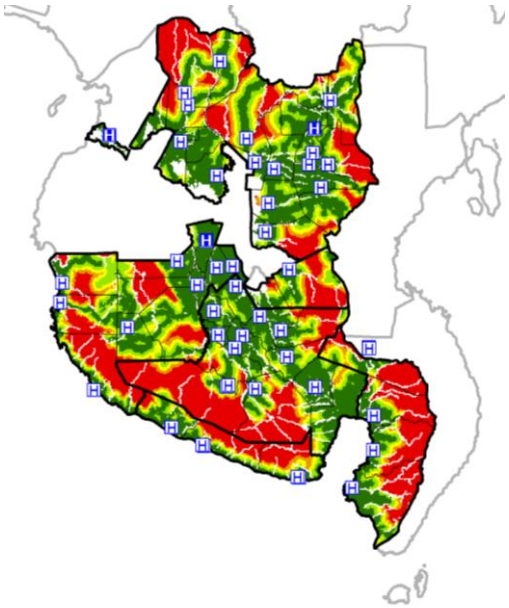
Geographic Accessibility to Emergency Obstetric and Neonatal Care (EmONC)

Region XII (Soccsksargen)



Last Update: May 2015

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- The Department of Health (DOH);
- The National Mapping and Resource Information Authority (NAMRIA)
- The National Statistic Office (NSO);
- The OpenStreetMap community (OSM);

Dr Steeve Ebener, consultant, on behalf of the World Health Organization Country Office of the Philippines, prepared this report.

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Executive Summary

Objective
Maternal mortality remains relatively high and the Maternal Mortality Rate (MMR) is still far from the reaching the MDG target by 2015 in the Philippines.

In several places in the country, the population, especially the one part of the lowest income quintiles, is particularly vulnerable when it comes to care in general, and Maternal and Newborn Health (MNH) care in particular.

In this context, the objective of the present study is to analyse how accessible EmONC facilities are to the population in Region XII as well as identify potential gaps towards achieving Universal Health Care in this area.

Methodology
Working in close collaboration with the Department of Health of the Philippines and other key stakeholders, a freely available GIS extension developed by WHO to measure physical accessibility to health care, called AccessMod (See Chapter 4), has been used in combination with statistical data from existing sources (household surveys, census data,...) to measure accessibility coverage according to the following indicators:

1. At Province and Municipality level, the percentage of births where the household is located within 2 hours travel time from a BEmONC, including CEmONC, facility;
2. The travel time between each BEmONC facility and the nearest CEmONC facility;

The results coming out of these analyzes (Chapter 7) are presented in the form of tables, graphs and maps to be included into the analysis of maternal and new born health investments in the country.

Results
In the case of Region XII, the analyses performed indicate that:

- At the level of the Region:
  - With 89.8%, the accessibility coverage provided by the existing BEmONC, including CEmONC, facilities is very close to universal coverage (90%, see Chapter 3);
- At the Province level (looking only at the combined travelling scenario):
  - Three Provinces find themselves above the 90% universal coverage benchmark when it comes to physical access to BEmONC, including CEmONC, facilities;
  - The lowest level of accessibility coverage is observed in Sarangani Province with 70.8%
- At the Municipality level (looking only at the combined travelling scenario):
  - Universal accessibility coverage is reached in 27 of them;

- 3 municipalities present an accessibility coverage below 50%, namely: Alamada (Cotabato (North Cotabato), Lake Cebu (South Cotabato) and Malungon (Sarangani);

The measure of the travel time between each BEmONC and the nearest CEmONC facility has itself shown that 11 BEmONC facilities are finding themselves beyond 2 hours of reach of a CEmONC facility, the maximum travel time being observed for Palimbang RHU with 4.6 hours.

Finally, the scaling up scenario aiming at upgrading the Polomok Municipality Hospital from BEmONC to CEmONC would then allow for 8 of these 11 BEmONC to find themselves within 2 hours of reach of a CEmONC facility.

Key messages

Despite the data limitations described in Chapter 6 (mainly time discrepancies between datasets and GIS data quality issues), the results obtained provide a first set of evidence that could be considered for any strategic decision related to accessibility to EmONC facilities in Region XII.

In this context, the accessibility coverage analysis first demonstrated that any program aiming at financially supporting the transportation of pregnant women at the moment of delivery would have an important positive impact on their chance to reach a BEmONC, including CEmONC, facility within 2 hours.

This study also highlights the important heterogeneity that exists at the Province level when it comes to accessibility coverage of BEmONC facilities. This heterogeneity is even more pronounced at the Municipality level where 46% of the Municipalities are below the 90% universal coverage benchmark for accessibility coverage.

Finally, by analysing travel time between each BEmONC and CEmONC, this type of analysis can help identifying potential gap in the referral system and propose possible scenarios to fill them.

Conclusion and recommendations

By analysing how accessible EmONC facilities are to the population of Region XII and identifying potential gaps towards achieving Universal Health Maternal and Newborn Health (MNH) care in that Region, the present study can inform policy discussions on how to optimize or target the location, and potentially capacity if additional analysis were to be conducted, of EmONC facilities.

Beyond the results obtained and presented here, this study should also be used to demonstrates the benefit that the health sector would gain if geography and time were to be further integrated into the Health information System (HIS), the GIS capacity of the DOH was further strengthened and GIS standards and procedures were to be agreed upon

and collaboration improved not only within the health sector but also among all key producers of geo spatial information in the country.

Working on these points would not only ensure the transfer and sustainability of the methods used here but also open opportunities to use the integrating and visualization power of geography and GIS in other health areas such as emergency preparedness and response, disease surveillance, immunization and/or programme delivery.

As such, the main recommendations are for the DOH to:

- Look at the result of the present study as a way to advocate for:
    - Conducting comprehensive EmONC assessment in the country in order to have a good picture of the current functional network of services;
    - Continuing to work at improving the National Health Facility Registry (NHFR) so that it contains a precise geographic location (latitude and longitude) for each of the health facility in the country;
    - Continuing at improving its data management and GIS capacity in order to be in the position to conduct the type of analysis presented here on its own.
- Complete the analysis presented here in order to, for example, look into the link between MCP accredited facilities and functional EmONC as well as integrating the health workforce in the analysis to see if the capacity on the ground is actually sufficient to cover the demand as per the results of the accessibility analysis.

1. Introduction

Maternal mortality is still relatively high in the Philippines and, according to the MDG watch, Maternal Mortality Rate (MMR) is still far from the 2015 target in the country.

In several places in the country, the population, especially the one part of the lowest income quintiles, is particularly vulnerable when it comes to care in general, and Maternal and Newborn Health (MNH) care in particular.

In this context, the objective of the present study is to analyse how accessible EmONC facilities are to the population in Region XII as well as identify potential gaps towards achieving Universal Health Maternal and Newborn Health (MNH) Care in this Region.

After presenting the study area, the report describes the analytical methods, tool and data that have been used in order to conduct the different analysis. The results obtained through the implementation of these methods are then presented before providing some recommendations in the conclusion.

2. The study area

As of January 2014, Region XII (Soccsksargen) is divided into 5 Provinces (Figure 1) and 50 Municipalities (Annex 1) which are themselves further divided into 1195 Barangays.

Figure 1 – 5 Provinces on which the project has been implemented

3. Assumptions used during the project

The following assumptions are considered in the context of the present project:

- Skilled care at birth refers to "the care provided to a woman and her newborn during pregnancy, childbirth and immediately after birth by an accredited and competent health care provider who has at her/his disposal the necessary equipment and the support of a functioning health system, including transport and referral facilities for emergency obstetric care" [1]. This implies having at direct disposal the capacity and capability to the Basic Emergency Obstetric Care lifesaving interventions;
- As such, for this particular study we assess the accessibility to skilled care at birth, interpreting this as births attended by skilled health personnel in facilities. In the context of the analysis presented here, this means access to BEmONC care where the needed skills and competencies are available, supported by the necessary medicines and equipment; and a functioning referral system at every level of care;
- Based on the target set by the ICPD UNGASS resolution [2], we compare current accessibility of BEmONC to a target of 90%;
- In the Philippines, a facility is classified as a Basic Emergency Obstetric and Newborn Care (BEmONC) if it is performing all the following 6 Basic EmONC functions, namely [3]: (1) parenteral administration of oxytocin in the third stage of labor; (2) parenteral administration of loading dose of anti-convulsants; (3) parenteral administration of initial dose of antibiotics; (4) performance of assisted deliveries (Imminent Breech Delivery); (5) removal of retained products of conception; and (6) manual removal of retained placenta. Compare to the internal norm [4] basic neonatal resuscitation (e.g. with bag and mask) is therefore not taken into account and the use of manual vacuum extraction still being debated;
- A facility is classified as a Comprehensive Emergency Obstetric and Newborn Care (CEmONC) facility if it performs all the signal functions of a BEmONC facility plus [4]: surgery (e.g. caesarean section), and blood transfusion;
- CEmONC facilities are also considered to be BEmONC facilities as they are performing the 7 Basic EmONC functions as well;
- Would a complication requiring blood transfusion and/or surgery occur during the delivery in the BEmONC facility, the patient should be transferred to a CEmONC facility;
- It is considered that 15% of all births are to develop complications, and among them about 30% of complications (5% of all births) would require blood transfusion and/or C-section, and therefore a transfer from the BEmONC facility to a CEmONC facility;
- The maximum acceptable travel time from home to reach a skilled care (BEmONC) at a facility within our model is 2 hours and this intends to account for:

    - The standard for the availability of services set to be between 2 and 3 hours in the 2009 hand book for monitoring emergency obstetric care [4]
    - In case of complications, especially haemorrhage, the estimated average interval between onset of a postpartum haemorrhage and death is set as being 2 hours [4]
- The maximum travel time considered in case of transfer between a BEmONC facility, where all women delivering should initially seek care, to a CEmONC facility because of severe complications is again of 2 hours (same rationale: time needed to address postpartum haemorrhage which is pre-managed at BEmONC facility but will require blood transfusion and/or C-section);
- The assumption is that women would walk or be carried from their home to the nearest road. This would take place during early labour (assuming that a birthing plan has been developed and that the woman has the support of her family to initiate care seeking as labour commences). At this stage in the delivery process a 50% reduction in walking speed is assumed. Upon reaching a road, women would then travel by motor vehicle to the nearest BEmONC facility. The analysis will include an alternative scenario where women are assumed to travel to the BEmONC facility by foot alone. This scenario is analysed to estimate the gains made by financially supporting women to be able to access road vehicle transportation;
- The transfer between the BEmONC facility to the CEmONC facility is done using a motor vehicle (ambulance, car, truck, boat…)
- Analyzes are performed considering transportation conditions during the dry season. While the tool used here (AccessMod) can account for areas and/or roads being flooded during the wet season, this particular context has not been analysed here;
- Based on a 90% target asset by the ICPD for 2015 [2], conditions that support universal accessibility and universal geographic coverage are assumed to be in place when:
    - 90% of all births in the country would be within 2 hours of travel from a BEmONC facility and that the capacity of the BEmONC facility, in terms of skilled birth attendants, is sufficient to cover the demand;
    - 5% of all births taking place in a BEmONC facility (considered as presenting complications) could be transferred to a CEmONC facility in less than 2 hours[1] and that the capacity of the CEmONC facility, in terms of EmONC facility surgical teams, is sufficient to cover the demand.

It is important to note here that this model:

- Does consider:

[1] We note that the assumption of a potential maximum 4 hours travel time (2 hours to skilled care and BEmOC and a further 2 hours to CEmOC) may be too long since there is a risk that in a small proportion of women with severe bleeding after a birth, blood transfusions and surgical treatment if required may be required sooner than that.

  - That women have enough resources in order to pay for the transportation on the road network or maritime route;
- Does not consider:
  - The availability of waiting homes to allow for women living in remote areas to come close to MCP accredited facility before the due date;
  - Demand generation activities (where demand appears to be lower than supply)
  - Improving transport links (e.g., improving the quality of some roads) and the expected impact on accessibility.

4. Tool used for the different analysis: AccessMod 4.0

All analyzes conducted in the context of this project have been possible thanks to the use of AccessMod ©.

AccessMod© is a toolbox that has been developed by WHO to provide Ministries of Health, and other health partners, with the possibility to use the power of Geographic Information System (GIS) to:

- Measure physical accessibility to health care,
- Estimate geographical coverage (a combination of availability and accessibility coverage) of an existing health facility network,
- Complement the existing network in the context of a scaling up exercise or to provide information for cost effectiveness analysis when no information about the existing network is available.

AccessMod© uses the functions of Esri's GIS technology to apply a specific set of algorithms on a series of GIS layers containing the information influencing the time taken by a patient to reach the nearest health facility depending on the mode of travel (for example, by feet, by car, etc).

