GEOSPATIAL ASPECT OF THE LAND BORDER
BETWEEN INDONESIA AND TIMOR-LESTE

(Aspek Geospasial Perbatasan Indonesia dan Timor Leste)

by/oleh :
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ABSTRACT

Indonesia has international land borders with three neighboring countries, including the land border with Timor-Leste. The establishment of the international land boundary between Indonesia and Timor-Leste was agreed by the two Governments, the Republic of Indonesia (RI) and the Democratic Republic of Timor-Leste (RDTL) to be based on the Dutch and Portuguese 1904 Treaty and the 1914 Arbitral Awards. Presently, the joint border survey demarcation have been in progress and achieving of about 96% of the total length of the land border lines. According to the verbal description in the 1904 Treaty the boundaries are defined based on geomorphological features, i.e. the watersheds, rivers, and thalwegs of large rivers. All these morphological elements of the border were carefully identified and accurately measured to produce geospatial information about the boundaries. This paper describes how the geospatial information along the border lines were measured and fixed.

Keywords: Geospatial Information; International Land Boundary; Indonesia and Timor-Leste; Delineation and Demarcation Surveys.

ABSTRAK


Kata Kunci: Informasi Geospasial; Batas Darat Internasional; Indonesia dan Timor-Leste; Survei Delineasi dan Demarkasi.
INTRODUCTION

After about 400 years of Portuguese administration over the East Timor territory, the country were left in a chaotic situation. So that after the 1976 “declaration” of “Act of Integration” made by the most of the East Timorese political parties (known as “People’s Assembly”) in Dili, they agreed to be the integral part of the Republic of Indonesia (“Indonesian invasion of East Timor: Integration Efforts”, wikipedia.org, December 2010). In 1976, with reference to those “declaration”, the House of Representative of the Republic of Indonesia decided that the East Timor was the 27th province of Indonesia, namely the Province of Timor Timur.

In the years of 1997 and 1998 Indonesia was in a very serious crises (in economics, politics, and in socio-cultural), as it also happened in other countries, such as in Singapore, Malaysia, Thailand, and the Phillipines. In this period, there was a political pressure from the people in the Province of East Timor and International communities addressed to the Indonesian Government, demanding a referendum. In 1998 President B.J. Habibie decided to agree with the referendum with two options, (1) obtain the independence and separate from Indonesia, and (2) stay as part of Indonesia. Further in 1999, a referendum was taken place in the Province of East Timor and conducted under the United Nations facilitation. The referendum resulted that around 80% of the East Timorese people choosen to have the independence and separated from Indonesia. Finally, in the 20th May 2002 the East Timorese declared to become an independent country and named after the Democratic Republic of Timor-Leste (RDTL) (Sutisna and Handoyo, 2006), and assisted by the UNTAET (United Nations Transitional Administration in East Timor).

Concerning the boundary between Indonesia and Timor-Leste, under the Joint Border Commission between Indonesia and UNTAET, a joint technical sub-commission of the border demarcation and regulation was established and a workplan to carry out land border survey and demarcation between Indonesia and Timor-Leste was agreed upon by Indonesia and the UNTAET. The main references are the 1904 Treaty between the Dutch and Portuguese, and the Permanent Commission Award 1914 (PCA 1914).

In the Indonesian side, the Joint Border Committee (JBC) is chaired by the Director General for General Governance Affairs, and Technical Sub-Committee on Border Demarcation and Regulation (TSC-BDR) is chaired by the Head of BAKOSURTANAL). The first JBC and the TSC-BDR meetings was held in Dili in November 2001.

Following the independence declaration of Timor-Leste on the 20th May 2002, the 1st meeting of the Joint Ministerial Commission (JMC) of the Indonesia and Timor-Leste Ministers of Foreign Affairs was held in Jakarta on July 2002. Among other decission made, the JMC instructed the TSC-BDR to carry out joint delineation and demarcation surveys (see Figure 1).

Figure 1. The Organizational Chart of RI-RDTL Land Border Establishment.

Geomorphological Boundary

Theoretically, a boundary can be defined by means of natural or artificial boundary (Smith, 1995). Boundaries drawn according
to cultural elements such as language, religion or ethnology, are known as anthropomorphic. Among the best known of such boundaries are those between India and Pakistan and between India and Bangladesh (Anderson, 1999).

