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Interim Report **IR-09-011**

GEO Information For Disaster Recovery - Case Study: The use of Orthophotos in Aceh, Indonesia

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Abstract

This study, carried out between July-September 2008, looks specifically at the use of a high resolution aerial photograph (orthophoto) data set acquired in June 2005 over post tsunami Aceh, Indonesia. The study clearly demonstrates the benefit of the use of EO data for disaster recovery showing that the orthophoto data set, costing 1.4 million Euro, critically supported projects (primary users of the data set), worth over 16 times its actual cost (28 million Euro) and provided support to projects worth over 600 times its actual cost (880 million Euro).

The study concludes that a simple robust methodology to quantify the benefit of EO data in disaster recovery may be implemented by monitoring the total costs of projects that are critically supported by the EO data set. To implement that monitoring mechanism, a robust and straightforward method must be in place with the EO data distributor that records simple criteria for each of the data users and related projects.

The report provides a number of lessons that have been learnt from the spatial data initiatives between Official Development Agencies and the Government of Indonesia in response to the Tsunami. The report recommends that in order to ensure that the spatial data is used to its greatest benefit, prior to the initiation of any campaign, the donor funding the project must ensure that there is a defined and clearly proven, transparent, and accountable mechanism to ensure that the data is effectively delivered to the humanitarian aid community in a timely and efficient manner.

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Executive Summary

The main aim of the study was to quantifiably assess the benefit of the use of a specific spatial data set in disaster recovery.

Within the Global Earth Observation System of Systems (GEOSS), the EU-funded project Geo-Bene (www.geo-bene.eu) is charged with estimating cost-benefits of Earth Observation (EO) data for nine societal benefit areas. One of these areas is titled *reducing loss of life and property from natural and human-induced disasters* Ref [1]. In an effort to better understand the benefits associated with using EO data in disaster regions, Aceh, Indonesia was selected as a case study within Geo-Bene.

The study, carried out between July-September 2008, looks specifically at the use of a high resolution aerial photograph (orthophoto) data set acquired in June 2005. The Norwegian Government funded (NORAD) orthophoto data set was completed in April 2006 and delivered to the Spatial Information and Mapping Centre (SIM-Centre) of the Indonesian Governments Rehabilitation and Reconstruction Agency (BRR) by the Indonesian National Coordinating Agency for Surveys and Mapping (Bakosurtanal) in August 2006.

In the following two years since delivery, the study shows that the data was delivered to 99 different projects in the rehabilitation and reconstruction community. The majority of the data set requests (primary users) came from the Government of Indonesia (37%), and Non Governmental Organisations (27%) with its use focusing largely on Urban or Rural Planning (48%) and Environmental Protection (16%). Approximately 90% of the primary users of the case study data found the case study data to be most important during the planning and operational phases of their projects.

This study clearly demonstrates the benefit of the use of EO data for disaster recovery showing that the orthophoto data set (costing 1.4 million Euro) critically supported projects (primary users of the data set), worth over 16 times its actual cost (28 million Euro) and provided support to projects worth over 600 times its actual cost (880 million Euro).

Aside from these primary users of the data set, over 635 secondary users of the data set (i.e. those requesting only derived products) were identified, including the use of the data set by over 400 professional and semi professional spatial data users during GIS training courses.

The main constraint of the case study data set was its delayed delivery by Bakosurtanal to the rehabilitation and reconstruction community in late 2006. At this time at least 44% of the reconstruction and rehabilitation of housing was completed, with reconstruction in other sectors being in an advanced state. This suggests that the data failed was not used in at least 44% of the main reconstruction sector. This sector, having an allocated budget of some 26% of the 5.8 billion dollar reconstruction budget[1], was the largest of the 13 reconstruction sectors, for which

[1] allocated by the end of 2006

the case study data was deemed ideally suited as a tool for coordination and planning.

The study concludes that a simple robust methodology to quantify the benefit of EO data in disaster recovery may be implemented by monitoring the total costs of projects that are critically supported by the EO data set. To implement that monitoring mechanism a robust and straightforward method must be in place with the EO data distributor that records simple criteria for each of the data users and related projects.

The report summarizes a number of lessons that have been learnt from the spatial data initiatives between Official Development Agencies (ODA's) and the Government of Indonesia (GoI) in response to the Tsunami in NAD. The report recommends that in order to ensure that the spatial data is used to its greatest benefit, prior to the initiation of any campaign, the donor funding the project must ensure that there is a defined and clearly proven, transparent, and accountable mechanism to ensure that the data is effectively delivered to the humanitarian aid community in a timely and efficient manner.

The report clearly demonstrates the benefit of the use of EO data for disaster recovery, and provides a simple and robust method by which its benefit can be quantified, verified and accounted to either donor or user communities.

Table of Contents

Acronyms and Abbreviations

ADB	Asian Development Bank
AIPRD	Australia Indonesia Partnership for Reconstruction and Development
ARRIS	Aceh Rehabilitation and Reconstruction Information System (JICA)
AT	Aerial Triangulation
AusAID	Australian Agency for International Development
BAKOSURTANAL	Badan Koordinasi Survei dan Pemetaan Nasional - (National Coordinating Agency for Surveys and Mapping)
BAPPEDA	Badan Perencanaan dan Pembangunan Daerah - (National Planning Agency)
BAPPENAS	Badan Perencanaan Pembangunan Nasional - (National Development Planning Agency)
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe -(Federal Institute for Geosciences and Natural Resources)
BPN	Badan Pertanahan Nasional - (National Land Administration)
BPS	Badan Pusat Statistik - (Statistics Indonesia)
BRR	Badan Rehabilitasi dan Rekonstruksi - (Agency for Rehabilitation and Reconstruction of NAD and NIAS)
CDA	Community Driven Adjudication
DAC5	Development Assistance Committee Coding Scheme 5
DCAS	Development Cooperation Analysis System (UNDP)
DEM	Digital Elevation Model
DGPS	Differential Global Positioning System
EO	Earth Observation
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GTZ	Deutsche Geeselschaft fuer Technische Zusammenarbeit - (German International Development Agency)
IDR	Indonesian Rupiah
IFRC	International Federation of Red Cross and Red Crescent Societies
IFSAR	Interferometric Synthetic Aperture Radar
INS	Inertial Navigation System
IOM	International Organisation for Migration
IP	Internet Protocol
ISO	International Standards Organisation
JICA	Japan International Cooperation Agency
LAPAN	Lembaga Antarilesa dan Penerbangan Nasional - (National Aerospace and Aviation Association)
MDTF	Mutli Donor Trust Fund
MODIS	Moderate Resolution Imaging Spectroradiometer
NAD	Nanggroe Aceh Darussalam