As GIS technology evolves, and to address needs specific to the present project, a new version of AccessMod (version 4.0) has been developed to work on a more recent version of Esri's technology, ArcGIS 9.3.1 software. This version of AccessMod is freely accessible either through the WHO [5] or Esri ArcGIS online [6] web sites and comes with a user manual and a sample dataset to guide users on the use AccessMod's different modules, namely:

- Module 1 tocreate the combined land cover distribution grid and the travelling scenario table based on the land cover, road and hydrographic network layers;
- Module 2 to measure the travelling time to or from for a given health facility network;
- Module 3 to analyze the geographic coverage an existing health facility network through the generation of catchment areas and determination of the population covered by each of the facilities;

- Module 4 to determine the locations for new health facilities, and the population they cover, to scale up an existing network or to perform different analysis when no information about the location of the existing health facility networks is available (e.g. for cost-effectiveness analysis).

5. Analytical approach

Accessibility coverage in Region XII as been measured according to the following indicators:

1. At Province and Municipality level, the percentage of births where the household is located within 2 hours travel time from a BEmONC, including CEmONC, facility;
2. The travel time between each BEmONC facility and the nearest CEmONC facility;

Method: The methodology takes into account the location of the EmONC facilities, the environment that the patient will have to cross to reach the nearest care provider (including the hydrographic network as barriers), the road network as well as the following transportation scenarios: walking outside of the road network/maritime route and then a motor vehicle on the road network/maritime route.

In this first analysis, as well as all the other subsequent ones, the total number of births is spatially distributed using the approach described in section 6.2.8.

Output considering normal conditions (dry season):

- Maps presenting the travel time to the nearest BEmONC facility (for two scenarios: walking only, and walking + motor vehicle on the road network/maritime route);
- Excel file presenting, at the Province and municipality level, the total number and percentage of births where the household is located within 2 hours from a BEmONC facility (for two scenarios: walking only, and walking + motor vehicle on the road network);
- Map presenting, at the sub national level the percentage of births where the household is located within 2 hours of a BEmONC facility (walking + motor vehicle on the road network);
- Excel file presenting the travel time between each BEmONC facility and the nearest CEmONC facility (use of motor vehicle);

6. Data and national norms used in the different analysis

Performing the different analysis considered in the context of this requires an important volume of data that can be grouped into three main categories:

- Statistical data,

- Geospatial data,
- National norms.

From a statistical point of view, this concerns data collected at different levels, namely:

1. At the national level:
    i. Urban/rural Crude Birth Rate (CBR);
2. At the sub national level:
    i. Total population;
    ii. Total number of births for a recent year;

From a geospatial perspective, the different analysis requires to have the following GIS layers at disposal:

1. Administrative boundaries matching the level of desegregation of the sub national statistical data;
2. Geographic location of all the EmONC facilities,
3. Road network;
4. Hydrographic network (major rivers and water bodies);
5. Location and extension of the cluster for the household survey data;
6. Land cover including the extend of urban areas;
7. Digital Elevation Model (DEM);
8. Spatial distribution of the number of birth.

In addition to these layers, mosaic of satellite images have been used as ground reference to evaluate the accuracy, and to some extend level of completeness, of the different layers as well as insure consistency among the different source of GIS data used for each country. The mosaics used in the context of this project have been collected through the Landsat ETM+ program and can be downloaded from the Earth Science Data Interface (ESDI) at the Global Land Cover Facility [7].

When it comes to national norms, the different analysis required the maximum expected travel speed for the different transportation media and road type considered for the analysis.

The following sections describes more in details the sources of the data and norms used in the context of project presented as well as the potential preparation, adjustments or transformations that have been operated on the data in order to obtain the final dataset necessary to implement the different analysis described in Chapter 5.

It is important to emphasize here the temporal discrepancies that exist between the different datasets that have been used. From a statistical perspective, the data used range from 2008 (DHS) to 2010 (Population census), some of these data having been projected to 2014 for analytical purpose. In addition to that, it is very difficult to estimate the representativeness of some of the GIS layers used in the different analysis, mainly the road network and land cover. A temporal shift is therefore possible between the two types of data and has to be taken into account when analyzing the results presented here.

6.1 Statistical data

6.1.1 National level figures

The only national level figure used in the context of this project is the urban/rural Crude Birth Rate (CBR) estimated during the 2008 Demographic Health Survey (DHS) [8] as follow:

- Urban: 23.4
- Rural: 24.6

6.1.2 Sub national level figures

The only statistics needed at the sub national level for this study was the number of births for 2014.

The last population census having been conducted back in 2010 it has been necessary to generate the 2014 figure by projecting the census data.

This has been done has follow (Annex 1):

1. The Municipality level total population and number of births observed during the 2010 census have been used to estimate a Municipality level Crude Birth Rate (CBR) for that same year;
2. The 2014 Municipality level total population has then been estimated using the yearly grow rate reported in the CIA World Factbook through the Index Mundi web site [9]. The value for 2014 has itself been directly obtained from the CIA World Factbook web site [10];
3. The 2010 Municipality level CBR has been applied on the 2014 projected population in order to obtain an estimation of the number of births for that year.

This approach does of course present several limitations mainly due to the time difference between the census and the year considered for the present study.

Looking at the 2015 projected population for Region XII (4,524,000 inhabitants) provided by the Philippine Statistical Authority [11] it is most likely that Annex 1 is underestimating the population, and therefore indirectly the number of births considered in that Region for the present study.

This being said, the impact of the above on the result is limited as these results are being expressed in terms of percentages and not real numbers of births.

6.2 Geospatial data

In order to ensure compatibility between the difference sources of GIS data, and in order for AccessMod to produce correct results, all the GIS data presented in this section have been homogenized in terms of projection and spatial resolution (for GIS data in raster format).

When it comes to projection, it has been decided to use the Universal transverse Mercator (UTM) projected coordinate system as the data needs to be projected in a metric system when using AccessMod. Here are the different elements that define this particular projected coordinated system when it comes to the UTM zone in which Mindanao Island is located (Zone 51 North) as it appears in Esri's GIS software:

- Projected Coordinate System: WGS_1984_UTM_Zone_51N
- Projection: Transverse_Mercator
- False_Easting: 500000.00000000
- False_Northing: 0.00000000
- Central_Meridian: 123.00000000
- Scale_Factor: 0.99960000
- Latitude_Of_Origin: 0.00000000
- Linear Unit: Meter

The geographic coordinate system on which the UTM system is the following:

- Geographic Coordinate System: GCS_WGS_1984
- Datum: D_WGS_1984
- Prime Meridian: Greenwich
- Angular Unit: Degree

The spatial resolution of the GIS data in raster format used in this project (land cover, DEM and birth distribution) has itself been decided based on two criteria:

1. The resolution of the freely available data for the concerned layers;
2. The volume of RAM memory in the computer used for performing the different analysis as this is unfortunately one of the limiting factor when using AccessMod.

In view of the above, and taking into account the analysis already conducted over the all Mindano Islands [12] the spatial resolution that has been used is of 500 meters once projected according to the above-mentioned projected coordinate system.

AccessMod performing the different analysis in raster format, 500 meters is to be considered as a low resolution that induces an important simplification of the reality.

As an example, a road, which in the reality would seldom be wider than 10 meters, would be presenting a width of 500 meters during the different analysis. This has two major implications:

1. The traveling speed within the cells crossed by road segments would be higher than in the reality as the model would consider the patient to be travelling by road

over the all surface of these cells while he would normally still have to cross some lands by feet before reaching the road;

2. When roads are located along rivers the combination of the layers in AccessMod might result into the creation of "fake bridges" and therefore potential crossover that do not exist in the reality.

While it has been possible to make some adjustments in the road and hydrographic GIS layers regarding the second point (see section 6.2.5) nothing can unfortunately be done when it comes to the first one.

Because of this, catchments areas obtained with AccesMod tend to be a little bit bigger than what they should be. This being said, this error has been quantified and could finally happen to be smaller than those generated by some of the other assumptions made in the context of this project.

Taking the above into account, the following sections describe more in details the source of the geospatial data that have been used in the context of this project as well as the modifications that have been performed on them before conducting the different analysis described in Chapter 5.

6.2.1 Administrative boundaries

According to the list of administrative divisions provided by NSCB, the study area is composed of 50 municipalities as of January 2014 (Figure 2).

Figure 2 – 50 Municipalities observed in Region XII as of January 2014

The Province level boundaries map (Figure 1) has been obtained by merging the corresponding Municipalities together from NAMRIA Municipality boundaries level map (Figure 2).

6.2.2 Geographic location of EMONC facilities

Unfortunately, a comprehensive EmONC assessment remains to be implemented in the country in order to know which facilities are currently providing all the signal functions attached to a BEmONC or a CEmONC facility.

In the meantime, the list of health facility to which the Department of Health (DOH) Family Health Office (FHO) has been providing EMONC specific training as of July 9, 2014 has been used as the starting point for the present study.

Once organized, this list contained 79 health facilities distributed as follow:

- 24 hospitals (9 CEmONC and 15 BEmONC),
- 38 Rural Health Units (RHU) all considered as BEmONC,
- 17 Barangay Health Stations (BHS).

This being said, the FHO was reporting having trained teams in only 51 of these health facilities. Once removed, we end up with:

- 16 hospitals, two of them only being considered as CEmONC (Lambayong and Arakan Valley District Hospitals);
- 35 RHUs, all considered as BEmONC.

It was noticed that then noticed that the Cotabato Regional and Medical Center located in Cotabato City was missing in the list while this is a CEmONC health facility. It has therefore been added to the list to reach a total of 52 EmONC for Region XII, 3 CEmONC and 49 BEmONC (without counting the 3 CEmONC which are actually also operating as BEmONC facilities). Table 3 presents the distribution of these facilities by Province.

Province code (PSGC)	Province name (PSGC)	Number of BEmONC (without CEmONC)	Number of CEmONC
124700000	COTABATO (NORTH COTABATO)	15	1
126300000	SOUTH COTABATO	13	0
126500000	SULTAN KUDARAT	10	1
128000000	SARANGANI	11	0
129800000	COTABATO CITY (Not a Province)	0	1
	Total	49	3

Table 3 – Province level distribution of the EmNOC facilities in Region XII as of July 9th, 2014 (DOH/FHO)

The Department of Health (DOH) is still in the process of getting a geographic coordinate for each health facility in the country.

As such a geographic coordinate, collected with a GPS were only available for 27 facilities (Annex 2).

Different approaches have then been used to obtain a location for the remaining 176 facilities. These approaches include:

- Identifying the location directly on the satellite images accessible in Google Map (11 facilities);
- Using the delimitation of the Barangay in which the facility is located in connection with the road network to get an approximate potential location for the facility (12 facilities);
- Using other sources (2 facilities).

Once all these coordinates stored in an excel file, these have been displayed on top of the Landsat satellite images mosaic as well as the final road network (see section 6.2.4) to make any last adjustment in order to avoid facilities to be located on water bodies and or on areas where they are most likely not located (top of a mountain for example).

Annex 2 contains the final geographic coordinates, in decimal degrees (geographic projection). Figure 3 shows the location of these facilities making the distinction between the BEmONC and CEmONC facilities. Please note that the final GIS layer has been projected according to the UTM 51coordinate system before being used in the context of the present study

In view of the mixed approaches that have been used it is clear that this location remains approximate for most of the health facilities. This uncertainty is therefore to be taken into account when looking at the results from the different analysis conducted here.

Please note that two EmONC facilities, Malungon Municipal Hospital and Malungon Rural Health Unit, are appearing outside of Region XII in Figure 3 (South Eastern part of the Region). After checking this issue, it appears that the problem is not coming from the location of the health facilities but from a potential error in the administrative boundaries layer itself.

As it was difficult to correct this without potentially generating other errors, and also in order to account for border effects, all the GIS layers used in the context of the study, except the distribution of births, have been extended to cover all the surrounding Provinces.

