



United Nations Institute for Training and Research



# UNOSAT

## Madagascar – Tropical Cyclone Enawo-17

### 6 March 2017



Population Exposure Analysis

6 March 2017

Geneva, Switzerland

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## Overview

A strong tropical cyclone Enawo-17 in the Indian Ocean is heading towards coasts of Madagascar. It is expected to make land fall on the eastern coast of Madagascar, Tuesday 07 march and will likely cross the island and may affect several regions inland including Antananarivo. The tropical cyclone will reach a maximum wind speed of 195 km/h. Based on the observed and predicted cyclone track as of 6<sup>th</sup> of March 2017, sustained wind speeds zones and population data from WorldPop, UNITAR-UNOSAT conducted a population exposure analysis for Madagascar. ~20 million people are exposed to wind speed of at least 60 km/h :

- 597,427 people are exposed to the 120 km/h winds,
- 5,100,218 people are exposed to the 90 km/h winds,
- 14,293,874 people are exposed to the 60 km/h winds.

Taking into account the zones with a flood hazard of 25 years return period within the predicted wind speed zones, about 1,100,000 people are living in these flood hazard zones and are potentially exposed to 60 km/h winds. About 630,000 people in the flood hazard zones of 25 years of return period and exposed to 90 km/h sustained wind speed and 83,000 in the 120km/h.

# Population Exposure to Tropical Cyclone

## Wind Speed Zones

Population exposure estimates are based on cyclone track from JRC and WorldPop data



**23,852,000**

Total population of  
Madagascar

**597,427**

Total population living  
in **120 km/h** wind  
speed zones

**5,100,218**

Total population living  
in **90 km/h** wind speed  
zones

**14,293,874**

Total population living in  
**60 km/h** wind speed  
zones

Region / District	Wind speed zones			Total Population
	120 km/h	90 km/h	60 km/h	
<b>Alaotra Mangoro</b>	<b>52,356</b>	<b>726,693</b>	<b>339,297</b>	<b>1,118,346</b>
Ambatondrazaka		354,710		354,710
Amparafaravola	174	295,292		295,466
Andilamena	52,182	26,921		79,103
Anosibe-An'ala			95,279	95,279
Moramanga		49,771	244,018	293,788
<b>Amoron I Mania</b>			<b>781,790</b>	<b>781,790</b>
Ambatofinandrahana			171,498	171,498
Ambositra			286,412	286,412
Fandriana			221,826	221,826
Manandriana			102,055	102,055
<b>Analamanga</b>		<b>136,128</b>	<b>3,642,101</b>	<b>3,778,228</b>
Ambohidratrimo			430,676	430,676
Andramasina			181,736	181,736
Anjozorobe		124,645	64,459	189,104
Ankazobe		11,483	150,344	161,826
Antananarivo Atsimondrano			657,025	657,025
Antananarivo Avaradrano			392,045	392,045
Antananarivo Renivohitra			1,547,751	1,547,751
Manjakandriana			218,065	218,065
<b>Analanjirfo</b>	<b>351,281</b>	<b>758,649</b>		<b>1,109,930</b>
Fenerive Est	6,531	322,751		329,281
Mananara-Avaratra	148,662	32,791		181,453
Maroantsetra	148,063	92,393		240,456
Sainte Marie		28,343		28,343
Soanierana Ivongo	48,025	97,240		145,266
Vavatenina		185,131		185,131