NOAA	National Oceanographic and Atmospheric Administration
NORAD	Norwegian Agency for International Development
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OGC	Open GIS Consortium
OWS	Open Web Source
PEMKO	Pemerintah Kota - City Government
PPC	Project Preparation Consultant (ADB)
PU	Departemen Pekerjaan Umum - (Department of Public Works)
PUSDATIN	PUSAT DATA & INFORMASI (BRR) - Office for Data and Information
RAND	Recovery Aceh Nias Database
RTRW	Rencana Tata Ruang Wilayah
SLGSR	Support for Local Governance for Sustainable Reconstruction (GTZ)
SPAN	Sensus Penduduk Aceh Nias - Census of Residents of Aceh and Nias
SPOT	Système Pour l'Observation de la Terre
SUMUT	Sumatera Utara
TEM	Transient Electromagnetic Surveys
TLM	Topographic Line Map
TRWMP	Tsunami Recovery Waste Management Programme (UNDP)
UNDP	United Nations Development Programme
UNIMS	United Nations Information Management Service
USAID-ESP	United States Agency for International Development - Environmental Services Program
USD	United States Dollars
USGS	United States Geological Service

Related Documents

1: IIASA Interim Report, IR-08-048, Banda Aceh - The Value of Earth Observation Data in Disaster Recovery and Reconstruction: A Case Study, 27 November 2008. On-line Report, http://www.iiasa.ac.at/Admin/PUB/Documents/IR-08-048.pdf (resource verified on 06/12/2008)

1 Introduction and Document Overview

1.1 Introduction

The main aim of the study was to quantifiably assess the benefit of the use of a specific spatial data set in disaster recovery.

Within the Global Earth Observation System of Systems (GEOSS), the EU-funded project Geo-Bene (www.geo-bene.eu) is charged with estimating cost-benefits of Earth Observation (EO) data for nine societal benefit areas. One of these areas is titled *reducing loss of life and property from natural and human-induced disasters* Ref [1]. In an effort to better understand the benefits associated with using EO data in disaster regions, Aceh, Indonesia was selected as a case study within Geo-Bene.

In this case study, the EO data set comprises high resolution orthorectified aerial photographs (orthophoto) acquired in June 2005 over the province of Nanggroe Aceh Darussalam (NAD), Indonesia, in the aftermath of the December 26th, 2004 Tsunami (henceforth the Tsunami). The funding for the data set was granted by the Aid Development Arm of the Norwegian Government (NORAD) with the project being initiated, and managed, by the Indonesian National Coordinating Agency for Surveys and Mapping (Bakosurtanal).

The project to capture, create and deliver the orthophoto and spatial data was initiated in January 2005 and completed in August 2006. From August 2006 to July 2008 the whole, or parts, of the case study data set was distributed to 99 different primary data users and projects within the rehabilitation and reconstruction community in NAD. The study, reported in this document, to assess the benefit of the use of the case study data, was undertaken between July and September 2008.

The first step in quantifying the benefit of the use of the case study data was by means of a limited number of detailed interviews with technical managers responsible for the use of the case study data within their respective projects. The second step involved the creation and distribution of a detailed questionnaire to all primary data users to ascertain answers to the following questions:

- Who used the case study data
- How was the case study data used
- When was the case study data used
- What was the benefit of using the case study data
- What problems were associated with the case study data

The result of the study provides an applicable method for quantifying the benefit of the use of EO data in post disaster environments and provides development and donor agencies with an objective measure of the benefit in supporting spatial data capture campaigns in post disaster environments.

The study highlights some critical areas of concern in the implementation of similar data capture campaigns and provides a number of recommendations driven by observations from the management and delivery of the case study data.

1.2 Document Overview

An overview of the affect of the Tsunami within NAD is detailed in section 2. Following this, the requirements for the capture of new spatial data across NAD and the Nias Islands during the post disaster, emergency relief phase, are presented. Further details are also provided concerning the main responses and projects initiated by Official Development Agencies (ODA's) during 2005 to provide new, or enable access to, post disaster spatial data.

The project to acquire and deliver the orthorectified photography, forming the spatial data set of this study, is described in section 3. The description also includes an overview of the initial project objectives and deliverables, the actual project chronology, the methods by which access to the data set was enabled, and methods by which the data was distributed to the rehabilitation and reconstruction community.

In section 4, using information maintained by the data set distributors, a profile of the users of the case study data set and its' usage across the recovery community is presented. Some detailed examples on the use of the data set are presented in section 5.

The aims and rationale of the questionnaire concerning the actual usage of the case study data set are presented in section 6; the questionnaire itself is presented in 0. The results of the responses by agencies and projects technical managers to the questionnaire are summarised and presented in section 7.

A summary and discussion on the use, benefit and constraints of the case study data is presented in section 8. Conclusions on the benefit of the use of the case study data set are presented in section 9 along with recommendations how to implement a method to assess the benefit of the use of EO data in disaster recovery and recommendations to be followed by ODAs and donor agencies prior to funding or participating in spatial data campaigns.

2 Requirement for spatial data in post Tsunami rehabilitation and reconstruction in Nanggroe Aceh Darussalam

The earthquake and subsequent Tsunami devastated wide areas and hundreds of communities across Nanggroe Aceh Darussalam (NAD). In post Tsunami Nanggroe Aceh Darussalam the available topographic data (i.e. relief and the spatial location of man made and natural features) was approximately 30 years old and contained significant errors. Immediately after the Tsunami there was a large demand for up to date topographic and spatial data to support all of the rehabilitation and reconstruction activities. Some of the reconstruction activities that drove the requirement for updated spatial data are presented in section 2.1.The demand led to a number of initiatives between Official Development Agencies (ODA's) and the Government of Indonesia (GoI) specifically to collect spatial data in a number of ways. The main activities that were initiated in 2005 are presented in section 2.2. The NORAD funded orthophoto project was one of these initiatives.