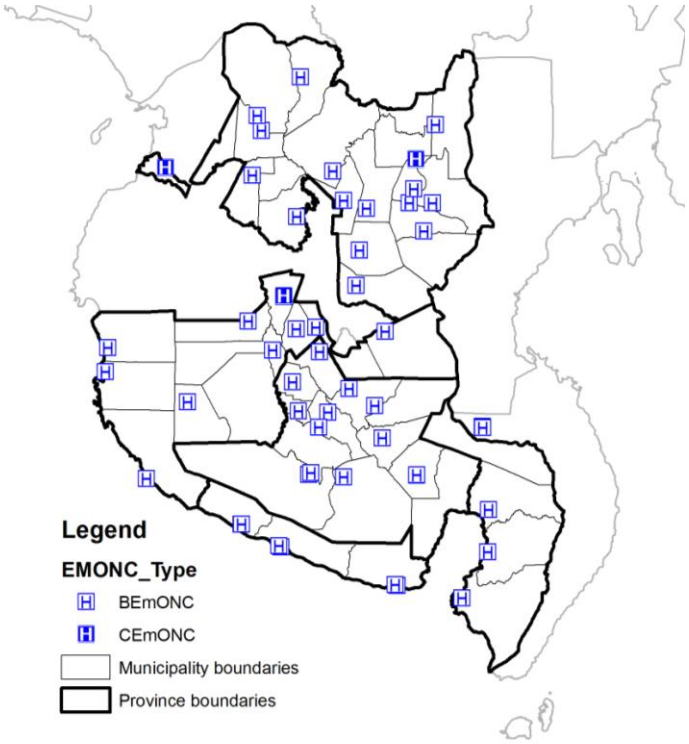

Figure 3 – Location of the EmONC facilities over the study area

6.2.3 Land cover including the extend of urban areas

This project used the land cover distribution GIS layer generated by NAMRIA.

The original vector format layer contains 20 land cover types that have been regrouped in order to obtain a simplified classification in six types (Table 4).

Once the simplified classification applied on NAMRIA's original layer, the last step consisted into converting it into a grid presenting a resolution of 500 m. The grid in question is presented in Figure 4 for Region XII. As mentioned in the previous section, the final grid used for the analysis is actually extending beyond Region XII to cover all surrounding Provinces.

Original NAMRIA land cover types	Original NAMRIA landcover classes	Final land cover types	Final land cover classes
Closed forest, broadleaved	1	Dense vegetation	5
Closed forest, mixed	2	Dense vegetation	5
Open forest, broadleaved	4	Dense vegetation	5
Open forest, mixed	5	Dense vegetation	5
Mangrove forest	7	Water	6
Forest plantation, broadleaved	8	Dense vegetation	5
Forest plantation, coniferous	9	Dense vegetation	5
Other wooded land, shrubs	10	Medium dense vegetation	4
Other wooded land, fallow	11	Medium dense vegetation	4
Other wooded land, wooded grassland	12	Low dense vegetation	3
Other land, natural, barren land	13	Bare areas	1
Other land, natural, grassland	14	Low dense vegetation	3
Other land, natural, marshland	15	Water	6
Other land, cultivated, annual crop	16	Medium dense vegetation	4
Other land, cultivated, perennial crop	17	Medium dense vegetation	4
Other land, cultivated, perennial	17	Medium dense vegetation	4
Other land, fishpond	19	Water	6
Other land, built-up area	20	Urban	2
Inland water	21	Water	6
Forest plantation, mangrove	23	Water	6

Table 4 – Original NAMRIA and final landcover types and classes

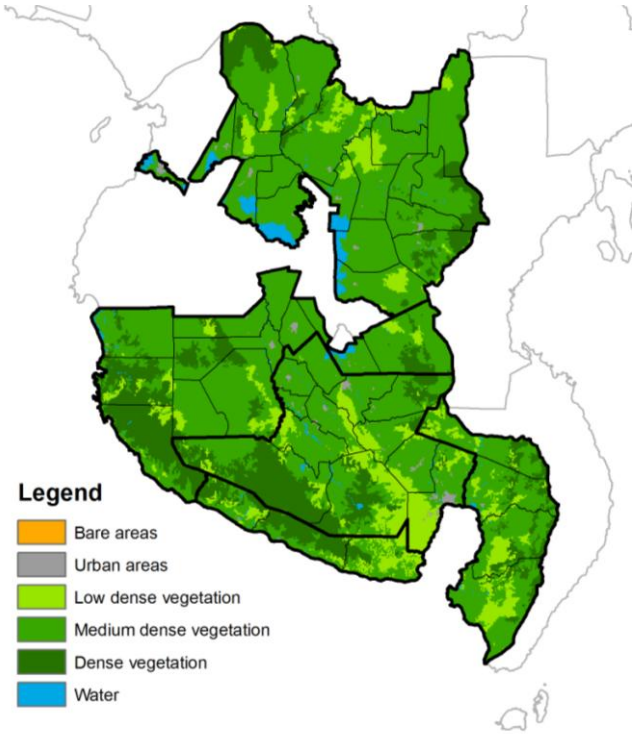

Figure 4 – Land cover distribution layer used in the different analysis

6.2.4 Transportation network

The starting point for creating the transportation network layer over the study area is the one developed by the OpenStreetMap (OSM) community and extracted from the bbbike web site [13] on April 5, 2015.

In a first phase, the following changes have been applied on this layer:

1. The segments presenting the following categories have been removed as not used for transportation purposes:
    - Bridleway
    - construction
    - Cycleway
    - Emergency access
    - Raceway
    - Crossing
2. The segments presenting the following categories were reclassified into Foot tracks as all corresponding to path used by feet:
    - Ford
    - Footway
    - Passing place
    - Path
    - Pedestrian
    - Steps
3. The segments presenting the following categories were then reclassified:
    - Trunk and trunk_link into Highways
    - Primary_link into Primary roads
    - Roads, Unclassified and secondary_link and secondary_unclass unto Secondary roads
    - Services (access to fuel station, parking lot, reserved residence place, between properties), Residential and tertiary_link into Tertiary roads

In a second phase, a GIS datasets received from the Department of Public Works and Highways has been used to add secondary roads segments that were not present in the original OSM dataset.

In the third phase, Google Map and the Landsat satellite mosaic have been used to manually add:

- Important road segments that were not in the OSM nor in the DPHW datasets,
- Boat routes between the main islands.

In the fourth, and final phase, the layer has been cleaned manually to remove small segments and correct disconnect over the all network.

At the end of this process, the resulting map (Figure 5) contains the following road categories for Region XII: highways, primary roads, secondary roads, tertiary roads,

tracks, foot tracks and boat routes. As mentioned previously, the final layer used for the analysis is actually extending beyond Region XII to cover all surrounding Provinces.

Please note that transportation by boat has not been considered in the case of Region XII as no population was finding itself on islands.

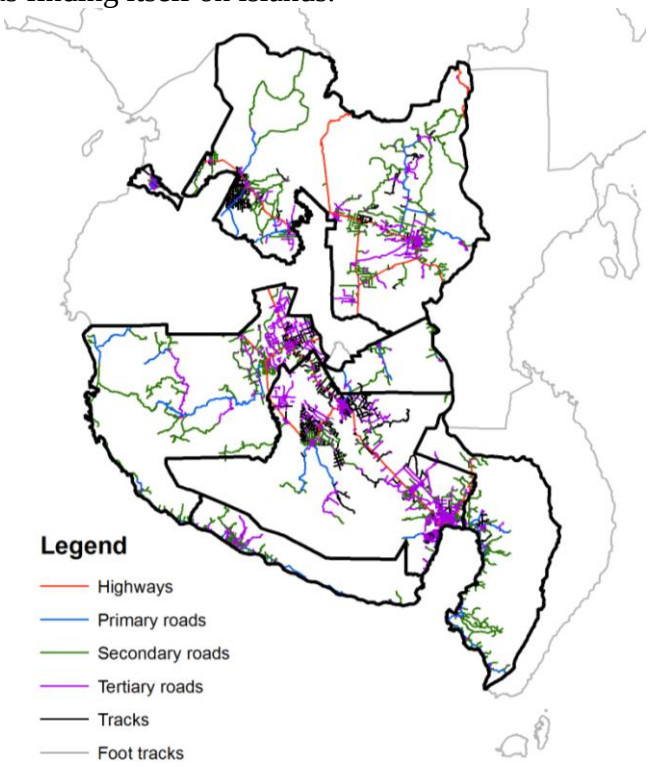

Figure 5 - Road network layer used in the different analysis

6.2.5 Hydrographic network

The hydrographic network has to be separated into two different layers:

- The river network (lines)
- Water bodies (polygons)

When it comes to the river network, four different GIS datasets were available for the study area at the beginning of the project, namely the one:

- provided by the Department of Public Work and Highways (DPWH);
- provided by the Department of Science and Technology (DOST);
- provided by NAMRIA through the Global Mapping Project [14];
- generated by the OpenStreetMap (OSM) community and extract from the bbbike web site [13].

Unfortunately, each of them was presenting some limitations towards their use in the context of the project as follow (Figure 6):

- The dataset from DPWH is too generalized;

- The datasets from DOST and NAMRIA are both presenting important shifts compare to the location of the real network observed on the satellite images and the direction and amplitude of this shift is not constant over the surface of the study area;
- The OSM dataset is the one presenting the best match with the real network but is not complete;

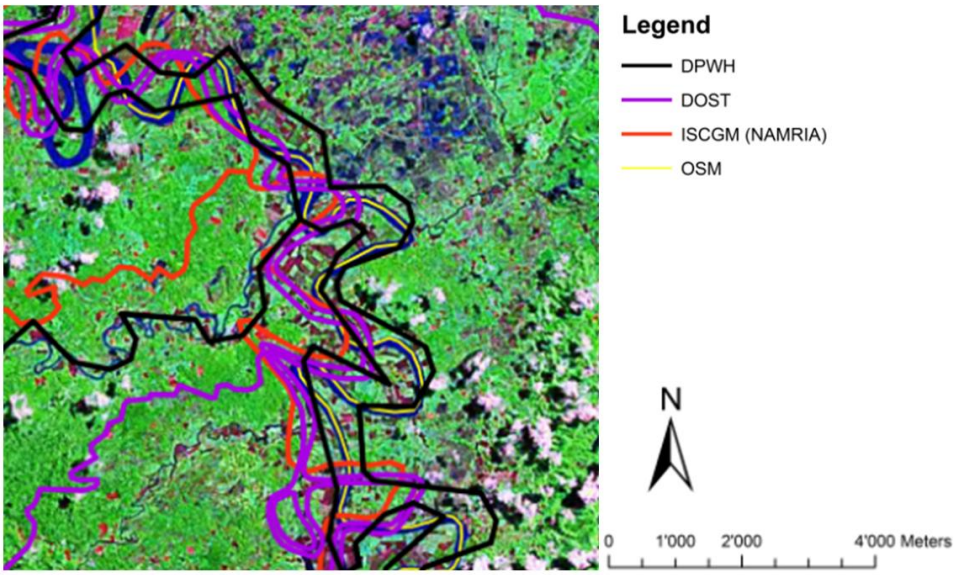

Figure 6 – Example of overlay of the different source of river network on top of the Landsat satellite images mosaic

In view of the above, and in order to ensure that the natural barriers represented by rivers are in the right location and is complete as much as possible, it has finally been decided to proceed as follow in order to obtain the final river network layer:

1. The OSM dataset has been used as the basis for the final layer. In this layer, segments categorized as ditches have been removed
2. The river segments from NAMRIA's dataset have been added to the OSM one and manually corrected in order to:
    a. Match the location of the real river on the Landsat mosaic
    b. Connect with OSM segments
3. Additional major river segments visible on the Landsat mosaic but not present in the OSM or NAMRIA datasets have been digitized on the screen in ArcView

The result from this process is presented in Figure 7 for Region XII. As mentioned previously, the final layer used for the analysis is actually extending beyond Region XII to cover all surrounding Provinces.

Because of the low resolution used in the context of this project (500 meters) adjustments have then been made on this layer in order to ensure that once converted into raster format in AccessMod the road network was not generating any artificial bridges in the dataset.

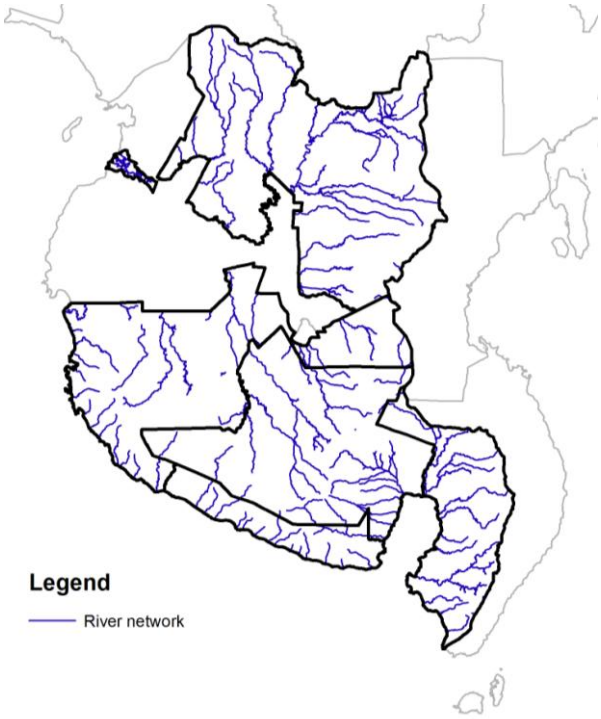

Figure 7 – River network layer used in the different analysis

This has been done by combining the land cover (Figure 4), road (Figure 5) and river network (Figure 7) layers using the first module of AccessMod and then manually correcting areas where these artificial bridges where appearing. Figure 8 gives an example of the type of corrections that has been implemented in order to keep the consistency between roads and rivers, namely:

1. In Figure 8a two artificial bridges, red arrows, have been created by the overlap of the road network converted into raster cells (in green) over the river network (in white) while the original vector layers (lines) clearly shows that there are no existing crossover between the left and right side of the river;
2. To correct this, a buffer equivalent to 1.5 times the resolution of the grid (750 meters) has been drawn from the road network (blue area on Figure 8b). An additional, and artificial, river segment has then been drawn at the limit of this buffer (light blue line on Figure 8b)
3. Once the first module of AccessMod applied on the modified layer created under the previous point we can see on Figure 8c) that the two artificial bridges are not there anymore and that the river is therefore playing its role of barrier to movement.