In the case of Indonesia and Timor-Leste, both local people along the border have the same culture, same languages (Tetun in the East Sector border and Dawan in the West Sector) and same religion as Christian. However, according to what is written in the Treaty 1904 the boundaries between Indonesia and Timor-Leste are defined as geomorphological. These border lines consist of watersheds, rivers, and thalwegs of large rivers. All these geomorphological features were identified and measured jointly to produce a geospatial information data set about the boundaries. Figure 2 shows the illustrative map of Indonesia and Timor-Leste locations.

**Figure 2:** The illustrative map showing the location of Timor-Leste (modified from the source of www.freeworldmaps.net) (Handoyo, 2011).

**BORDER LINE DEMARCATION**

With reference to the 1904 Treaty between the Dutch and Portuguese, and to the Permanent Commission Award 1914 (PCA 1914), the land border line demarcation was realized by delineating it on agreed border maps and in the field. This field survey is georeferenced to a frame work of the RI-RDTL CBDRF (Common Border Datum Reference Frame) which was established jointly in 2002-2003.

The delineation surveys were carried out jointly by the TSC-BDR after the instruction given by the JMC and JBC. The TSC-BDR held a number of meetings in the auspice of its responsibilities. They have, among others, produced standards and specification, survey methodology, and the Standard Operating Procedures (SOP) applied in the field delineation survey.

Up to the year of 2005 the implementation of the land border between Indonesia and Timor-Leste has reached the progress of 96% out of the total length 268.8 kilometers. These achievements were then promulgated in the Provisional Agreement signed by the Ministers of Foreign Affairs of both countries representing both Governments of Indonesia and Timor-Leste in Dili, April 8th, 2005 (known further as PA-2005).

Table 1 shows a chronology of TSC-BDR joint field surveys for the borderline in the field as being carried out in sequence.

**Table 1. The Chronology of Related Joint Field Surveys**

<table>
<thead>
<tr>
<th>Survey</th>
<th>Period</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Reconnaissance</td>
<td>April-May 2002</td>
<td>To assess on the conditions of work and visit some of the more complex border segments.</td>
</tr>
<tr>
<td>CBDRF survey</td>
<td>May 2003</td>
<td>To establish the CBDRF, intended to support future surveys and to serve as the coordinate reference frame for the border line.</td>
</tr>
<tr>
<td>Joint Delineation Survey</td>
<td>June-July 2003</td>
<td>To survey the border line and to survey Ground Control Points.</td>
</tr>
<tr>
<td>Extra Joint Delineation</td>
<td>November 2003</td>
<td>To resurvey some segments that were left as unresolved in the previous survey.</td>
</tr>
<tr>
<td>Joint Demarcation Survey</td>
<td>August 2005</td>
<td>To survey and build the border markers along the border line.</td>
</tr>
</tbody>
</table>
Research Activities

The activities to establish the land border between Indonesia and Timor-Leste consist of the following stages:

a. Studying the documents of Treaty 1904 and other relevant documents. This is to make interpretations of the Treaty verbal description of the border lines.
b. Joint reconnaissance survey. This is to jointly make traces in the field of those border line descriptions.
c. Joint survey and construction of the common border datum reference frame (CBDRF). This jointly establishes a set of common border datum in both sides of the border line as the reference frame for the border point coordinates measurements.
d. Joint delineation surveys. These activities are to jointly decide the border point positions and measure its coordinates.
e. Joint demarcation surveys. This is the following activities of the joint delineation surveys to establish markers on or between the border points.
f. Joint mapping and reporting. This is to produce joint border maps, depicting the border points and lines, at scale of 1:25,000 covering both the East (main) and the West (Oecussi) sectors.

All those joint activities were carried out and based on related joint technical specifications and standard operational procedures.