The Tsunami devastated the coastal areas of the province of Nanggroe Aceh Darussalam (NAD) in Sumatra, Indonesia. It affected over 220km of coastline, damaging or destroying over 950 sq km of coastal area (640 sq km agricultural land, 150 sq km aquaculture), affecting some 300,000 parcels of land. Damage to property and infrastructure was also immense; over 600 villages, 12 % of the 4900 provincial villages, were affected; over 150,000 houses were damaged or destroyed; 8 hospitals and 114 health clinics were damaged or destroyed; approximately 50%, over 2100, of the provincial schools were damaged; 3000km of roads destroyed or made impassable; 120 arterial bridges destroyed and all major sea ports were destroyed or severely damaged. Over 140,000 people were killed and over 600,000 were displaced Ref [1], Ref [3].

2.1 The Demand for Updated Spatial Data

In the post Tsunami emergency relief phase during early 2005, the vast majority of the available topographical base maps for mapping purposes were obtained from the 1:50,000 national topographic map series from the National Coordinating Agency for Surveys and Mapping (Bakosurtanal). These maps were provided as hard copy products by Bakosurtanal.

These maps were derived from aerial photography flown in 1976 and were known to contain significant topographical errors. Considering that the Tsunami affected areas had also been ravaged by a civil war lasting over 30 years, the possibility to provide any update to this topographic data was also limited and no revisions were ever made to the original 1976 data. It is also obvious that during the intervening period there had been a significant changes in land use activities, especially so following the Tsunami. Also, as a result of the magnitude 9.1 Richter earthquake that triggered the Tsunami[2], there was a vast extent of differential rise and fall in ground levels, and,

[2] As reported by the United States Geological Service (USGS)

due to this, all existing topographical maps contained significant errors and were not suitable for engineering design work.

An assessment of priority mapping needs in NAD Ref [4] reported on the critical requirements for the update of topographic data. Spatial data and updated maps were essential for use in a wide range of planning and data collection purposes including the restoration of the ownership of more than 300,000 parcels of land which had been destroyed or for which evidence of ownership had been lost.

The report, Ref [4], notes that updated mapping was required to support a number of planning and reconstruction activities. Some of major activities are detailed in the following sections.

2.1.1 Master Plan Spatial Information Needs

The Master Plan for the Rehabilitation and reconstruction of the regions and communities of the Province of Nanggroe Aceh Darussalam and the Islands of Nias of North Sumatra, Ref [5], was published in April 2005. It identified several priority activities for which new mapping was required to progress the reconstruction program.

Chapter 5 of the Master Plan specifically relates to spatial mapping needs for the preparation of structure plans, mapping of land ownership boundaries, land consolidation, the green protection zone, mapping of pre- and post-disaster impacts and community based mapping of land occupied prior to the Tsunami. The need for new mapping was also closely related to other cross sector issues including land titling, compensation related to land matters, monitoring and evaluation of land use activities, sector policy development and disaster impact mitigation

2.1.2 Spatial Planning needs of local Government

Indonesian National Law 24/1992[3] requires that all government agencies prepare a range of spatial plans for development purposes, at specific scales as given in Government Regulation 10/2000 (see Table 1). Most of these plans are prepared by the National Development Planning Agency (Bappenas) and the National Planning Agency (Bappeda) at the provincial and district level, but also Public Works (PU), Provincial Environmental Agency (Bapedalda) and the National Statistics Agency (BPS) were also required to prepare a range of maps.

[3] The Spatial Planning Law 24/1992 stipulates the hierarchical spatial planning in Indonesia and consists of the national spatial plan (RTRW Nasional), the provincial spatial plans (RTRW Propinsi) and the district spatial plans (RTRW Kabupaten). All levels of the government are required to make spatial plans for directing the development in their respective regions. This law also differentiates spatial plans by the main function (i.e. environmental conservation - kawasan lindung) and the main activity of the area.

Type of Map	Scale
National	1:1000000
Provincial	1:250000
Special Area Provincial	1:100000 & 1:50000
City District (Kota, Kabupaten)	1:50000 contour + 50 m
City District (Kota, Kabupaten Special)	1:10000 + m
Village Sub-district (Desa, Kecamatan)	1:10000 + 12.5 and + 7.5 m

Table 1 Scale of Mapping Required by Government Agencies

2.1.3 Banda Aceh Action Plan

An action plan for Banda Aceh was required to identify areas needing priority actions, with a focus on reconstruction of housing and infrastructure services in devastated areas within the city. The action plan also identified a need for topographic digital and hardcopy base maps at scales between 1:10,000 and 1: 2,000 scale.

2.1.4 Village Development Mapping

More than 100 NGOs and community-based organizations were involved in a community based mapping program (CBM). An important step in the recovery process was the preparation of village or community development plans.

These plans, prepared at 1:5,000 to 1:10,000 scale, showed land use, infrastructure, drainage, emergency access routes and community facilities proposed to be developed for each village. The basis for preparing these plans were community-based maps which required that each parcel of land to be superimposed upon updated topographic base maps.

2.1.5 Fish Farm Maps

The Tsunami destroyed over 150 sq km of coastal fish farms (Tambak) and included a heavy loss of life amongst fishermen who owned or operated many of these farms. There was a need for a community based mapping approach to establish ownership of fish farms and reissues licences where these were held previously.

Pre- and post- Tsunami maps showing the location of boundaries and structures associated with fish farms were required to re-establish the aquaculture industry in the province.

2.1.6 Infrastructure Services

The damage to infrastructure (i.e. electricity, telecommunication, road networks, drainage systems and water supply services) caused by the earthquake and Tsunami was widespread across the province. The Ministry of Public Works (PU), responsible for the reconstruction of roads, drainage and other public utility services, required large-scale topographic and cadastral maps (1:1,000 to 1:5,000) to prepare detailed plans for the reconstruction and relocation of roads and other services.