In some cases, adjustments have also been applied on the road network layer to obtain the above-mentioned consistency.

The water bodies have themselves been extracted from the land cover GIS layer from NAMRIA (see section 6.2.3).

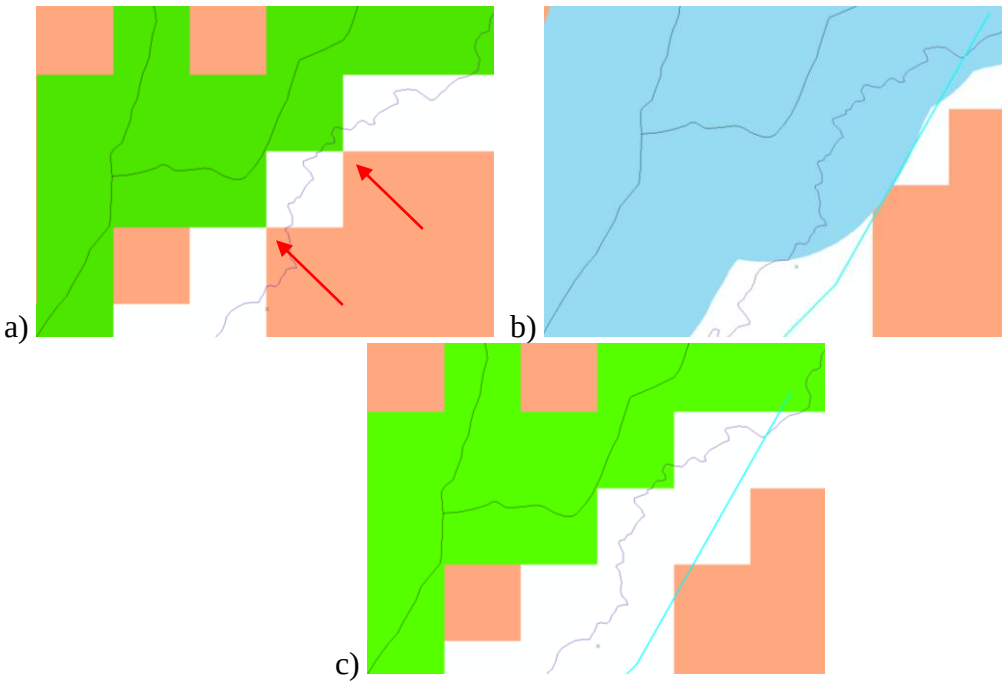

Figure 8 – Example of correction made on the river network layer to keep the consistency between the road and the hydrographic network

6.2.6 Digital Elevation Model

This project used the freely accessible 90m Shuttle Radar Topography Mission (SRTM) dataset accessible from the CGIAR Consortium for Spatial Information (CSI) web site [15].

In order to comply with the resolution used in the context of this project (500m), the original data has been resampled using the Data Management Tools > Raster > Raster Processing > Resample function in ArcGIS. The resulting layer is presented in Figure 9 for Region XII. As mentioned previously, the final grid used for the analysis is actually extending beyond Region XII to cover all surrounding Provinces.

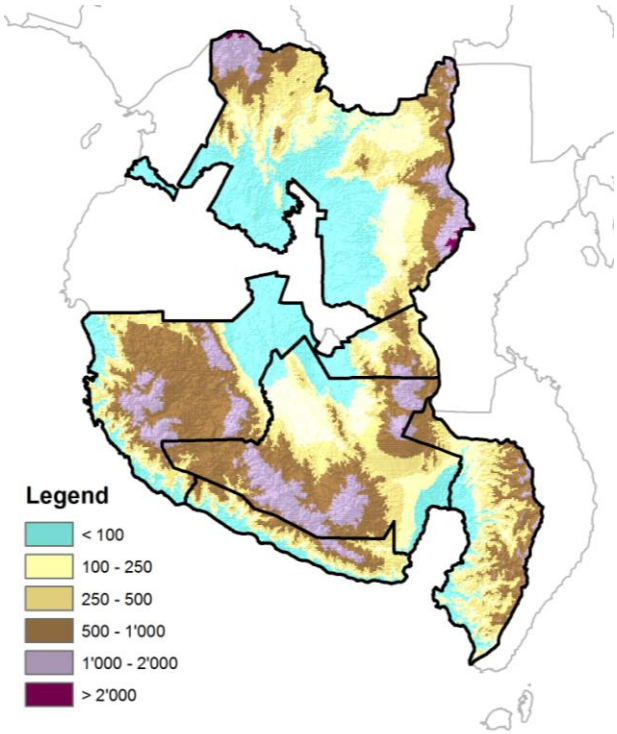

Figure 9 – Digital Elevation Model (DEM) used in the different analysis

6.2.8 Spatial distribution of the number of births

When using AccessMod, there is a need to spatially distribute the number of births down to the resolution of the other projected GIS layers in raster format, 500 meters in the context of the present study.

Such distribution over Region XII has been obtained by adjusting the spatial distribution of births used in the context of the accessibility to MCP facilities over Mindanao Islands [12] to the Municipality level total number of births reported in Annex 1. The result of this operation is presented in Figure 10. In this case, and as the result is meant for Region XII only, this grid does not extend beyond the borders of that Region.

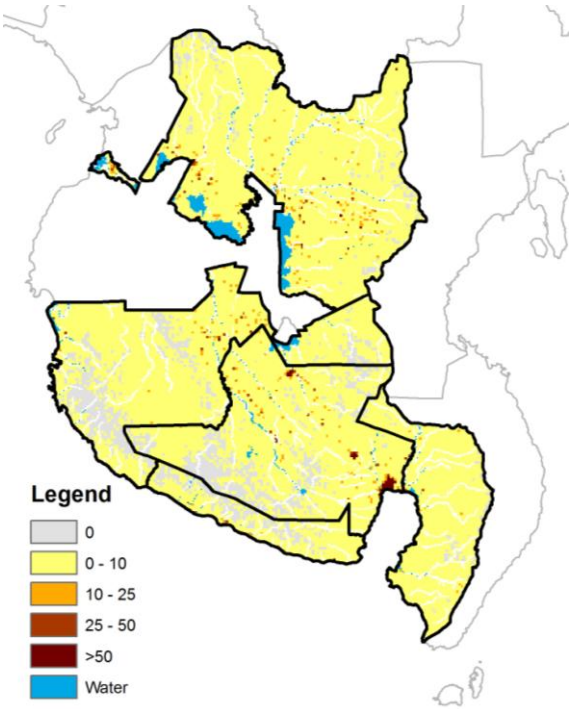

Figure 10 – Spatial distribution of the total number of births used in the different analysis

6.3 National norms

Only one set of national norms are needed to produce the outputs listed in Chapter 5, namely: the maximum speed expected on the different road types and boat routes observed over the study area.

The maximum speed expected on the transportation network over the study area, the norms reported in Republic Act nº 4136 (http://www.gov.ph/1964/06/20/republic-act-no-4136/) has been used as a starting point (Table 5).

Using this table as well as local knowledge, maximum expected speed for each type of road reported in the road network distribution layer (Figure 5) has been identified (Table 6).

Then, estimating the maximum expected speed for boats is not easy as many different of boats could be used. Using the information reported on the following web site for ferries: http://www.wiseship.biz/ferryspeeds.html it has finally been decided to consider a speed of 20 miles per hours, equivalent to 32 km/hour as reported in Table 6.

Finally, considering a walking speed for a women in age to give birth, but not being pregnant, to be around 5 km/h and making the assumption that her speed would be reduced by half close to the delivery, the maximum traveling speed by feet outside of the

road network/boat routes has been attributed for each of the classes reported in the final land cover layer (Figure 4). These speeds are also reported in Table 6.

Maximum allowable speeds	Passengers cars and motorcycle	Motor trucks and buses
1. On open country roads, with no "blinds corners" not closely bordered by habitations.	80 km. per hour	50 km. per hour
2. On "through streets" or boulevards, clear of traffic, with no " blind corners," when so designated.	40 km. per hour	30 km. per hour
3. On city and municipal streets, with light traffic, when not designated "through streets".	30 km. per hour	30 km. per hour
4. Through crowded streets, approaching intersections at "blind corners," passing school zones, passing other vehicles which are stationery, or for similar dangerous circumstances.	20 km. per hour	20 km. per hour

Table 5 – Maximum allowable speeds on different road types as per Republic Act nº 4136

Land cover/Transportation type	Speed (Km/h)	Transportation Media
Bare areas	2.5	Feet
Urban	2.5	Feet
Low dense vegetation	2	Feet
Medium dense vegetation	1.5	Feet
Dense vegetation	1	Feet
Foot track	2.5	Feet
Boat route	32	Boat
Highway	80	Motor Vehicle
Primary road	50	Motor Vehicle
Secondary road	40	Motor Vehicle
Tertiary road	30	Motor Vehicle
Track	20	Motor Vehicle

Table 6 – Maximum travel speed on the different land cover and transportation media types considered in the different analysis

7. Results

This Chapter describes the results obtained for the accessibility coverage analysis as described in Chapter 5.

This set of analyzes look at measuring how the EmONC facilities are accessible, in terms of travel time.

The following GIS layer and associated data previously generated have been used for this set of analyzes:

1. Location of the EmONC facilities (see section 6.2.2);
2. Road network (see section 6.2.4),
3. Hydrographic network (see section 6.2.5),
4. Digital Elevation Model (DEM) (see section 6.2.6),
5. Land cover (see section 6.2.3)
6. Municipality and Province boundaries (see section 6.2.1)
7. Births distribution (see section (6.2.8)
8. The following travelling scenarios
    a. Pregnant woman walking or being carried until reaching a road/boat route and then taking a vehicle/boat
    b. Pregnant woman walking only
9. The maximum travelling speeds reported in Table 6.

7.1 Physical accessibility to the nearest BEmONC, including CEmONC, facility

The first module of AccessMod has then been used to generate the combine land cover and scenario file and have the maximum travelling speeds reported in Table 6 integrated into it.

These two files, the DEM as well as the location of the EmONC facilities have then been used as the input data for the second module of AccessMod.

The first result coming out of this module is the spatial distribution of the travel time to the nearest BEmONC, including CEmONC, facilities when considering that pregnant women are walking, or are being carried, until reaching a road and then taking a vehicle until the facility (Figure 11).

The traveling scenario table has then been modified in order to consider women would only be walking or being carried until the nearest facility. In this case, the maximum speed on any road was considered to be of 2.5 km/h. Figure 12 presents the results when using this scenario.