<b>Anosy</b>			<b>213,300</b>	<b>213,300</b>
Amboasary-Atsimo			21,042	21,042
Betroka			28,317	28,317
Taolagnaro			163,941	163,941
<b>Atsimo Andrefana</b>			<b>5,022</b>	<b>5,022</b>
Beroroha			5,022	5,022
<b>Atsimo Atsinanana</b>			<b>964,401</b>	<b>964,401</b>
Befotaka			56,617	56,617
Farafangana			370,104	370,104
Midongy-Atsimo			48,934	48,934
Vangaindrano			352,023	352,023
Vondrozo			136,723	136,723
<b>Atsinanana</b>		<b>641,602</b>	<b>752,982</b>	<b>1,394,585</b>
Antanambao Manampontsy			51,967	51,967
Brickaville		71,050	129,755	200,806
Mahanoro			262,192	262,192
Marolambo			159,697	159,697
Toamasina I		323,444		323,444
Toamasina II		247,108		247,108
Vatomandry			149,370	149,370
<b>Betsiboka</b>		<b>192,642</b>	<b>117,075</b>	<b>309,718</b>
Kandreho			18,317	18,317
Maevatanana		62,443	98,758	161,201
Tsaratana		130,199		130,199
<b>Boeny</b>		<b>91,921</b>	<b>643,303</b>	<b>735,224</b>
Ambato Boeni			139,011	172,971
Mahajanga I			257,367	257,367
Mahajanga II		14,526	68,207	82,734
Marovoay		43,435	151,730	195,164
Mitsinjo			26,988	26,988
<b>Bongolava</b>			<b>450,851</b>	<b>450,851</b>
Fenoarivobe			142,944	142,944
Tsiroanomandidy			307,907	307,907
<b>Diana</b>		<b>344,572</b>	<b>422,962</b>	<b>767,534</b>
Ambanja			27,833	209,639
Ambilobe		162,360	68,835	231,195
Antsiranana I			136,218	136,218
Antsiranana II		406	112,152	112,559
Nosy-Be			77,925	77,925
<b>Haute Matsiatra</b>			<b>1,311,529</b>	<b>1,311,529</b>
Ambalavao			229,421	229,421
Ambohimahasoa			229,205	229,205
Fianarantsoa I			225,385	225,385
Ikalamavony			98,731	98,731
Isandra			138,173	138,173
Lalangina			180,991	180,991
Vohibato			209,623	209,623
<b>Ihorombe</b>			<b>244,728</b>	<b>244,728</b>

Iakora			53,823	53,823
Ihosy			128,365	128,365
Ivohibe			62,539	62,539
<b>Itasy</b>			<b>789,095</b>	<b>789,095</b>
Arivonimamo			330,019	330,019
Miarinarivo			259,207	259,207
Soavinandriana			199,869	199,869
<b>Melaky</b>			<b>3,080</b>	<b>3,080</b>
Ambatomainty			3,080	3,080
<b>Menabe</b>			<b>144,515</b>	<b>144,515</b>
Belo Sur Tsiribihina			210	210
Mahabo			63,531	63,531
Miandrivazo			80,774	80,774
<b>Sava</b>	<b>96,024</b>	<b>964,975</b>	<b>1,946</b>	<b>1,062,945</b>
Andapa		202,863		202,863
Antalaha	96,024	158,218		254,242
Sambava		331,457		331,457
Vohemar		272,437	1,946	274,384
<b>Sofia</b>	<b>97,766</b>	<b>1,243,035</b>	<b>1,352</b>	<b>1,342,154</b>
Analalava		157,363	1,352	158,715
Antsohihy		150,933		150,933
Bealanana		152,689		152,689
Befandriana Nord		259,445		259,445
Mampikony		144,468		144,468
Mandritsara	97,766	176,160		273,926
Port-Berge (Boriziny-Vaovao)		201,978		201,978
<b>Vakinankaratra</b>			<b>1,941,028</b>	<b>1,941,028</b>
Ambatolampy		279,122		279,122
Antanifotsy		328,831		328,831
Antsirabe I		264,082		264,082
Antsirabe II		434,251		434,251
Betafo		272,029		272,029
Faratsiho		206,396		206,396
Mandoto		156,318		156,318
<b>Vatovavy Fitovinany</b>			<b>1,523,515</b>	<b>1,523,515</b>
Ifanadiana		168,483		168,483
Ikongo		198,737		198,737
Manakara Atsimo		397,487		397,487
Mananjary		338,439		338,439
Nosy-Varika		257,774		257,774
Vohipeno		162,597		162,597
<b>Total</b>	<b>597,427</b>	<b>5,100,218</b>	<b>14,293,874</b>	<b>19,991,519</b>

The population exposure, summarized by Region and District, has been calculated using a 100 m resolution WorldPoP dataset. This is a preliminary analysis & has not yet been validated in the field.

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# Population Living Within Flood Hazard Zones with 25 Years of return period and Exposed to Tropical Cyclone Enawo-17

Population exposure estimates are based on flood hazard zones of 25 years return period (GAR Risk Data Platform), cyclone track (JRC) and WorldPop data.