2.1.7 Disaster Hazard and Risk Mapping

In order to prepare the province for other natural hazards and risks, selected areas of the province which are susceptible to tsunami, earthquake damage, landslide and subsidence, groundwater contamination and flooding and inundation needed to be mapped.

2.2 Activities in 2005 to Capture Spatial Data

During 2005 at the request of the Government of Indonesia (GoI) a number of Official Development Agencies (ODA's) provided support to address the need for the capture of spatial data and the provision of updated topographic data and products to the rehabilitation and reconstruction community.

A summary of the main activities initiated in 2005 to support the capture of spatial data are presented in the following sections[4].

2.2.1 Bakosurtanal

As primary custodians of national 1:50,000 to 1:250,000 topographic maps Bakosurtanal initiated a project to digitize this data and to make the data available to the rehabilitation reconstruction community. This data was available to National Governmental or UN agencies (only on request), in 2006.

2.2.2 LAPAN

One of the tasks of LAPAN (National Aerospace and Aviation Association) is for the reception of Landsat, MODIS and NOAA satellite imagery over Indonesia. LAPAN is also an authorised user of the International Space Disaster Charter and requested access to available satellite imagery acquired over NAD in early 2005.

A number of scenes from various satellites (SPOT, Landsat, Ikonos, ASTER) at various resolutions over various areas of interest were acquired via the Charter, ortho-corrected, and provided to Bappenas (National Development Planning Agency), however this was not made further available to the reconstruction community by Bappenas.

2.2.3 World Bank – RALAS

A US $28m program of assistance for a community-mapping program known as Reconstruction of Aceh Land Administration System (RALAS) was established by the World Bank via the Multi Donor Trust Fund (MDTF). Through Community Driven Adjudication (CDA) the program provided community based mapping to BPN (National Land Administration) to legally restore land titles and certification. A number of programmatic and legislative issues significantly delayed the progress of the project. The project is on-going at the time of this report.

[4] Note this ONLY reflects projects initiated in 2005 as an immediate response to the need for updated topographic and spatial data across the province of NAD and the Nias Islands

2.2.4 Asian Development Bank – ETESP

The on-going Earthquake and Tsunami Emergency Support Program (ETESP) of the Asian Development Bank provides rehabilitation and reconstruction support to mitigate the damages caused by the earthquake and Tsunami. The ETESP includes a strong mapping component providing strategic environmental assessment and monitoring of rural and urban communities to assess long-term impacts of the disaster. Specific spatial information requirements include land cover, land use and monitoring of the environmental impacts of reconstruction. A number of mapping activities including Sub-district Action Plans (spatial planning) and environmental impact and management plans were successfully completed and spatial data and maps made available to the rehabilitation and reconstruction community.

2.2.5 European Commission

The European Commission (EC) provided very high resolution pre and post Tsunami satellite imagery (Ikonos and Quickbird) and technical assistance to the National Land Administration (BPN) to perform ortho-rectification of imagery using precision Differential Global Positioning System (DGPS). Imagery was provided to BPN but access to the imagery, due to data licensing constraints, was withheld solely to BPN.

2.2.6 AusAID – IFSAR Mapping of Nias Island

The orthophoto project funded by NORAD (see section 2.2.10) was initiated prior to a second disaster occurring on the Islands of Nias. Nias, an island on the west coast of Sumatra, escaped the majority of damage of the 2004 Tsunami, but was greatly affected by a magnitude 8.7 Richter earthquake in March 2005. The urgent need to provide up to date topographic data was to be met by the capturing of airborne IFSAR (Interferometric Synthetic Aperture Radar) data and the production of high resolution digital elevation model (DEM) and at least 1:10,000 map products covering the whole island of Nias.

The AusAID funded IFSAR project was flown in June 2006 and also provided “gap-fill” map products in areas in coastal NAD not covered by the NORAD orthophoto project. The project included capturing new data over the city of Banda Aceh and its environs.

The project was completed in mid 2006. The IFSAR products and DEM’s were made available by Bakosurtanal to the reconstruction community in early 2007. This was possible only via the Spatial Information & Mapping Centre (SIM-Centre) of the Agency for Rehabilitation and Reconstruction of NAD and NIAS (BRR).

2.2.7 French Government Assisted Mapping

The French Government provided a grant to Bakosurtanal to tender a city mapping project. Based on the orthophoto imagery acquired under the NORAD funded project, (see section 2.2.10) and using detailed field surveys this project sought to create city map books at 1:10,000 scale of the five main Tsunami affected cities in NAD.

The project was completed in early 2007 and all products (40 1:10,000 maps sheets and associated spatial data) were provided to Bakosurtanal. The products were not provided to the rehabilitation and reconstruction community.

2.2.8 German Government – BGR

The German Bundesanstalt für Geowissenschaften und Rohstoffe, BGR, (Federal Institute for Geosciences and Natural Resources) undertook a detailed hydro-geological survey to assess groundwater resources within the river valley of Banda Aceh, and within water catchments around Calang, Meulaboh and Sigli.

After completion of an airborne geophysical survey (electromagnetic) and a hydro-geological reconnaissance survey maps were produced of the groundwater system to assess levels of saltwater contamination and potential yield. The data and all maps were made available to the rehabilitation and reconstruction community at the completion of the project in 2006.

2.2.9 Japanese International Cooperation Agency

The Japanese International Cooperation Agency (JICA) provided assistance to the BRR to prepare a draft spatial plan at 1:10,000 scale for Banda Aceh. Using post Tsunami high resolution satellite imagery from Ikonos and Quickbird new maps at 1:2000 scale were prepared for the most damaged sub districts of Banda Aceh. These maps included details of proposed new roads and land use activities. The data sets were integrated in a geographic information system (GIS) named Aceh Rehabilitation and reconstruction Information System (ARRIS) and, in 2005, was also provided to the United Nations Information Management (UNIMS) for dissemination to the wider reconstruction community.