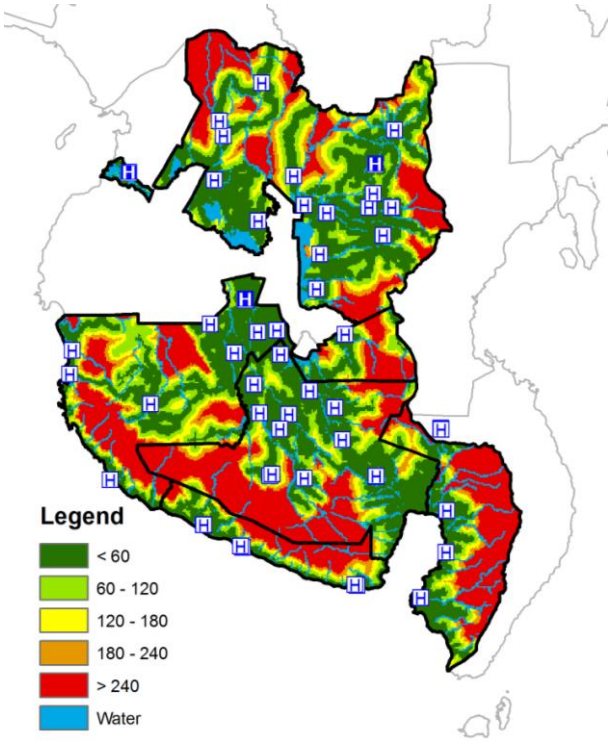

Figure 11 – Travel time (minutes) to the nearest BEmONC, including CEmONC, facility considering that pregnant women are walking, or are being carried, until reaching a road and then taking a motor vehicle until the facility

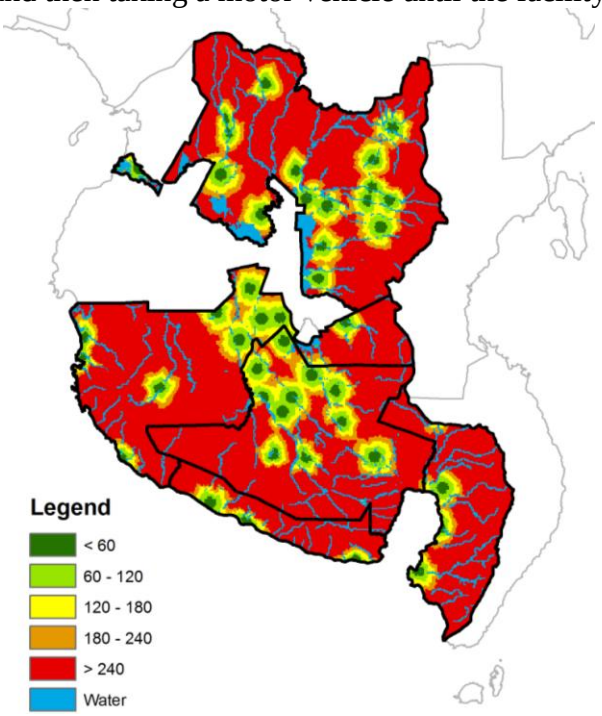

Figure 12 – Travel time (minutes) to the nearest BEmONC, including CEmONC, facility considering that pregnant women are walking, or are being carried, until reaching the facility

As we can see comparing Figure 11 and 12, the possibility to take a vehicle once reaching the road network is having a very important and positive impact on accessibility coverage. This confirms the importance of any programs aiming at financially supporting the transportation of pregnant women at the moment of delivery;

It is important to note here that Region XII has been considered as a closed system in the context of this project, meaning that movements of pregnant women to surrounding Regions have not been considered in the analysis. It can therefore be that EmONC facilities located close to the border of Region XII do contribute to covering part of its population.

This being said, looking the road network extending from Region XII (Figure 13), this improvement would only concern three areas along the Eastern border of Region XII (red circles) and would on the availability of a EmONC facility near the border in the corresponding surrounding Province. In other areas, the road network is not developed enough to have an impact on coverage in Region XII.

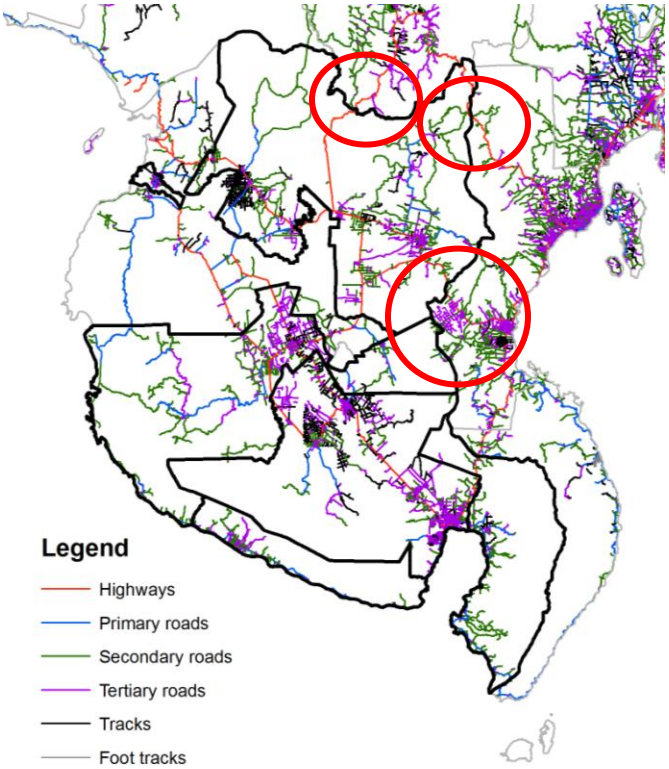

Figure 13 - Extension of the road network beyond Region XII with the indication of the areas where coverage could be improved depending on the availability of EmONC facilities in the surrounding Region (red circle)

Using GIS makes it possible to extract the Province and Municipality level number, and therefore indirectly the percentage, of births located within 2 hours of travel time from a BEmONC, including CEmONC, facility for both scenarios.

Annex 3 and Figure 14 present the coverage at the Province level while Annex 4 and Figure 15 present the same result at the Municipality level. Please note that the maps on Figure 14 and 15 are only presenting the results for the combined scenario.

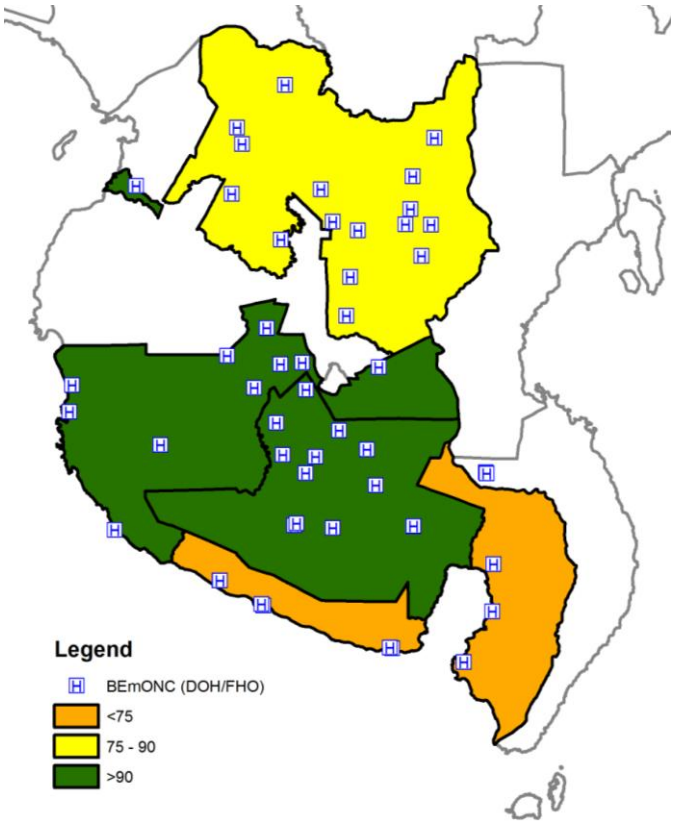

Figure 14 – Province level percentage of births reaching an BEmONC, including CEmONC, facility in less than 2 hours when considering the combined walking/carried and motor vehicle scenario

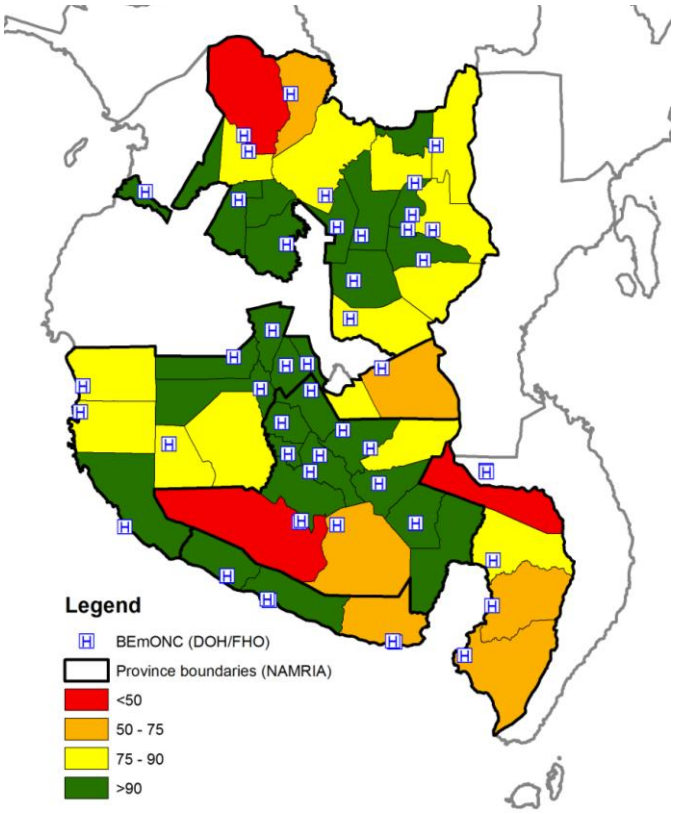

Figure 15 – Municipality level percentage of births reaching an BEmONC, including CEmONC, facility in less than 2 hours when considering the combined walking/carried and motor vehicle scenario

The following can be observed from Figure 14 and 15 as well as Annexes 3 and 4:

- Figures 14 and 15 are a good illustration that aggregating information might mask pockets of heterogeneity at a lower level;
- Annex 3 and 4 confirms the important difference in coverage that exists between the combined and the walking/carrying scenario only;
- At the level of the Region:
  - With 89.8%, the accessibility coverage provided by the existing BEmONC, including CEmONC, facilities is very close to universal coverage (90%, see Chapter 3);
- At the Province level (looking only at the combined travelling scenario):
  - Three Provinces find themselves above the 90% universal access benchmark when it comes to physical access to BEmONC, including CEmONC, facilities;
  - The lowest level of accessibility coverage is observed in Sarangani Province with 70.8%
- At the Municipality level (looking only at the combined travelling scenario):
  - Universal accessibility coverage is reached in 27 of them

- 3 municipalities present an accessibility coverage below 50%, namely: Alamada (Cotabato (North Cotabato), Lake Cebu (South Cotabato) and Malungon (Sarangani);

When looking at the above it is important to remember that the list of BEmONC, including CEmONC, facilities has been defined only on the fact that some of the staff in those facilities have received a BEmONC oriented training. The fact that these facilities are being functional, meaning that they do perform the required signal functions, has not been assessed.

7.2 Travel time between each BEmONC and the nearest CEmONC facility

The second module of AccessMod has been used to identify the travel time between each BEmONC, including CEmONC, facility and the nearest CEmONC facility. The result of this analysis is reported in Annex 5. In this Annex facilities are listed by decreasing order of travel time, this time being equivalent to 0 when the BEmONC facility is actually a CEmONC facility as well.

From Annex 5 we can observe that patients with complications from 11 BEmONC facilities (in red) would have to travel more than 2 hours to reach the nearest CEmONC facility, this the maximum travel time being observed for Palimbang RHU with 4.6 hours (281 minutes).

For the other 41 BEmONC facilities, which include the 3 CEmONC facilities, the travel time would be below the 2 hours benchmark.

Figure 16 allows visualizing the travel time between each BEmONC and the nearest CEmONC facility. As we can see on this figure, most of the BEmONC for which the travel time would be above the 2 hours benchmark are located along the coast in the Southern part of the Region and at the border with Davao Occidental (Region XI).

When looking at these results it is important to remember that the travel time obtained here is conditional to the presence of a motor vehicle at the BEmONC at the time of the transfer. If this is not the case, the travel time would be higher and directly influenced by how long the vehicle would have to take to reach the BEmONC in question.

In addition to that, the fact that the Region does only count 3 CEmONC facilities does limit the choices when it comes to the referral of patients with complications.

As a result of this, 35 of the BEmONC facilities are to refer patients with complications to the same CEmONC facility based on the minimum travel time (Table 7): Lambayong District Hospital.

While the analysis conducted here does not allow estimating the volume of patients this represent this is for sure an important burden that this hospital might not have the capacity to absorb.