Status of the Results

As the results of the bilateral meetings and the joint field surveys between Indonesia and Timor-Leste, from 2001 to present, there are now in existence as follows:

a. Length of the land border lines: the East sector of 149.1 kilometers, and the West sector of 119.7 kilometers, giving the total length of 268.8 kilometers.
b. “Interim Report on the land Border Delineation between Republic of Indonesia and Democratic Republic of Timor-Leste”, 2004, consists of three volumes:
   i. Volume 1: Results of the Land Border Delineation.
   iii. Volume 3: Joint Compilation of Reference and Auxiliary Documents.
c. “Provisional Agreement between the Government of the Republic of Indonesia and the Government of the Democratic Republic of Timor-Leste on the Land Boundary”, 2005, covering nine Articles and Annexes:
   ii. Annex B-1 sheet of General Map at Scale 1:125,000 and 17 sheets of Border Maps at Scale 1:25,000.
   iii. Annex C-Unresolved Segments.
d. 103 demarcated border markers.
e. Documents and Record of Discussion (RoD) of: JMC meetings (2 times), JBC meetings (2 times), Special JBC meeting (1 time), TSC-BDR meetings (23 times).

Notes: there were no bilateral activities in 2006 and 2007 due to internal problems in Timor-Leste.

Geospatial Works of the Land Border

Although the Netherlands and Portugal have first attempted to delimit their administration territories in the island of Timor in 1859, historically, the geospatial works have been carried out when the main boundary of the island of Timor was surveyed in 1915 by a joint Dutch-Portuguese commission. The work of the commission began in early April 1915, and it was concluded later that same month.

Boundary posts were sited on both banks of the northern and southern termini rivers, with a further 29 posts in between, where the boundary alignment did not follow the drynage features. In addition, five astronomic stations were surveyed in for the accurate fixing of the boundary posts and stones. The number and name of the stations are: A.S.1 Silaba, A.S.2 Dafala,
A.S.3 Mottaalas, A.S.4 Noena-oera, A.S.5 Boeloe. These stations have two type of geographical coordinates of Batavia and Greenwich meridians (Deeley, 2001).

The activities of the land border establishment is now once again being traced back to describe the geospatial works involved within.

Legal Documents and the Joint Reconnaissance Survey

Studying the documents of 1904 Treaty and other relevant documents is to make interpretations of the verbal description of the border lines. Commonly, the verbal sentences of the Treaty are so general that there is lack of detail of features along a border line or inconsistencies between present toponymy. In general, there is not much discrepancy in the interpretation of the Treaty. Nevertheless there are some different interpretations in disputes by the Indonesia and Timor-Leste teams. These different interpretations are now known as unresolved segments.

Joint reconnaissance survey is to jointly make traces in the field of those border line descriptions resulted from the Treaty interpretations. The traces in the field can be either being agreed or not agreed by both survey teams. Again those disagreements may also lead to problems. An example of a serious border line problem due to different interpretations of the Treaty and in the field is the unresolved segment Noel Besi/Citrana. This problem has an implication of about 1,096 hectares fertile land in the west sector of the border (TSC-BDR RI-RDTL, June and October 2004).

Joint Survey and Construction of CBDRF

The accurate delineation of the border between RI and RDTL was a major issue after the independence of the latter country. On some segments, the uncertainty about the correct line of the border was high due to several factors (e.g., destruction of old markers, change on river courses, etc.). In addition, the accurate surveying of the entire border line in a known international reference frame was required by the two countries in order to solve any possible issue in the future. Therefore, it comes into a decision to establish a reference frame for defining the reference coordinate system, from then on identified as Common Border Demarcation Reference Frame (CBDRF). Joint survey to construct the CBDRF establishes a set of common border datum (the fiducial network) in both sides of the border line as the reference frame and support for the delineation field work. This CBDRF is the starting geospatial work after the independence of Timor-Leste.

The guidelines adopted by the two governments required that ITRF2000 (International Terrestrial Reference System, solution 2000) has been selected to map the CBDRF into a known international frame. The observation of the CBDRF network has been carried out jointly by RI and RDTL teams using GPS observation only. The total number of CBDRF stations is 69 divided by three classes, a priori defined, functioning of the planned number of occupations and hours of observations:

- Zero-Order–stations continuously observed during the entire period of the campaigns.
- First-Order–stations with minimum of two daily sessions (each session with a minimum of 12 hours).
- Second-Order–stations observed with a minimum observational period of at least two hours.

