - 61.8]	88.0 [77.7 - 93.0]	62.4 [51.1 - 71.3]	95.6 [84.4 - 99.8]	12.2 [8.6 - 15.3]	28.6 [21.8 - 35.4]
Est-Mono	37.3 [26.9 - 45.4]	75.0 [62.8 - 86.6]	38.9 [28.0 - 46.8]	78.5 [61.6 - 94.1]	5.1 [3.7 - 6.3]	12.2 [8.9 - 16.2]
Golfe	100 [99.5 - 100]	100 [100 - 100]	100 [100 - 100]	100 [100 - 100]	67.1 [52.5 - 80]	99.9 [97.1 - 100]
Haho	50.0 [38.0 - 61.4]	89.7 [78.8 - 94.9]	49.7 [41.0 - 58.4]	85.1 [74.0 - 94.0]	11.4 [8.8 - 13.3]	20.4 [16.9 - 24.3]
Keran	42.0 [29.5 - 54.9]	87.8 [74.9 - 93.3]	34.4 [26.3 - 42.7]	86.0 [64.7 - 97.7]	4.3 [3.0 - 5.7]	12.6 [9.3 - 15.3]
Kloto	85.5 [76.7 - 91.9]	99.4 [98.0 - 99.7]	97.2 [90.5 - 99.8]	100 [100 - 100]	22.7 [18.3 - 27]	40.7 [34.7 - 45.6]
Kozah	85.2 [76.6 - 90.3]	97.1 [95.1 - 98.1]	92.9 [87.6 - 95.9]	100 [99.8 - 100]	22.1 [17.6 - 26.3]	42.3 [33.8 - 50.8]
Kpele	71.8 [62.3 - 80.1]	98.2 [91.3 - 99.7]	78.4 [71.8 - 84.3]	99.6 [94.2 - 100]	16.8 [12.2 - 20.2]	29.6 [25.3 - 34.3]
Kpendjal	64.2 [47.9 - 76.5]	98.7 [92.9 - 99.8]	59.7 [38.6 - 74.8]	99.5 [92.8 - 100]	3.7 [2.7 - 4.7]	10.3 [7.0 - 13.6]
Lacs	94.9 [91.1 - 97.1]	99.7 [99.0 - 100]	95.4 [91.5 - 97.8]	100 [99.9 - 100]	22.2 [15.9 - 28.8]	51.8 [40.1 - 64.2]
Lomé Commune	100 [100 - 100]	100 [100 - 100]	100 [100 - 100]	100 [100 - 100]	100 [93.9 - 100]	100 [100 - 100]
Moyen-Mono	39.6 [25.9 - 50.9]	94.0 [79.8 - 98.2]	42.6 [34.4 - 50.6]	90.7 [66.3 - 99.3]	3.4 [2.2 - 4.5]	12.6 [7.8 - 19.2]
Naki-Ouest	77.5 [60.5 - 89.8]	99.7 [98.5 - 100]	64.3 [49.3 - 77.9]	100 [97.8 - 100]	11.4 [8 - 15.2]	26.3 [21.6 - 30.8]
Ogou	54.9 [44.2 - 66.3]	95.9 [85.7 - 99.2]	54.9 [46.7 - 62.9]	93.2 [79.1 - 99.9]	10.1 [7.4 - 13]	26.0 [19.5 - 30.9]
Oti	79.3 [68.4 - 86.2]	97.7 [93.5 - 98.8]	78.4 [67.6 - 86.4]	98.0 [96.1 - 99.4]	20.6 [15.5 - 24.7]	37.1 [30.7 - 44.7]
Oti-Sud	47.8 [33.5 - 58.5]	95.3 [83.1 - 98.6]	36.7 [23.6 - 49.8]	87.4 [69.7 - 99.4]	5.5 [3.7 - 6.7]	11.5 [8.9 - 13.6]
Plaine de Mo	33.8 [21.1 - 45.9]	72.8 [62.8 - 78.8]	37.3 [24.0 - 52.7]	87.3 [75.7 - 94.1]	1.7 [1.1 - 2.5]	7.3 [4.5 - 11.2]
Sotouboua	42.4 [31.5 - 52.7]	75.2 [67.8 - 77.9]	49.9 [40.1 - 57.8]	82.2 [70.4 - 89.6]	3.9 [2.9 - 4.9]	9.0 [6.9 - 11.6]
Tandjoare	85.6 [76.7 - 91.2]	99.8 [98.3 - 100]	76.2 [65.5 - 84.7]	98.6 [92.9 - 100]	8.8 [6.3 - 11.7]	27.5 [18.9 - 37.0]
Tchamba	54.9 [37.3 - 67.9]	90.2 [83.7 - 93.4]	45.9 [33.4 - 60.9]	96.5 [88.8 - 99.2]	8.2 [6.4 - 9.9]	15.7 [12.9 - 18.3]
Tchaoudjo	65.0 [53.3 - 74.8]	93.4 [88.0 - 95.7]	71.8 [57.6 - 80.1]	98.5 [92.4 - 99.5]	16.7 [11.7 - 21.2]	30.4 [26.5 - 34.8]
Tone	91.8 [80.5 - 97.4]	100 [99.9 - 100]	82.4 [71.9 - 89.2]	99.9 [98.5 - 100]	13.9 [10.1 - 17.3]	28.1 [22.7 - 34.6]