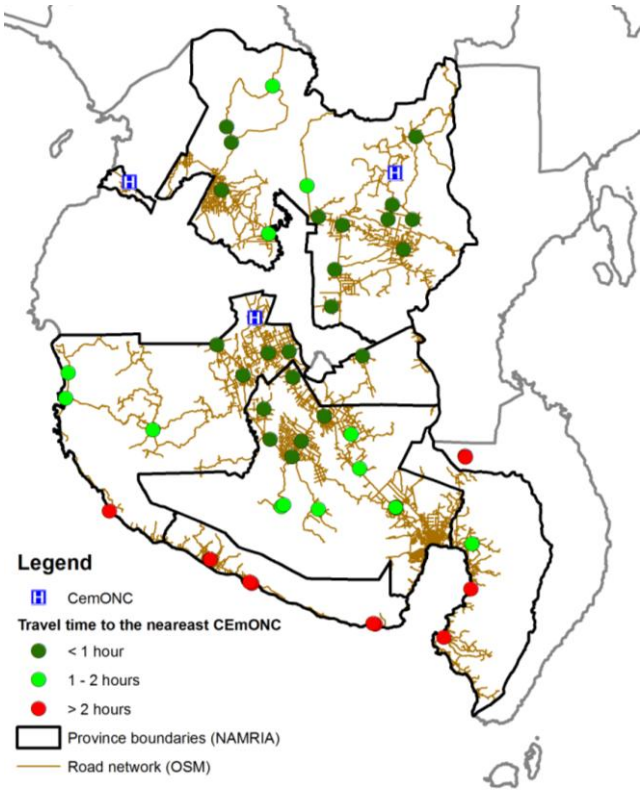

Figure 16 - Travel time between each BEmONC and the nearest CEmONC facility

Name of the CEmONC facility	Number of BEmONC referring to that CEmONC based on travel time
ARAKAN VALLEY DISTRICT HOSPITAL	8
COTABATO REGIONAL AND MEDICAL CENTER	7
LAMBAYONG DISTRICT HOSPITAL	34
Total	49

Table 7 - Number of BEmONC facilities referring to each CEmONC facility based on travel time

Just looking at Figure 16, it seems that adding a CEmONC facility in the vicinity of General Santos city would reduce the travel time in case of referral for most if not all of these 11 BEmONC facilities for which the referral would take more than 2 hours.

As a first test of this assumption, the travel time to Polomok Municipal Hospital, currently considered as a BEmONC facility in DOH/FHO list, has been measured using AccessMod (Figure 17).

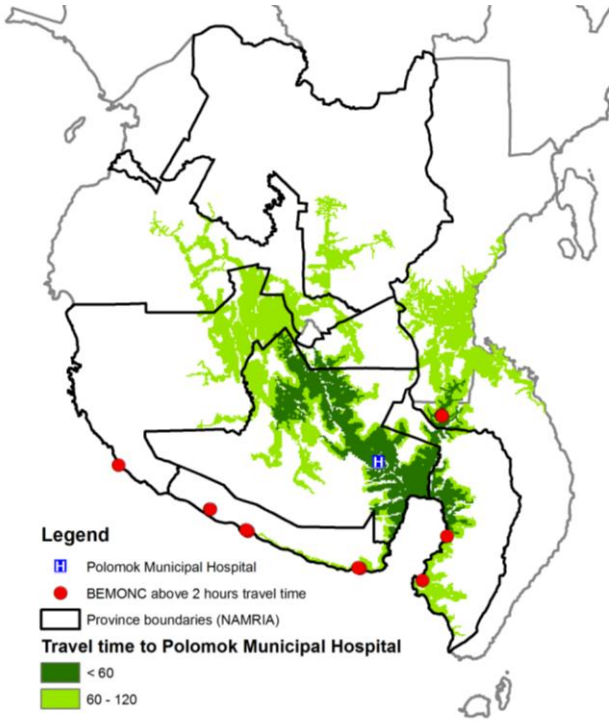

Figure 17 - Travel time to Polomok Municipal Hospital

As we can see on Figure 17, converting Polomok Municipal Hospital into a CEmONC facility would allow for 8 of the 11 concerned BEmONC to then find themselves within 2 hours of reach of a CEmONC facility would a motor vehicle be on site at the time of referral.

This scaling up would also reduce the referral travel time for the other BEmONC located in this area.

8. Conclusion and recommendations

The present study had for objective to analyse how accessible EmONC facilities were to the population in Region XII as well as to identify potential gaps towards achieving Universal Health Maternal and Newborn Health (MNH) Care in this same Region.

At first, the all data preparation process highlighted several important gaps that should be addressed in order to facilitate the implementation of this kind of study in other parts of the country in the future.

These gaps mainly concern the lack of:

1. A regularly updated registry of functional EmONC in the country. While the Family Health office (FHO) from the Department of Health (DOH) maintain a list of the facilities having received EmONC related training, the effective delivery of the signal functions required for a facility to be qualified as BEmONC or CEmONC is not been assessed. As such the results presented here are to be taken with caution;
2. While the DOH, with WHO's support, has made a lot of progresses over the past two years for the National Health Facility Registry (NHFR) to be complete and up-to-date, a precise geographic location (latitude and longitude) is still missing for an important number of these facilities in the country;
2. Complete, up-to-date, compatible and of quality GIS dataset for the administrative divisions, roads and the river network (see Sections 6.2.1, 6.2.4 and 6.2.5);

The above gaps do not only result in time consuming efforts to prepare the different datasets but also in potential errors in the final results.

At the same time, this study highlights once more the importance to improve data management not only within the health sector but also among other key institutions in charge of collecting, maintaining and sharing these core data sets. In other words, the analysis presented here depends very much on having a strong Information System in place in which the geographic and time dimensions are well integrated.

In addition to the data quality and completeness issues mentioned here above, it is important to emphasize once more the temporal shift that exists between the different sources of statistical data as well as the uncertainty regarding the level of completeness of some of the GIS layers that have been used here (Chapter 6).

Finally, when looking at these results it is important to remember that the travel time obtained here is conditional to the presence of a motor vehicle on site at the BEmONC at the time of the referral. If this is not the case, the travel time would be higher and directly influenced by how long the vehicle would have to take to reach the BEmONC in question.

Taking these limitations into account, the results obtained through the different analysis performed in the context of this project are presented here.

At first, the accessibility coverage provided by the BEmONC, including CEmONC, facilities considered in the present study has been analysed to see if 90% of all births within Region XII would be within 2 hours of travel from one of these facilities and this considering two different scenarios: 1. Walking/being carried until reaching a road and from there taking a motor vehicle until the nearest facility; 2. Walking/being carried until the facility itself.

This analysis first demonstrated that any program aiming at financially supporting the transportation of pregnant women at the time of delivery would have an important and positive impact on their chance to reach a BEmONC facility within 2 hours.

Then, this analysis also demonstrated that:

- At the level of the Region:
  - With 89.8%, the accessibility coverage provided by the existing BEmONC, including CEmONC, facilities is very close to universal coverage (90%, see Chapter 3);
- At the Province level (looking only at the combined travelling scenario):
  - Three Provinces find themselves above the 90% universal coverage benchmark when it comes to physical access to BEmONC, including CEmONC, facilities;
  - The lowest level of accessibility coverage is observed in Sarangani Province with 70.8%
- At the Municipality level (looking only at the combined travelling scenario):
  - Universal accessibility coverage is reached in 27 of them;
  - 3 municipalities present an accessibility coverage below 50%, namely: Alamada (Cotabato (North Cotabato), Lake Cebu (South Cotabato) and Malungon (Sarangani);

In conclusion, Region XII would reach BEmONC universal accessibility coverage if all the facilities listed by DOH/FHO were to be confirmed as being functional BEmONC. This being said, heterogeneities in coverage are observed at both the Province and Municipality level (see Figures 14 and 15).

The travel time between each BEmONC facility and the nearest CEmONC facility has then been measured to see in which case this time would be above 2 hours.

As per the results of this analysis (Annex 5), 11 BEmONC facilities are finding themselves beyond 2 hours of reach of a CEmONC facility, the maximum travel time being observed for Palimbang RHU with 4.6 hours.

A preliminary scaling up analysis (Figure 17) has nevertheless demonstrated that upgrading one BEmONC into a CEmONC facility near General Santos City would allow

for 8 of these 11 BEmONC to then find themselves within 2 hours of travel time of a CEmONC facility.

While all the results presented here above are subject to the quality, accuracy and level of completeness of the data that have been used (see Chapter 6) the information they provide does already allow identifying potential areas on which the government might want to invest and/or particular situation that could require more in depth analyzes.

In addition to that, the analysis performed here are only basic ones looking at how accessible EmONC facilities are to the population. More in depth analysis such as the ones performed over the all Mindanao Island [12] could provide additional guidance to the DOH when it comes to improving availability and accessibility to EmONC services in the Region.

In view of the above, it is therefore recommended for the DOH to:

- Look at the result of the present study as a way to advocate for:
    - Conducting comprehensive EmONC assessment in the country in order to have a good picture of the current functional network of services;
    - Continuing to work at improving the National Health Facility Registry (NHFR) so that it contains a precise geographic location (latitude and longitude) for each of the health facility in the country;
    - Continuing at improving its data management and GIS capacity in order to be in the position to conduct the type of analysis presented here on its own.
- Complete the analysis presented here in order to, for example, look into the link between MCP accredited facilities and functional EmONC as well as integrating the health workforce in the analysis to see if the capacity on the ground is actually sufficient to cover the demand as per the results of the accessibility analysis.

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[15] SRTM 90 m CGIAR Consortium for Spatial Information (CSI) web site: http://srtm.csi.cgiar.org/ [Accessed May 15, 2015]

Annex 1 – Administrative structure (Provinces and Municipalities) of Region XII with the population figures used in the context of the different analysis

Province code (PSGC)	Province name	Municipality code (PSGC)	Municipality Name (PSGC)	2010 Population (Census)	Live births 2010 (census)	Estimated CBR (2010)	2014 total Population	2014 Estimated number of births (using 2010 CBR)
124700000	Cotabato (North Cotabato)	124701000	ALAMADA	56,813	963	16.95	58,995	1,000
		124702000	CARMEN	82,469	1600	19.40	85,636	1,661
		124703000	KABACAN	81,282	1409	17.33	84,404	1,463
		124704000	CITY OF KIDAPAWAN (Capital)	125,447	3148	25.09	130,265	3,269
		124705000	LIBUNGAN	45,295	732	16.16	47,035	760
		124706000	MAGPET	45,183	973	21.53	46,918	1,010
		124707000	MAKILALA	77,508	1710	22.06	80,485	1,776
		124708000	MATALAM	74,034	1600	21.61	76,877	1,661
		124709000	MIDSAYAP	134,170	2099	15.64	139,323	2,180
		124710000	M'LANG	87,749	1773	20.21	91,119	1,841
		124711000	PIGKAWAYAN	59,975	1129	18.82	62,278	1,172
		124712000	PIKIT	113,014	1401	12.40	117,354	1,455
		124713000	PRESIDENT ROXAS	44,229	1024	23.15	45,928	1,063
		124714000	TULUNAN	54,884	912	16.62	56,992	947
		124715000	ANTIPAS	25,242	620	24.56	26,211	644
		124716000	BANISILAN	39,914	667	16.71	41,447	693
		124717000	ALEOSAN	35,746	716	20.03	37,119	743
		124718000	ARAKAN	43,554	833	19.13	45,227	865
126300000	South Cotabato	126302000	BANGA	76,343	1140	14.93	79,275	1,184
		126303000	GENERAL SANTOS CITY (DADIANGAS)	538,086	12350	22.95	558,752	12,824
		126306000	CITY OF KORONADAL (Capital)	158,273	2854	18.03	164,352	2,964
		126311000	NORALA	44,635	673	15.08	46,349	699
		126312000	POLOMOLOK	138,273	2658	19.22	143,584	2,760
		126313000	SURALLAH	76,035	1457	19.16	78,955	1,513
		126314000	TAMPAKAN	36,254	678	18.70	37,646	704
		126315000	TANTANGAN	40,461	550	13.59	42,015	571
		126316000	T'BOLI	79,175	957	12.09	82,216	994
		126317000	TUPI	61,843	1184	19.15	64,218	1,229
		126318000	SANTO NIÑO	39,738	747	18.80	41,264	776
		126319000	LAKE SEBU	76,170	641	8.42	79,095	666

126500000	Sultan Kudarat	126501000	BAGUMBAYAN	63,700	998	15.67	66,146	1,036
		126502000	COLUMBIO	27,440	407	14.83	28,494	423
		126503000	ESPERANZA	63,207	832	13.16	65,635	864
		126504000	ISULAN (Capital)	86,602	1662	19.19	89,928	1,726
		126505000	KALAMANSIG	46,408	515	11.10	48,190	535
		126506000	LEBAK	83,280	1135	13.63	86,478	1,179
		126507000	LUTAYAN	56,179	209	3.72	58,337	217
		126508000	LAMBAYONG (MARIANO MARCOS)	65,557	991	15.12	68,075	1,029
		126509000	PALIMBANG	83,265	250	3.00	86,463	260
		126510000	PRESIDENT QUIRINO	38,753	588	15.17	40,241	611
		126511000	CITY OF TACURONG	89,188	1759	19.72	92,613	1,827
		126512000	SEN. NINOY AQUINO	43,508	739	16.99	45,179	767
128000000	Sarangani	128001000	ALABEL (Capital)	75,477	1154	15.29	78,376	1,198
		128002000	GLAN	106,518	975	9.15	110,609	1,012
		128003000	KIAMBA	54,871	1080	19.68	56,978	1,121
		128004000	MAASIM	52,933	769	14.53	54,966	799
		128005000	MAITUM	41,675	585	14.04	43,276	607
		128006000	MALAPATAN	72,386	664	9.17	75,166	690
		128007000	MALUNGON	95,044	1057	11.12	98,694	1,098
129800000	Cotabato City (not a province)	129804000	COTABATO CITY	271,786	814	3.00	282,224	845
				4,109,571	66,381	16.15	4,267,403	68,930