**23,852,000**

Total population of Madagascar

**83,226**

Total population living in flood hazard zones of 25 years return period and exposed to **120 km/h** cyclone winds

**628,072**

Total population living in flood hazard zones of 25 years return period and exposed to **90 km/h** cyclone winds

**1,088,019**

Total population living in flood hazard zones of 25 years return period and exposed to **60 km/h** cyclone winds

Administrative level (Region / District)	Flood Hazard Zones of 25 Years Return Period						Total	
	120 km/h		90 km/h		60 km/h			
	Area (ha)	Pop.	Area (ha)	Pop.	Area (ha)	Pop.	Area (ha)	Pop.
<b>Alaotra Mangoro</b>	<b>5,019</b>	<b>371</b>	<b>218,726</b>	<b>79,318</b>	<b>51,053</b>	<b>18,697</b>	<b>274,798</b>	<b>98,386</b>
Ambatondrazaka			58,978	27,600			58,978	27,600
Amparafaravola			110,685	46,156			110,685	46,156
Andilamena	5,019	371	37,428	1,457			42,447	1,828
Anosibe-An'ala					17,130	5,476	17,130	5,476
Moramanga			11,636	4,104	33,923	13,222	45,559	17,326
<b>Amoron'I Mania</b>					<b>83,629</b>	<b>24,283</b>	<b>83,629</b>	<b>24,283</b>
Ambatofinandrahana					58,196	6,128	58,196	6,128
Ambositra					14,563	10,842	14,563	10,842
Fandriana					9,635	6,264	9,635	6,264
Manandriana					1,235	1,048	1,235	1,048
<b>Analamanga</b>			<b>27,791</b>	<b>9,245</b>	<b>89,897</b>	<b>149,619</b>	<b>117,688</b>	<b>158,864</b>
Ambohidratrimo					13,691	45,614	13,691	45,614
Andramasina					1,965	2,563	1,965	2,563
Anjozorobe			19,599	7,594	18,619	7,146	38,218	14,740
Ankazobe			8,192	1,651	39,077	8,865	47,269	10,516
Antananarivo								
Atsimondrano					7,916	53,369	7,916	53,369
Antananarivo					4,601	27,362	4,601	27,362
Avaradrano					4,028	4,700	4,028	4,700
Manjakandriana								

<b>Analanjirofo</b>	<b>79,765</b>	<b>75,902</b>	<b>120,684</b>	<b>85,239</b>			<b>200,449</b>	<b>161,140</b>
Fenerive Est	1,101	805	41,272	47,274			42,373	48,080
Mananara-Avaratra	31,752	14,823	5,076	2,221			36,828	17,044
Maroantsetra	35,183	55,708	23,859	9,108			59,042	64,816
Soanierana Ivongo	11,730	4,566	31,547	13,281			43,277	17,846
Vavatenina			18,929	13,354			18,929	13,354
<b>Anosy</b>					<b>37,589</b>	<b>9,360</b>	<b>37,589</b>	<b>9,360</b>
Amboasary-Atsimo					4,775	550	4,775	550
Betroka					6,210	817	6,210	817
Taolagnaro					26,605	7,992	26,605	7,992
<b>Atsimo Andrefana</b>					<b>15,615</b>	<b>330</b>	<b>15,615</b>	<b>330</b>
Beroroha					15,615	330	15,615	330
<b>Atsimo Atsinanana</b>					<b>240,449</b>	<b>155,966</b>	<b>240,449</b>	<b>155,966</b>
Befotaka					12,705	2,533	12,705	2,533
Farafangana					58,234	90,299	58,234	90,299
Midongy-Atsimo					63,478	12,447	63,478	12,447
Vangaindrano					81,327	41,222	81,327	41,222
Vondrozo					24,705	9,465	24,705	9,465
<b>Atsinanana</b>		<b>55,762</b>	<b>27,677</b>	<b>186,119</b>	<b>81,423</b>		<b>241,881</b>	<b>109,100</b>
Antanambao					5,766	2,249	5,766	2,249
Manampontsy					7,911	3,194	79,021	26,960
Brickaville							86,932	30,154
Mahanoro							34,465	15,154
Marolambo							26,869	11,780
Toamasina II					47,851	24,483		
Vatomandry							39,998	25,280
<b>Betsiboka</b>			<b>113,171</b>	<b>11,818</b>	<b>124,019</b>	<b>14,673</b>	<b>237,190</b>	<b>26,491</b>
Kandreho							22,031	309
Maevatanana					29,828	5,144	101,988	14,364
Tsaratanana					83,343	6,673		
<b>Boeny</b>			<b>72,482</b>	<b>17,431</b>	<b>264,310</b>	<b>68,064</b>	<b>336,791</b>	<b>85,495</b>
Ambato Boeni					43,007	9,488	106,249	26,456
Mahajanga II					25,061	6,444	36,190	8,482
Marovoay					4,413	1,499	92,340	27,173
Mitsinjo							29,532	5,953
<b>Bongolava</b>							<b>117,942</b>	<b>24,909</b>
Fenoarivobe							58,603	8,532
Tsiroanomandidy							59,339	16,377
<b>Diana</b>			<b>89,878</b>	<b>93,725</b>	<b>55,421</b>	<b>18,836</b>	<b>145,299</b>	<b>112,561</b>
Ambanja					38,934	75,765		
Ambilobe					50,511	17,909	46,934	16,511
Antsiranana II					433	51	8,486	2,325
<b>Haute Matsiatra</b>							<b>160,105</b>	<b>70,832</b>
Ambalavao							37,268	9,934
Ambohimahasoa							9,285	7,415
Ikalamavony							70,061	4,814
Isandra							10,892	7,847
							10,892	7,847