2.2.10 Norwegian Government

The Norwegian Government, through it development agency Norad, funded Bakosurtanal to complete new imagery capture campaign and topographic mapping at 1:5,000 to 1:10,000 scale across 6500 sq km of NAD including the Tsunami affected area. After ortho-rectification of the 25cm resolution imagery, acquired in June 2005, topographic line maps (TLM) and digital elevation models (DEM) were derived.

The project was completed in April 2006 and the orthophotos and TLM data were provided, in August 2006, to the BRR for further distribution to the rehabilitation and reconstruction community via its SIM-Centre.

3 The NORAD funded Orthophoto project

The NORAD funded orthophoto project was initiated at the request of Indonesia's National Coordinating Agency for Survey and Mapping in January 2005. As detailed in section 3.1, the project to complete the capture of approximately 6500 sq km of digital imagery for the creation of 1:10,000 scale orthophotos was granted and funded by the Norwegian Government in March 2005. Although the onset of the project suffered from unforeseen delays, the project was completed in April 2006, and data was available to the rehabilitation and reconstruction community in August 2006. A fuller project chronology is presented in section 3.3. Upon delivery of the project deliverables to the BRR data access and dissemination was ensured to the rehabilitation and reconstruction community across NAD at no cost by the BRR's Spatial Information & Mapping Centre.

3.1 Project Overview

Following the International Aid conference in response to the Tsunami held in Jakarta, Indonesia, on the 4th and 5th January 2005, the National Coordinating Agency for Surveys and Mapping (Bakosurtanal) applied to the Norwegian Royal Ministry of Foreign Affairs (MFA) for a grant for a project to establish base maps and imagery required for the recovery of the devastated parts of Sumatra. The project was named "Creation of an emergency GIS for the Rehabilitation and Reconstruction of Nanggroe Aceh Darussalam (NAD) and Northern Sumatera (SUMUT)" Ref [6].

The project was funded in March 2005 by the Norwegian Agency for International Development (NORAD) with a grant of 13.700.000 NOK (1,729,798 Euro) being awarded to Bakosurtanal.

The project consisted of acquisition of aerial photography with a digital camera; survey of ground control points; production of digital terrain model (DTM); production of digital orthophotos and production of a digital base map in two different map scales. These deliverables are summarised in Table 2. The coverage of the project is shown in Figure 1. The project also saw for the delivery of a Geographic Information System (GIS) to handle the map data and imagery.

Description	**Coverage Area**
Aerial photography	6000 sq. km
DTM	6000 sq. km
50 cm. Orthophotos	5500 sq. km
25 cm. Orthophotos	500 sq. km
1:10,000 line mapping	3000 sq. km
1:5,000 line mapping	450 sq. km

Table 2: NORAD funded Orthophoto Project Deliverables

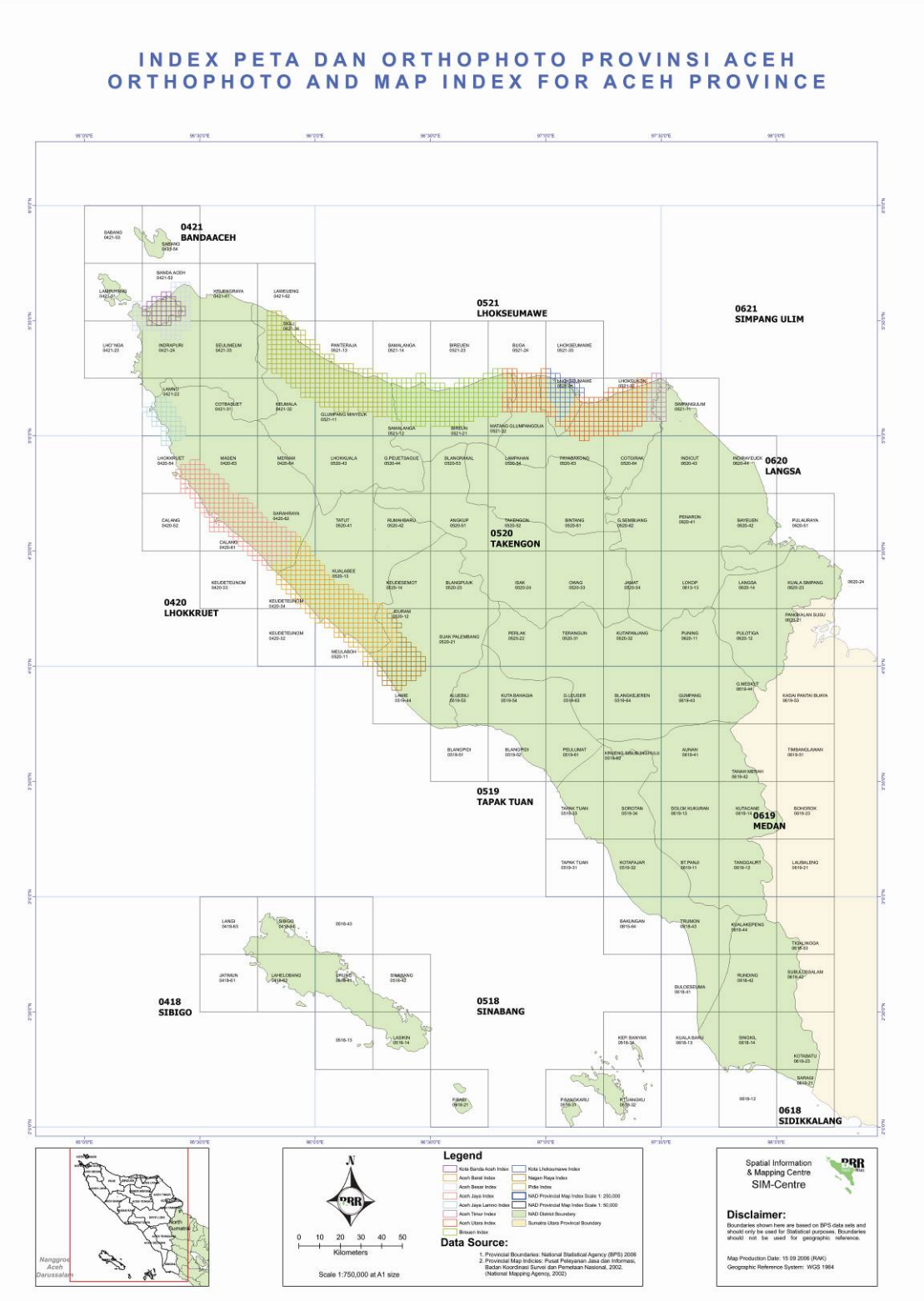

Figure 1 Location of NORAD orthophotos (case study data set) shown as small coloured boxes on coastal areas of Aceh Province (NAD)