Annex 2 – Emergency Obstetric and Neonatal Care (EMONC) facilities in Region XII (DOH/FHO)

DOH Code	Facility name (National Health Facility Registry)	Health facility type	EMONC_Type	# BemONC staff trained	Region Name	Region PSGC	Province Name	Province PSGC	City/Municipality Name	City/Municipality PSGC	Barangay Name	Barangay PSGC	Lat	Long	Source Lat/Long	Precision Lat/long
2850	ALAMADA PROVINCIAL COMMUNITY HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	ALAMADA	124701000	KITACUBONG (POB.)	124701006	7.33749	124.56416	DOH/KMITS (Google map)	Low
2499	FR TULIO FAVALI MUNICIPAL HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	TULUNAN	124714000	POBLACION	124714020	6.84179	124.85473	DOH/KMITS (Barangay centroid)	Low
4396	GLAN MEDICARE COMMUNITY HOSPITAL	Hospital	BEmONC	4	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	GLAN	128002000	POBLACION	128002023	5.82185	125.20619	CHD (GPS)	Unknow
601	KIAMBA DISTRICT HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	KIAMBA	128003000	POBLACION	128003014	5.98850	124.62264	DOH/KMITS (Google map)	High
602	KIDAPAWAN CITY HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	CITY OF KIDAPAWAN (Capital)	124704000	POBLACION	124704032	7.00896	125.08774	DOH/KMITS (Barangay centroid)	Low
610	LAKE SEBU MUNICIPAL HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	LAKE SEBU	126319000	POBLACION	126319014	6.22827	124.71863	DOH/KMITS (Google map)	High
4556	MAASIM MUNICIPAL HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MAASIM	128004000	POBLACION (MAASIM)	128004014	5.86295	124.99741	DOH/KMITS (Google map)	High
3939	MAITUM MUNICIPAL HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MAITUM	128005000			6.06221	124.49454	DOH/KMITS (Google map)	High
6031	MALUNGON MUNICIPAL HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MALUNGON	128007000	POBLACION	128007023	6.37640	125.27321	DOH/KMITS (Google map)	High
3627	M'LANG DISTRICT HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	M'LANG	124710000	POBLACION	124710031	6.94813	124.87879	DOH/KMITS (Google map)	High
4408	NORALA DISTRICT HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	NORALA	126311000	POBLACION	126311013	6.52247	124.66127	DOH/KMITS (Google map)	High
5381	POLOMOLOK MUNICIPAL HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	POLOMOLOK	126312000	POBLACION	126312014	6.21914	125.06091	DOH/KMITS (Google map)	Low
6061	PRES. ROXAS PROVINCIAL COMMUNITY HOSPITAL	Hospital	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	PRESIDENT ROXAS	124713000	NEW CEBU	124713022	7.099792	125.046469	DOH/KMITS (Barangay centroid)	Low
730	ROEL I. SENADOR, MD. MEMORIAL HOSPITAL	Hospital	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	TUPI	126317000	POBLACION	126317013	6.33964	124.95121	DOH/KMITS (Google map)	High
4452	ALABEL RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	ALABEL (Capital)	128001000	POBLACION (ALABEL)	128001010	6.10758	125.29323	CHD (GPS)	Unknow
4016	ALAMADA RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	ALAMADA	124701000	KITACUBONG (POB.)	124701006	7.38551	124.55	CHD (GPS)	Unknow
7213	ARAKAN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	ARAKAN	124718000	GREENFIELD	124718011	7.36481	125.13183	DOH/KMITS (Barangay centroid)	Low
7395	BANGA RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	BANGA	126302000	REYES (POB.)	126302018	6.42389	124.77546	CHD (GPS)	Unknow
7224	BANISILAN RURAL HEALTH UNIT	RHU	BEmONC	3	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	BANISILAN	124716000	BANISILAN POBLACION	124716001	7.51442	124.68275	DOH/KMITS (Barangay centroid)	Low
3615	CARMEN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	CARMEN	124702000	POBLACION	124702032	7.20401	124.7948	CHD (GPS)	Unknow
6832	COLUMBIO RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	COLUMBIO	126502000	POBLACION	126502023	6.68475	124.96193	CHD (GPS)	Unknow
2627	ESPERANZA RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	ESPERANZA	126503000	POBLACION	126503022	6.71968	124.51811	CHD (GPS)	Unknow
2118	ISULAN RURAL HEALTH UNIT	RHU	BEmONC	3	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	ISULAN (Capital)	126504000	KALAWAG III (POB.)	126504013	6.62533	124.59759	CHD (GPS)	Unknow
4679	KABACAN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	KABACAN	124703000	POBLACION	124703019	7.10946	124.82835	DOH/KMITS (Barangay centroid)	Low
3250	KALAMANSIG RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	KALAMANSIG	126505000	POBLACION	126505015	6.55703	124.05704	Philhealth (unknown)	Unknow
2794	KIAMBA RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	KIAMBA	128003000	POBLACION	128003014	5.99312	124.61628	CHD (GPS)	Unknow
89	KORONADAL CITY HEALTH OFFICE	RHU	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	CITY OF KORONADAL (Capital)	126306000	ZONE IV (POB.)	126306019	6.50031	124.84453	CHD (GPS)	Unknow
38	LAKE SEBU RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	LAKE SEBU	126319000	POBLACION	126319014	6.22870	124.71934	CHD (GPS)	Unknow
20518	LAMBAYONG RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	LAMBAYONG (MARIANO MARCOS)	126508000	POBLACION (LAMBAYONG)	126508020	6.79938	124.63445	CHD (GPS)	Unknow
3614	LEBAK RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	LEBAK	126506000	POBLACION	126506016	6.63500	124.06500	NAMRIA 2000 (unknown)	Unknow
5861	MAASIM RURAL HEALTH UNIT	RHU	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MAASIM	128004000	POBLACION (MAASIM)	128004014	5.86573	124.99054	CHD (GPS)	Unknow
1786	MAGPET RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	MAGPET	124706000	POBLACION	124706040	7.10179	125.08896	CHD (GPS)	Unknow
4013	MAITUM RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MAITUM	128005000	OLD POBLACION (MAITUM)	128005011	6.06323	124.49605	CHD (GPS)	Unknow
5426	MALAPATAN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MALAPATAN	128006000	POBLACION (MALAPATAN)	128006008	5.97039	125.28940	CHD (GPS)	Unknow
3405	MALUNGON RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SARANGANI	128000000	MALUNGON	128007000			6.37244	125.27453	CHD (GPS)	Unknow
3611	MATALAM RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	MATALAM	124708000	POBLACION	124708034	7.08403	124.90201	CHD (GPS)	Unknow
7144	MIDSAYAP RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	MIDSAYAP	124709000	BARANGAY POBLACION 3	124709037	7.19199	124.53403	CHD (GPS)	Unknow
7219	PALIMBANG RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	PALIMBANG	126509000	POBLACION	126509031	6.21324	124.19725	DOH/KMITS (Barangay centroid)	Low
3613	PIKIT RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	PIKIT	124712000			7.05748	124.67709	CHD (GPS)	Unknow
3479	POLOMOLOK RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	POLOMOLOK	126312000	POBLACION	126312014	6.21985	125.06083	CHD (GPS)	Unknow
4021	PRESIDENT QUIRINO RURAL HEALTH UNIT	RHU	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	PRESIDENT QUIRINO	126510000	POBLACION (SAMBULAWAN)	126510016	6.702104	124.741541	DOH/KMITS (Barangay centroid)	Low
4015	PRESIDENT ROXAS RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	PRESIDENT ROXAS	124713000	POBLACION	124713024	7.14629	125.05026	DOH/KMITS (Barangay centroid)	Low
20020	SANTO NIÑO RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	SANTO NIÑO	126318000	POBLACION	126318006	6.42886	124.67976	CHD (GPS)	Unknow
7225	SEN. NINOY AQUINO RURAL HEALTH UNIT	RHU	BEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	SEN. NINOY AQUINO	126512000	KULAMAN	126512011	6.45847	124.31871	DOH/KMITS (Barangay centroid)	Low
2737	SURALLAH RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	SURALLAH	126313000	LIBERTAD (POB.)	126313019	6.37578	124.74625	CHD (GPS)	Unknow
2204	TACURONG CITY HEALTH OFFICE	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	CITY OF TACURONG	126511000	POBLACION	126511013	6.69367	124.67469	CHD (GPS)	Unknow
3404	TAMPAKAN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	TAMPAKAN	126314000	POBLACION	126314006	6.44443	124.92657	CHD (GPS)	Unknow
5627	TANTANGAN RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	TANTANGAN	126315000	POBLACION	126315010	6.61934	124.74879	CHD (GPS)	Unknow
2278	T'BOLI RURAL HEALTH UNIT	RHU	BEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SOUTH COTABATO	126300000	T'BOLI	126316000	POBLACION	126316020	6.21496	124.82502	CHD (GPS)	Unknow
2974	ARAKAN VALLEY DISTRICT HOSPITAL	Hospital	CEmONC	2	REGION XII (SOCCSKSARGEN)	120000000	COTABATO (NORTH COTABATO)	124700000	ANTIPAS	124715000	MAGSAYSAY	124715006	7.24125	125.06335	DOH/KMITS (Google map)	High
459	COTABATO REGIONAL AND MEDICAL CENTER	Hospital	CEmONC	This is an EmONC training Hospital where all OB and Pedia staff are being trained	REGION XII (SOCCSKSARGEN)	120000000	COTABATO CITY (Not a Province)	129800000	COTABATO CITY	129804000	ROSARY HEIGHTS	129804004	7.216786	124.253404	DOH/KMITS (Barangay centroid)	Low
5296	LAMBAYONG DISTRICT HOSPITAL	Hospital	CEmONC	1	REGION XII (SOCCSKSARGEN)	120000000	SULTAN KUDARAT	126500000	LAMBAYONG (MARIANO MARCOS)	126508000	MALIGAYA	126508011	6.80970	124.63112	DOH/KMITS (Barangay centroid)	Low

Annex 3 – Province level number and percentage of births located within 2 hours of travel time of an BEmONC, including CEmONC, facility when considering both the combined walking/carried and motor vehicle scenario as well as the walking/carried scenario only

Province code (PSGC)	Province name (PSGC)	2014 Estimated nbr of birth (using 2010 CBR from census)	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario
124700000	Cotabato (North Cotabato)	24,204	21,292	88.0%	8,025	33.2%
126300000	South Cotabato	26,883	25,604	95.2%	8,173	30.4%
126500000	Sultan Kudarat	10,472	9,562	91.3%	4,445	42.4%
128000000	Sarangani	6,525	4,623	70.8%	1,867	28.6%
129800000	Cotabato City (not a province)	845	845	100.0%	807	95.4%
	Region total/percentage:	68,930	61,925	89.8%	23,317	33.8%

Color legend: Values obtained with AccessMod

Calculated variables

Annex 4 – Municipality level number and percentage of births located within 2 hours of travel time of an BEmONC, including CEmONC, facility when considering both the combined walking/carried and motor vehicle scenario as well as the walking/carried scenario only