Figures 3 show the distribution of the CBDRF stations of First- and Second-Order. Table 2 summarizes the specifications for the GPS observations that have been followed:

The results show that the CBDRF points, in particular the Zeroth- and First-Order stations, have very robust solutions with respect to ITRF2000. In this regard, the accurate connection of the points of the border line point coordinates between Timor-Leste and Indonesia with respect to a global reference frame is precisely defined. Furthermore, the results may be used in the
future for other type of projects, such as for
geodynamic studies in the vicinity of Timor
Island, and also for the definition of national

![Map of CBDRF network](image)

**Figure 3.** First-Order (black triangles; 9 in Timor-Leste and 7 in Indonesia) and Second-Order (white squares; 10 in Timor-Leste and 39 in Indonesia) stations of the CBDRF network. Also shown the two Zero-Order stations (white circles) located close to the border (Fernandes, et al, 2005).

**Table 2.** Major characteristics of the GPS observations of the CBDRF network

<table>
<thead>
<tr>
<th>Method</th>
<th>Static</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments</td>
<td>Dual-frequency geodetic-type receivers</td>
</tr>
<tr>
<td>Observation time-span</td>
<td>Continuous (during the campaign) for Zero-Order; 2-4x24 hours for Second-Order</td>
</tr>
<tr>
<td>Data recording rate</td>
<td>15 seconds (30 seconds for some points of Zero- and First-Order)</td>
</tr>
<tr>
<td>Elevation-mask angle</td>
<td>10°</td>
</tr>
</tbody>
</table>

**Joint Delineation Survey**

The joint delineation survey is aimed to jointly identify in the field the border points which constitute the international border in accordance with the 1904-Treaty and 1914-Arbitral Decision, agreed by both parties as the legal basis for the international boundary between Indonesia and Timor-Leste. This survey was carried out together with the survey of ground control points required for the use of Ikonos satellite image as the geospatial media (and other related accompanying maps) for visual reference in the field. The joint field work was based on the “Technical Guidelines for Methodology of the Field work for Border Delineation” (June 2003) (TSC-BDR RI-RDTL, June 2003).

The selection of candidate points, for river or nonriver boundaries, is to be made by taking into consideration the need for intervisible locations and that straight line segments should not have a considerable deviation (less than 10% of river width with a maximum of ten meters) from the natural feature. Maximum distance between border points should not be more than 150m. Agreement for surveying procedures are determined in the Guidelines for both river and nonriver boundaries.

In the case of river boundaries, each GPS position of the river bank should be achieved with 7 minutes of observation with a code receiver with observation rate of 5 seconds. For nonriver boundary there are two possibilities, i.e., with “location of old markers and natural features” and with “watershed and other points”. The surveying procedure for location of old markers and singular natural features (such as river sources or summits) is static observation with double frequency receiver for 30 minutes at a 15 seconds observation rate. The surveying procedure for watershed and other support points is fast-static positioning, i.e., 6 to 15 minutes observation time at a rate of 15 seconds, with a double frequency receiver. The data processing for all points was made using the software Leica Ski-Pro, used independently by both sides. The final result is the average of both independent calculations. When the difference between both calculations was lower than one meter, the result is considered final (TSC-BDR RI-RDTL, June 2004). When higher than one meter or when processed only by one of the delegations the result is considered provisional.
After proper and procedural processing of the observational data, the following, and the next Table 3, are the example of resulted border point coordinates.

**Classification Keys:**
- M – Median line point
- RB – River bank point
- OF – Border point in other feature
- HA – OF with high accuracy coordinates
- A – Alternative points (for unresolved segments).

**Type Keys:**
- Final – Coordinate values are final
- Provisional – Coordinate values may suffer corrections (typically of less than 2m).

Coordinates refer to the CBDRF: ITRF2000/WGS84, UTM Zone51 S [7].

Demarcation of the borderline is realized by placing permanent border markers were executed immediately after the borderline, newest coordinates are defined and evaluated by the JBC and agreed upon by both Governments to be the unequivocally defined borderline.

**Joint Demarcation Survey**

Joint demarcation survey is aimed to establish markers in the field. This activity is based on the “Technical Specifications for Border Demarcation” version on 23rd December 2004 (TSC-BDR RI-RDTL, 2004).

### a. Candidates points to be demarcated:

The process of demarcation is conducted by establishing border markers at selected points along the border line. The selected points should belong to one of the following categories:

i. Surveyed and agreed border points already with final coordinates.

ii. Densification points along the agreed approximate border line which thus becoming final points.