3.2 Potential Data Users

The purpose of the project was to provide updated and reliable information on the actual status of the Tsunami affected and surrounding areas. The up to date spatial information provided by the project was seen to be crucial for the efficient use of the

emergency aid funding, creating the base for the planning of the aid programmes as well as for monitoring and evaluating the programmes as they reconstruct and rehabilitate the province.

Aside from the general planning and coordination enabled by the use of spatial data a number of specific projects were identified as being key users of the data:

- Town planning;
- Land titling;
- Infrastructural Reconstruction (harbours, dams, roads etc., including cut-and-fill calculations).

Noting that all detailed engineering design (DED) for infrastructural projects (i.e. at scales better than 1:5,000) would have to be followed up by dedicated field surveys prior to implementation of final rehabilitation and reconstruction projects

3.3 Project Chronology

The project was initiated at the request of Bakosurtanal in January 2005, a grant was made available in early March 2005 by the Norwegian Agency for International Development (NORAD), and the project contractor (BLOM Info) was hired in mid March 2005.

After a number of delays (due to issues obtaining correct military security clearance for permission to fly) the flight campaign was started in late May 2005. Image acquisition was completed in July 2005, and imagery delivered to Bakosurtanal in September 2005. The first orthophoto mosaic (Banda Aceh) was delivered in mid November 2005, the orthophoto mosaic for West Coast in January 2006, and finally the East Coast in April 2006. A small number of areas were deemed to be of a nationally sensitive nature and were not given military approval for release. These areas were not included in the delivered orthophoto mosaics. Final deliverables were completed to Bakosurtanal in April 2006. The total invoiced cost of the project was just over 1.43 Million Euro

Project deliverables consisting of orthophoto mosaic and line mapping were provided to the BRR (Spatial Information & Mapping Centre, SIM-Centre) by Bakosurtanal for distribution to the aid and recovery community in Aceh in mid August 2006. Digital Elevation Models (DEM or DTM) were not provided for distribution by Bakosurtanal. A more detailed project chronology is provided in Table 3.

Date	Event
04/01/2005	International Aid Conference in Response to 26/12/04 Tsunami, Jakarta
12/01/2005	Bakosurtanal application to Royal Norwegian Ministry of Foreign Affairs (MFA) for project "Creation of an emergency GIS for the rehabilitation and reconstruction of Nanggroe Aceh Darussalam (NAD) and Northern Sumatra (SUMUT)"
04/03/2005	Letter of exchange established between Royal Norwegian Embassy (Jakarta) and a grant of 13.700.000 NOK (1,729,798 Euro) awarded to Bakosurtanal. Funding provided through Norwegian Agency for International Development (NORAD)
16/03/2005	Bakosurtanal and Blom ASA sign contract to initiate project
05/2005	Initial grant payment (75%) by MFA to Bakosurtanal
27/05/2005	Start of Aerial Photo acquisition campaign
12/07/2005	All raw data from completed aerial photo flight was handed over to Bakosurtanal
21/09/2005	Delivery of all imagery including Global Positioning System (GPS), Inertial Navigation System (INS) data after Aerial Triangulation (AT)
10/2005	Final grant payment (25%) by MFA to Bakosurtanal
16/11/2005	Delivery of Orthophotos and Digital Terrain Model (DTM) and 25 cm orthophotos for 537 sq. km (Banda Aceh and Lamno)
30/01/2006	Delivery of Orthophotos and Digital Terrain Model (DTM) and 25 cm orthophotos for 2285 sq. km (West Coast)
22/03/2006	Line mapping 1:5.000 for 537 sq. km (Banda Aceh, Lamno)
19/04/2006	Delivery of Orthophotos and Digital Terrain Model (DTM) and 25 cm orthophotos for 3427 sq. km (East Coast)
25/04/2006	Delivery of line mapping 1:10.000 for 3015 sq. km (West Coast and East Coast)
17/05/2006	Approval of Emergency GIS hardware and software installed at Bakosurtanal
14/08/2006	Delivery of all orthophotos and line mapping data by Bakosurtanal to BRR, Banda Aceh (Spatial Information & Mapping Centre)

Table 3 Chronology of Events and Deliverables for NORAD funded Orthoimagery for NAD

3.4 Data Distribution to the Rehabilitation and Reconstruction Community

In mid August 2006 the Spatial Information & Mapping Centre (SIM-Centre) of the BRR were tasked by Bakosurtanal to be the point of distribution for the orthophoto mosaic and line mapping data to all agencies within the rehabilitation and reconstruction community in NAD.

The data set is regarded as a national data set and as such comes under strict Military and National Security control. Due to this sensitive nature of the data, stringent procedures comprising user registration, verification of requirement for data, and data user agreement, were established at the SIM-Centre to ensure that rigorous tracking of primary data users was maintained.

At the end of 2006 the GIS software that was also delivered to Bakosurtanal was customised and installed at the SIM-Centre, BRR. The software, a web based solution (WebGIS), was based on Open Geospatial Consortium (OGC) compliant Open Web Source (OWS) architectures and enabled clients simple and direct access to the

orthophoto mosaic, without the need for costly or technically demanding software installations.

Limitations in bandwidth, and connectivity issues, across Banda Aceh and NAD initially restricted this application to an intranet application accessible only within the BRR, but the improvements in IT infrastructure across NAD in 2007 and 2008 saw the application move to a more accessible and stable platform within the Governor of Aceh's office (http://www.webgis.nad.go.id/).