Province code (PSGC)	Province name (PSGC)	Municipality code (PSGC)	Municipality name (PSGC)	2014 Estimated nbr of birth (using 2010 CBR from census)	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario
124700000	Cotabato (North Cotabato)	124701000	ALAMADA	1,000	460	46.0%	94	9.4%
		124702000	CARMEN	1,661	1,309	78.8%	443	26.7%
		124703000	KABACAN	1,463	1,329	90.8%	902	61.6%
		124704000	CITY OF KIDAPAWAN (Capital)	3,269	3,251	99.5%	1,498	45.8%
		124705000	LIBUNGAN	760	601	79.1%	25	3.2%
		124706000	MAGPET	1,010	780	77.2%	570	56.4%
		124707000	MAKILALA	1,776	1,565	88.1%	122	6.9%
		124708000	MATALAM	1,661	1,563	94.1%	828	49.8%
		124709000	MIDSAYAP	2,180	2,115	97.1%	1,190	54.6%
		124710000	M'LANG	1,841	1,708	92.8%	613	33.3%
		124711000	PIGKAWAYAN	1,172	1,150	98.1%	0	0.0%
		124712000	PIKIT	1,455	1,326	91.2%	540	37.1%
		124713000	PRESIDENT ROXAS	1,063	978	92.0%	400	37.6%
		124714000	TULUNAN	947	768	81.1%	463	48.9%
		124715000	ANTIPAS	644	530	82.2%	167	25.9%
		124716000	BANISILAN	693	467	67.4%	94	13.5%
		124717000	ALEOSAN	743	730	98.1%	20	2.8%
		124718000	ARAKAN	865	662	76.6%	57	6.6%
126300000	South Cotabato	126302000	BANGA	1,184	1,181	99.8%	737	62.3%
		126303000	GENERAL SANTOS CITY (DADIANGAS)	12,824	12,680	98.9%	0	0.0%
		126306000	CITY OF KORONADAL (Capital)	2,964	2,961	99.9%	2,494	84.2%
		126311000	NORALA	699	692	99.1%	420	60.0%
		126312000	POLOMOLOK	2,760	2,754	99.8%	1,913	69.3%
		126313000	SURALLAH	1,513	1,442	95.3%	463	30.6%
		126314000	TAMPAKAN	704	631	89.6%	387	55.0%
		126315000	TANTANGAN	571	569	99.7%	332	58.2%
		126316000	T'BOLI	994	574	57.7%	275	27.7%
		126317000	TUPI	1,229	1,132	92.1%	472	38.4%
		126318000	SANTO NIÑO	776	774	99.8%	607	78.3%
		126319000	LAKE SEBU	666	213	31.9%	73	11.0%

Province code (PSGC)	Province name (PSGC)	Municipality code (PSGC)	Municipality name (PSGC)	2014 Estimated nbr of birth (using 2010 CBR from census)	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the combined walking + vehicle scenario	Number of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario	Percentage of births located within 2 hours of travel to a BEmOC (including CEmOC) with the walking/carried only scenario
126500000	Sultan Kudarat	126501000	BAGUMBAYAN	1,036	890	85.9%	32	3.1%
		126502000	COLUMBIO	423	316	74.8%	86	20.4%
		126503000	ESPERANZA	864	847	98.0%	362	42.0%
		126504000	ISULAN (Capital)	1,726	1,709	99.0%	1,128	65.3%
		126505000	KALAMANSIG	535	467	87.3%	319	59.6%
		126506000	LEBAK	1,179	894	75.9%	324	27.5%
		126507000	LUTAYAN	217	181	83.3%	12	5.3%
		126508000	LAMBAYONG (MARIANO MARCOS)	1,029	1,007	97.8%	382	37.1%
		126509000	PALIMBANG	260	235	90.4%	48	18.3%
		126510000	PRESIDENT QUIRINO	611	611	100.0%	416	68.1%
		126511000	CITY OF TACURONG	1,827	1,827	100.0%	1,254	68.6%
		126512000	SEN. NINOY AQUINO	767	579	75.4%	84	11.0%
128000000	Sarangani	128001000	ALABEL (Capital)	1,198	1,050	87.6%	450	37.5%
		128002000	GLAN	1,012	701	69.2%	277	27.4%
		128003000	KIAMBA	1,121	1,027	91.6%	435	38.8%
		128004000	MAASIM	799	495	62.0%	266	33.3%
		128005000	MAITUM	607	593	97.7%	394	64.8%
		128006000	MALAPATAN	690	372	53.9%	46	6.6%
		128007000	MALUNGON	1,098	384	35.0%	0	0.0%
129800000	Cotabato City (not a province)	129804000	COTABATO CITY	845	845	100.0%	807	95.4%
			Region total/percentage:	68,930	61,925	89.8%	23,317	33.8%

Color legend: Values obtained with AccessMod

Calculated variables

Annex 5 – Travel time between each BEmONC, including CEmONC, facility and the neareast CEmONC

DOH Code	Facility_Name_NHFR	Health facility type	EmONC type	Province Name	City/Municipality Name	travel time to the nearest CEmONC (Min)	DOH Code of the nearest CEmONC	Name of the Nearest CEmONC
7219	PALIMBANG RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	PALIMBANG	281	5296	LAMBAYONG DISTRICT HOSPITAL
4013	MAITUM RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	MAITUM	227	5296	LAMBAYONG DISTRICT HOSPITAL
3939	MAITUM MUNICIPAL HOSPITAL	Hospital	BEmONC	SARANGANI	MAITUM	227	5296	LAMBAYONG DISTRICT HOSPITAL
2794	KIAMBA RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	KIAMBA	206	5296	LAMBAYONG DISTRICT HOSPITAL
601	KIAMBA DISTRICT HOSPITAL	Hospital	BEmONC	SARANGANI	KIAMBA	206	5296	LAMBAYONG DISTRICT HOSPITAL
4396	GLAN MEDICARE COMMUNITY HOSPITAL	Hospital	BEmONC	SARANGANI	GLAN	162	5296	LAMBAYONG DISTRICT HOSPITAL
5861	MAASIM RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	MAASIM	148	5296	LAMBAYONG DISTRICT HOSPITAL
4556	MAASIM MUNICIPAL HOSPITAL	Hospital	BEmONC	SARANGANI	MAASIM	146	5296	LAMBAYONG DISTRICT HOSPITAL
5426	MALAPATAN RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	MALAPATAN	132	5296	LAMBAYONG DISTRICT HOSPITAL
6031	MALUNGON MUNICIPAL HOSPITAL	Hospital	BEmONC	SARANGANI	MALUNGON	127	5296	LAMBAYONG DISTRICT HOSPITAL
3405	MALUNGON RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	MALUNGON	126	5296	LAMBAYONG DISTRICT HOSPITAL
3250	KALAMANSIG RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	KALAMANSIG	120	459	COTABATO REGIONAL AND MEDICAL CENTER
4452	ALABEL RURAL HEALTH UNIT	RHU	BEmONC	SARANGANI	ALABEL (Capital)	118	5296	LAMBAYONG DISTRICT HOSPITAL
7224	BANISILAN RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	BANISILAN	110	459	COTABATO REGIONAL AND MEDICAL CENTER
3614	LEBAK RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	LEBAK	106	459	COTABATO REGIONAL AND MEDICAL CENTER
7225	SEN. NINOY AQUINO RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	SEN. NINOY AQUINO	86	5296	LAMBAYONG DISTRICT HOSPITAL
38	LAKE SEBU RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	LAKE SEBU	85	5296	LAMBAYONG DISTRICT HOSPITAL
2278	T'BOLI RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	T'BOLI	82	5296	LAMBAYONG DISTRICT HOSPITAL
5381	POLOMOLOK MUNICIPAL HOSPITAL	Hospital	BEmONC	SOUTH COTABATO	POLOMOLOK	81	5296	LAMBAYONG DISTRICT HOSPITAL
3479	POLOMOLOK RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	POLOMOLOK	81	5296	LAMBAYONG DISTRICT HOSPITAL
610	LAKE SEBU MUNICIPAL HOSPITAL	Hospital	BEmONC	SOUTH COTABATO	LAKE SEBU	78	5296	LAMBAYONG DISTRICT HOSPITAL
730	ROEL I. SENADOR, MD. MEMORIAL HOSPITAL	Hospital	BEmONC	SOUTH COTABATO	TUPI	67	5296	LAMBAYONG DISTRICT HOSPITAL
3404	TAMPAKAN RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	TAMPAKAN	65	5296	LAMBAYONG DISTRICT HOSPITAL
3615	CARMEN RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	CARMEN	64	2974	ARAKAN VALLEY DISTRICT HOSPITAL
3613	PIKIT RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	PIKIT	62	459	COTABATO REGIONAL AND MEDICAL CENTER
4016	ALAMADA RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	ALAMADA	59	459	COTABATO REGIONAL AND MEDICAL CENTER
3627	M'LANG DISTRICT HOSPITAL	Hospital	BEmONC	COTABATO (NORTH COTABATO)	M'LANG	58	5296	LAMBAYONG DISTRICT HOSPITAL
2737	SURALLAH RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	SURALLAH	57	5296	LAMBAYONG DISTRICT HOSPITAL
7395	BANGA RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	BANGA	56	5296	LAMBAYONG DISTRICT HOSPITAL
6832	COLUMBIO RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	COLUMBIO	56	5296	LAMBAYONG DISTRICT HOSPITAL
4679	KABACAN RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	KABACAN	55	2974	ARAKAN VALLEY DISTRICT HOSPITAL
2499	FR TULIO FAVALI MUNICIPAL HOSPITAL	Hospital	BEmONC	COTABATO (NORTH COTABATO)	TULUNAN	53	5296	LAMBAYONG DISTRICT HOSPITAL
2850	ALAMADA PROVINCIAL COMMUNITY HOSPITAL	Hospital	BEmONC	COTABATO (NORTH COTABATO)	ALAMADA	51	459	COTABATO REGIONAL AND MEDICAL CENTER
4408	NORALA DISTRICT HOSPITAL	Hospital	BEmONC	SOUTH COTABATO	NORALA	47	5296	LAMBAYONG DISTRICT HOSPITAL

DOH Code	Facility_Name_NHFR	Health facility type	EmONC type	Province Name	City/Municipality Name	travel time to the nearest CEmONC (Min)	DOH Code of the nearest CEmONC	Name of the Nearest CEmONC
3611	MATALAM RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	MATALAM	46	2974	ARAKAN VALLEY DISTRICT HOSPITAL
20020	SANTO NIÑO RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	SANTO NIÑO	45	5296	LAMBAYONG DISTRICT HOSPITAL
89	KORONADAL CITY HEALTH OFFICE	RHU	BEmONC	SOUTH COTABATO	CITY OF KORONADAL (Capital)	45	5296	LAMBAYONG DISTRICT HOSPITAL
7144	MIDSAYAP RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	MIDSAYAP	43	459	COTABATO REGIONAL AND MEDICAL CENTER
602	KIDAPAWAN CITY HOSPITAL	Hospital	BEmONC	COTABATO (NORTH COTABATO)	CITY OF KIDAPAWAN (Capital)	43	2974	ARAKAN VALLEY DISTRICT HOSPITAL
2627	ESPERANZA RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	ESPERANZA	33	5296	LAMBAYONG DISTRICT HOSPITAL
7213	ARAKAN RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	ARAKAN	32	2974	ARAKAN VALLEY DISTRICT HOSPITAL
1786	MAGPET RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	MAGPET	31	2974	ARAKAN VALLEY DISTRICT HOSPITAL
5627	TANTANGAN RURAL HEALTH UNIT	RHU	BEmONC	SOUTH COTABATO	TANTANGAN	26	5296	LAMBAYONG DISTRICT HOSPITAL
2118	ISULAN RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	ISULAN (Capital)	25	5296	LAMBAYONG DISTRICT HOSPITAL
4021	PRESIDENT QUIRINO RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	PRESIDENT QUIRINO	24	5296	LAMBAYONG DISTRICT HOSPITAL
6061	PRES. ROXAS PROVINCIAL COMMUNITY HOSPITAL	Hospital	BEmONC	COTABATO (NORTH COTABATO)	PRESIDENT ROXAS	24	2974	ARAKAN VALLEY DISTRICT HOSPITAL
4015	PRESIDENT ROXAS RURAL HEALTH UNIT	RHU	BEmONC	COTABATO (NORTH COTABATO)	PRESIDENT ROXAS	17	2974	ARAKAN VALLEY DISTRICT HOSPITAL
2204	TACURONG CITY HEALTH OFFICE	RHU	BEmONC	SULTAN KUDARAT	CITY OF TACURONG	14	5296	LAMBAYONG DISTRICT HOSPITAL
20518	LAMBAYONG RURAL HEALTH UNIT	RHU	BEmONC	SULTAN KUDARAT	LAMBAYONG (MARIANO MARCOS)	0	5296	LAMBAYONG DISTRICT HOSPITAL
2974	ARAKAN VALLEY DISTRICT HOSPITAL	Hospital	CEmONC	COTABATO (NORTH COTABATO)	ANTIPAS	0	2974	ARAKAN VALLEY DISTRICT HOSPITAL
459	COTABATO REGIONAL AND MEDICAL CENTER	Hospital	CEmONC	COTABATO CITY (Not a Province)	COTABATO CITY	0	459	COTABATO REGIONAL AND MEDICAL CENTER
5296	LAMBAYONG DISTRICT HOSPITAL	Hospital	CEmONC	SULTAN KUDARAT	LAMBAYONG (MARIANO MARCOS)	0	5296	LAMBAYONG DISTRICT HOSPITAL