Vo	85.6 [70.3 - 93.2]	99.4 [98.3 - 99.8]	95.5 [83.9 - 99.5]	100 [100 - 100]	10.9 [7.0 - 15.4]	31.6 [23.3 - 43.4]
Wawa	51.6 [36.0 - 65.0]	93.0 [83.2 - 96.8]	67.7 [45.3 - 82.3]	100 [97.5 - 100]	2.7 [2.1 - 3.4]	6.5 [4.8 - 8.6]
Yoto	82.2 [71.7 - 88.2]	95.9 [93.3 - 97.5]	87.0 [78.9 - 92]	98.9 [97.2 - 99.6]	24.3 [18.0 - 29.0]	46.1 [37.8 - 55.4]
Zio	87.9 [77.4 - 93.9]	99.7 [98.5 - 99.9]	93.1 [85.3 - 96.4]	100 [99.5 - 100]	16.4 [11.9 - 21.2]	39.5 [29.4 - 49.7]
Country	78.3 [70.5 - 84.0]	95.5 [91.6 - 97.5]	79.2 [72.2 - 84.3]	96.0 [91.6 - 98.4]	33.4 [27.1 - 38.4]	50.8 [46.0 - 55.0]

Supplement 4: Effects of considering slopes to correct for walking speeds

When walking is used in a travel scenario, AccessMod computes the slope between adjacent raster cells using the Digital Elevation Model. Walking speeds are then corrected using the slope value, following the Tobler (1993) formula[3]:

$$V = V_F * e^{-3.5*|S+0.05|},$$

where V is the corrected walking speed in kilometers per hour (Km/h), V_F is the walking speed on a flat surface (given by the user-defined travel scenario), and S is the slope in hundredth of percent.

These corrections applied when walking off-road in the "Walking & Motorized scenario", and everywhere in the "Walking scenario". In the table below, each cell is composed of two results. The first figure takes slope correction into consideration, while the second figure does not take into account the slope correction.

	Walking & Motorized Scenario				**Walking Scenario**			
	2013		**2018**		**2013**		**2018**	
Regions	***1-hour***	***2-hour***	***1-hour***	***2-hour***	***1-hour***	***2-hour***	***1-hour***	***2-hour***
Plateaux	66.2/67.7	95.1/95.6	55.4/56.6	89.8/90.3	15.5/16.2	30.2/31.4	10.9/11.4	22.6/23.5
Kara	63.3/64.3	90.4/90.9	62.7/63.6	90.2/90.7	14.5/15.0	29.7/30.2	14.5/14.9	29.3/29.8
Maritime	94.7/94.8	99.5/99.5	94.4/94.5	99.4/99.4	47.9/48.2	74.8/75.1	47.7/48.0	76.4/76.5
Centrale	70.2/70.6	92.3/92.6	65.2/65.6	91.7/91.9	22.0/22.3	41.3/41.5	18.1/18.5	35.7/35.9
Savanes	81.7/81.9	98.9/99.0	80.7/80.9	98.9/99.0	12.1/12.4	26.5/27.2	11.4/11.6	24.2/24.9
Lomé Commune	100/100	100/100	100/100	100/100	100/100	100/100	100/100	100/100
Country	81.0/81.5	96.7/98.0	78.3/78.8	95.5/95.7	34.7/35.1	52.3/52.8	33.4/33.7	50.8/51.2

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Supplementary References

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