Lalangina				14,959	19,678	14,959	19,678
Vohibato				17,641	21,145	17,641	21,145
<b>Ihorombe</b>				<b>178,534</b>	<b>24,339</b>	<b>178,534</b>	<b>24,339</b>
Iakora				51,200	5,232	51,200	5,232
Ihosy				75,957	11,774	75,957	11,774
Ivohibe				51,377	7,332	51,377	7,332
<b>Itasy</b>				<b>53,714</b>	<b>57,990</b>	<b>53,714</b>	<b>57,990</b>
Arivonimamo				15,523	21,855	15,523	21,855
Miarinarivo				14,355	11,741	14,355	11,741
Soavinandriana				23,835	24,394	23,835	24,394
<b>Melaky</b>				<b>5,215</b>	<b>524</b>	<b>5,215</b>	<b>524</b>
Ambatomainty				5,215	524	5,215	524
<b>Menabe</b>				<b>98,157</b>	<b>45,408</b>	<b>98,157</b>	<b>45,408</b>
Mahabo				27,511	2,615	27,511	2,615
Miandrivazo				70,646	42,793	70,646	42,793
<b>Sava</b>	<b>9,115</b>	<b>3,520</b>	<b>218,077</b>	<b>105,846</b>	<b>6,031</b>	<b>1,385</b>	<b>233,222</b>
Andapa			26,698	12,447			26,698
Antalaha	9,115	3,520	35,689	13,934			44,804
Sambava			83,307	51,768			83,307
Vohemar			72,383	27,696	6,031	1,385	78,414
<b>Sofia</b>	<b>6,153</b>	<b>3,433</b>	<b>539,311</b>	<b>197,775</b>			<b>545,464</b>
Analalava			58,827	12,680			58,827
Antsohihy			94,558	54,661			94,558
Bealanana			53,299	14,235			53,299
Befandriana Nord			77,868	25,416			77,868
Mampikony			67,602	19,393			67,602
Mandritsara			6,153	3,433	66,999	37,395	73,152
Port-Berge (Boriziny-Vaovao)					120,158	33,995	120,158
<b>Vakinankaratra</b>					<b>106,799</b>	<b>95,937</b>	<b>106,799</b>
Ambatolampy					17,176	24,507	17,176
Antanifotsy					26,376	30,336	26,376
Antsirabe II					7,172	10,874	7,172
Betafo					23,145	13,529	23,145
Faratsihio					7,272	7,989	7,272
Mandoto					25,658	8,702	25,658
<b>Vatovavy Fitovinany</b>					<b>298,305</b>	<b>225,444</b>	<b>298,305</b>
Ifanadiana					35,188	12,776	35,188
Ikongo					32,462	22,594	32,462
Manakara Atsimo					71,620	58,984	71,620
Mananjary					70,745	41,157	70,745
Nosy-Varika					38,872	20,835	38,872
Vohipeno					49,419	69,098	49,419
<b>Total</b>	<b>100,052</b>	<b>83,226</b>	<b>1,455,883</b>	<b>628,072</b>	<b>2,172,902</b>	<b>1,088,019</b>	<b>3,728,837</b>
							<b>1,799,317</b>

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