In this manner the SIM-Centre ensured that the rehabilitation and reconstruction community had access to data in three manners:

- Data could be provided in digital format ready to be integrated into clients in-house GIS solutions (primary data user)
- The data could be provided as customised hardcopy (printed) or softcopy (digital) made to order bespoke maps (secondary data user), or
- Data could be accessed digitally and queried on-line (secondary data user).

The provision of the case study data, or creation of maps from the case study data, and the on-line access to the case study data was provided, by the SIM-Centre, at no cost to the rehabilitation and reconstruction community.

Bakosurtanal also maintained its own methods to distribute the data to the rehabilitation and reconstruction community in NAD.

4 Overview of Data Users and Data Usage

As noted in section 3.4 the data set was either distributed directly as an electronic data set to users, was provided as a customised product or access was enabled for users electronically via intra, or internet applications. Users who were given digital (soft) copies of the data set are termed primary data users, whilst users obtaining the data in another manner are termed secondary data users.

During the period August 2006 to July 2008 there was a total of 99 recorded primary data users and over 635 secondary data users. It is also noted that the data set was used as a core data set in GIS training provided to local government officials, and as such a wide range of professional and semi professional spatial data users were also exposed to the data set.

4.1 Primary Data Users

During the period August 2006 to July 2008 the SIM-Centre provided the orthophotos and associated data (line maps) to 79 users. The usage category and organisation type are summarised in Table 4 and Table 5. It is also known that Bakosurtanal provided orthophoto data sets to 20 further projects but due to insufficient information concerning project type or data usage from 18 of these projects they are not included in Table 4 and Table 5, and are not included further in this study

The total number of primary data users (projects) included within this survey is therefore 81. This comprises 79 primary users with the data set provided by SIM-Centre, and 2 primary users with the data set provided by Bakosurtanal.

Primary data users were obliged to provide project details, which were confirmed with independent project registration maintained within the Recovery Aceh Nias Database (RAND) of the BRR. For this study the description of the project type (usage category) has, where possible, been categorised using the DAC5 coding (Development Assistance Committee Coding Scheme 5) maintained by the Organisation for Economic Co-operation and Development (OECD). This categorisation is an integral part of the OECD's credit reporting system (CRS) and the DAC5 project type coding for humanitarian aid projects is the current standard between Official Development Assistance (ODA) agencies and the United Nations (UN)[5]

The four largest usage categories, as shown in Table 4, are for Urban or Rural Planning (other multisector), Environmental Protection, Project Planning and Transportation and Storage projects.

[5] For more information please refer to the United Nations Development Programme (UNDP) Development Cooperation Analysis System (DCAS)

Usage Category	Notes	DAC5 Code	Percentage of total
Agriculture		311	1.23
Basic Health	Malaria Monitoring	122	1.23
Data Provider		-	1.23
Forestry	Reforestation	312	1.23
Environmental Protection		410	16.05
Other Multisector	Urban and Rural Planning	430	48.15
Project Planning		-	7.41
Reporting		-	3.70
Research		-	4.94
Transport and Storage	Road Construction	210	6.17
Unallocated/Unspecified		998	4.94
Water Supply and Sanitation	Water Supply Systems, Basic Water Supply	140	3.70

Table 4 Orthophotos Users by Project Category

Similarly a categorisation of the primary data users by organisation type is presented in Table 5. In this study organisations have been categorised in the following manner:

- **GOI:** Government of Indonesia, including the BRR and any Indonesian Government agency
- **Donor:** A funding agency not directly responsible for the physical implementation of projects e.g. United States Agency for International Development (USAID)
- **IO:** International Organisation, or Intergovernmental Agency e.g. Asian Development Bank (ADB), International Organisation for Migration (IOM), or International Federation of Red Cross and Red Crescent Societies (IRFC)
- **NGO:** Non Governmental Organisation[6], includes International Non Governmental Organisation, and implementing arms of government e.g. German International Development Agency (GTZ)
- **UN:** United Nations Agency i.e. United Nations Development Programme (UNDP)
- **Others:** Including Universities or private contract Companies not working for any of the organisations mentioned in the other categories.

[6] also known as “not for profit organisations”

Organisation	Percentage
Government of Indonesia (GOI)	37.04
Donor	7.41
International Organisation (IO)	6.17
Non Governmental Organisation (NGO)	27.16
United Nations (UN)	13.58
Others	8.64

Table 5 Orthophotos Users by Organisation

As shown in Table 5 the three main organisation types that requested use of the case study data set are Government of Indonesia, Non Governmental Organisations and the United Nations.

4.2 Secondary Data Users

Although not all agencies within the rehabilitation and reconstruction community had in-house expertise (specifically GIS expertise, or software) to manage the case study data set, there was still a requirement for access to products derived from the case study data set. In general, these products were created upon request and delivered to the requesting agency by the SIM-Centre.

Once the case study data set had been transformed into a spatial data product i.e. a map or incorporated into a GIS data set, other than the electronic data sets (deliverables) mentioned in Table 2, it is termed here as secondary data. Although there was no requirement by Bakosurtanal to maintain a rigorous track of these secondary data users they are included in the following brief sections in this report.

4.2.1 Creation of Maps

A total of 113 maps were created and delivered to agencies within the rehabilitation and reconstruction community (SIM-Centre 93%, Bakosurtanal 7%). As shown in Table 6 large format maps were the most frequently requested, with the largest demand coming from NGO's Table 7.

This summary only includes maps that were created solely from the case study data set i.e. the orthophotos, and does not include maps that used GIS data or topography created or derived from TLM and DEM deliverables mentioned in Table 2. The summary also does not include maps that used the orthophotos purely as a means of visualisation of local topography e.g. simple visit and route maps.

Map Size[7]	Percentage
A4	10
A3	17
A2	8
A1	64

Table 6 Secondary Data Users: Orthophoto Maps Created[8]

Organisation	Percentage
Government of Indonesia (GOI)	43.5
Donor	
International Organisation (IO)	
Non Governmental Organisation (NGO)	50.5
United Nations (UN)	3
Others	3

Table 7 Secondary Data Users: Orthophoto Maps Requested

4.2.2 Access to on-line web mapping application

An on-line web mapping application, enabling access to the case study data set was initially hosted as an intranet application by the SIM-Centre at BRR. Due to numerous problems with local power outages and instability of local intranet within BRR no records were maintained concerning the number of users accessing the BRR intranet application.