Prior to the demarcation works, both sides selected and decided on the points or places for construction of border markers. The following aspects are taken into consideration:

- the relevance for the description of the border line, mainly where the border point does not correspond to an easily identifiable natural feature;
- the relevance for the activities of the local people, i.e., when daily activities require a clearly visible demarcation to prevent incidental trespassing;
- the spacing between consecutive markers of the border line.

### b. Demarcation methodology:

There are 4 (four) possible placements of markers to be agreed upon:

i. Placement of markers in border points with some kind of materialization.

<table>
<thead>
<tr>
<th>POINT_ID</th>
<th>EASTING</th>
<th>NORTING</th>
<th>TYPE</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T103001</td>
<td>662300.58</td>
<td>8985512.41</td>
<td>Provisional</td>
<td>OF</td>
</tr>
<tr>
<td>T103002</td>
<td>662256.74</td>
<td>8985452.57</td>
<td>Final</td>
<td>OF</td>
</tr>
<tr>
<td>T103003</td>
<td>662190.51</td>
<td>8985529.44</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103004</td>
<td>662274.82</td>
<td>8985486.01</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103005</td>
<td>662382.25</td>
<td>8985395.83</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103006</td>
<td>662408.09</td>
<td>8985301.69</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103007</td>
<td>662403.72</td>
<td>8985172.46</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103008</td>
<td>662414.29</td>
<td>8985071.09</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103009</td>
<td>662460.81</td>
<td>8984942.13</td>
<td>Final</td>
<td>M</td>
</tr>
<tr>
<td>T103010</td>
<td>662501.63</td>
<td>8984785.41</td>
<td>Final</td>
<td>M</td>
</tr>
</tbody>
</table>
For the purpose of verification, the position of the newly built marker should be determined again using GPS relative positioning, in conformance with the accuracy established for the border markers.

ii. Placement of markers on the approximate border line.
The points on the agreed approximate border line do not have a level of accuracy that requires complex stakeout procedures. These points frequently correspond to natural features, such as watershed lines, that can be identified in the field. In these situations, the approximate position of the point can be surveyed by GPS absolute positioning method using handheld GPS.

iii. Placement of markers in agreed border points.
The preferred method for staking out of agreed border points consist of the following procedure:
1. Positioning of at least two auxiliary reference points in the area using static GPS survey connected to the CBDRF;
2. The auxiliary reference points will be used frequently and classified as CBDRF densification points;
3. Terrestrial stakeout, based on the existing CBDRF points or auxiliary reference points, should be made using a total station with angular accuracy of 1” and distance accuracy of at least 2mm + 2ppm.
4. In locations where RTK-GPS is found to be suitable for use it may be used at discretion of the field team leaders, providing that the base station points are CBDRF points or auxiliary reference points;
5. The markers should be adequately recorded.

iv. Placement of auxiliary border markers in river banks.
Auxiliary markers (usually in set of two, one at each river bank) for the purpose of warning of the proximity of the border line are placed along river banks. The coordinates of these markers should be determined with the same positional accuracy as for the border markers.

**Joint Mapping**

The joint mapping activity is to produce some joint border maps, to depict the border points and lines, as well as its surrounding topographical features, at the scale of 1:25,000 in the vicinity of the East (main) and the West (Oecussi) sectors. These maps are designed and produced based on agreed specification derived from the Indonesian Topographic Map Series at scale of 1:25,000. As the joint maps, every sheet of the map is signed by the head of both delegations, Indonesia and Timor-Leste, in 2004 during the preparation of the “Provisional Agreement”. An illustrative example of the map is as follows in Figure 5.

![Figure 4](image1.png)

Figure 4. An example of the border marker facing the East view with a plate showing the Timor-Leste flag (Courtesy of PPBW, BAKOSURTANAL, 2005)

![Figure 5](image2.png)

Figure 5. An example of the joint border map at scale of 1:25,000 (Courtesy of PPBW, BAKOSURTANAL, 2005)
CONCLUDING REMARKS

The geospatial information of the definition and realization of the land boundary lines between Indonesia and Timor-Leste were produced and legally bind by the PA-2005. As the geospatial information were resulted by applying the proper principles and procedures for the accurate positioning fixing by using the present available advance technology, it is obviously providing a reliable geospatial infrastructure for the border management.

Acknowledgment

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