In 2008 as the IT infrastructure across the province of NAD became more stable (as noted in section 3.4), the on-line intranet application originally hosted by the SIM-Centre was moved to an internet application hosted from the office of the governor of Aceh. During the first two months of its operation from July to August 2008 the web application hosted at http://webgis.nad.go.id/ saw approximately 100[9] instances of use.

4.2.3 Training Data

The case data set was also used, in part, as a training data set during 19 of the GIS training courses provide by the SIM-Centre of the BRR to a total of 422 local government staff. As such, the professional and semi-professional spatial data users participating in the training courses can be considered to be secondary users of the case study data set.

[7] Based on standard "A format" ISO 216 paper size

[8] not including Bakosurtanal clients, for which no information was available

[9] Noted from the host server access logs as unique IP addresses actively accessing the application website

5 Example uses of the case study data

A sample of the primary data users were informally interviewed to obtain a broader picture of how the case study data had been used within their projects. The sample of primary data users that were selected for interview was selected from the members of the GIS User Group forum. The GIS User Group forum was an open group representing the interests of all professional GIS and spatial data users across the rehabilitation and reconstruction community. The sample of primary data users are representative of the professional GIS and spatial data users within the rehabilitation and reconstruction community within NAD.

The interviews were conducted in person by the author with the technical manager of each project, and the results of the interviews are presented in the following sections. Comments raised and points discussed in the interviews were used to aid in the design of the questionnaire (see section 6), which was later distributed to all primary data users.

5.1 Asian Development Bank – Earthquake and Tsunami Emergency Support Program (ETESP)

The Earthquake and Tsunami Emergency Support Project (ETESP) of the ADB used the case study data in four of their projects. The data was used to support their Spatial Planning and Environmental Management project, Agriculture Sector, Fisheries Sector and Road and Bridges project. Specifically the projects looked to the preparation of Kecamatan Action Plans (sub-district level), for 19 Sub-districts; the rehabilitation and reconstruction of livelihoods assets post Tsunami in both agriculture and fisheries sectors; support to fisheries rehabilitation across 11 district and towns in Aceh and Nias and the creation of the design and project preparation documents for 22 km of road segments on the East Coast Road of NAD and the within the city of Banda Aceh.

The four projects had over 125,000 direct beneficiaries and cost a total of over 79 Million Euro. The case study data was used, to some extent, in all five phase of the project lifecycle (i.e. project initiation, planning, operation, monitoring and evaluation and project closure) across each of the projects, but was most significantly used in the operational phase of the projects. Over 85 maps were created within the projects from the case study data set and GIS data sets were also derived.

The case study data set was deemed to be a critical factor in the successful completion of one of the projects, whilst the case study data set supported the completion of the other three projects. In the case where the data was considered to be critical to the successful completion of one of the projects, it was estimated that it would have cost 12,000 Euro to obtain the same information from a different data source.

The main issues that were raised about the use of the case study data set concerned;

- Long delivery time for the orthophoto product, meaning that the data set could not be used in project initiation phases,

- Given the quick developments of reconstruction and redevelopment in the Tsunami affected areas data was out-of-date, and
- Incomplete coverage by the case study data set of coastal areas that were also affected by the Tsunami

5.2 German International Development Agency (GTZ)

The German International Development Agency (GTZ) used the case study data in three of their projects. The case study data was used in their Support for the Local Governance for Sustainable Reconstruction (SLGSR) program for spatial planning activities. The three projects looked at sub district planning, integrated spatial planning for regional development planning and a development planning forum. The projects supported over 100,000 beneficiaries and cost over 400,000 Euro to implement. The case study data was used all of the five project phases, with the data being of most use in the planning and operation phases of the projects.

The main priority activities that the case study data were directly used for included: creation of village maps for collection of input from local community and stake holders, Atlas development, site survey for current land use, development and creation of land use map, creation of maps for public consultation and bottom up planning, identification and delineation of sub-district boundaries, and as input for sub-district spatial planning

The case study data was seen to be critical in the development planning forum whilst it supported the completion of the other projects. Within the development planning forum it was used to create an atlas to showing proposed planning by local communities and it was estimated that it would have cost some 16,000 Euro to obtain the same information from a different data source.

5.3 Management of GeoHazards in Nanggroe Aceh Darussalam (ManGEONAD)

The ManGeoNAD project is part of the German Indonesian technical cooperation between the Indonesian National Geological Agency, the Department for Mining and Energy for NAD (Distamben) and the German Federal Institute for Geosciences and Natural Resources (BGR). The project focuses on the collection and preparation of geological base data for the reconstruction process, provision of technical information and expert knowledge for spatial planning institutions, institutional strengthening, and has a comprehensive focus on the awareness raising of the population about natural hazards and geo-risks across NAD.

The case study data set was widely used in the project, largely in the planning and operational phases, and was considered to be critical to the successful completion of the 4 Million Euro project.

The data was used in the production of (potential) risk maps, to assist site selection to identify areas for excavation of raw construction materials, to assist for site selection for fresh water well drilling for various NGO's, for site selection for location for seismic measurements, for site selection for transient electromagnetic surveys (TEM), as training data in GIS training courses, as visualisation data in maps and as sample and verification data to support remotely sensed data sets. The case study

data set was incorporated in a GIS and it is estimated that maps created were used in excess of 150 times throughout the project.

To obtain the same information for other sources is estimated to cost in excess of 60,000 Euro. In general there were no issues with the use of the data, but it was noted that spatial accuracy of the data in some cases was not sufficient, and that data attributes, specifically in the TLM data sets was not complete.

5.4 United Nations Development Programme UNDP - Tsunami Recovery Waste Management Programme

The United Nations Development Programme (UNDP) through its Tsunami Recovery Waste Management Programme (TRWMP) began the program for the Agriculture land clearances in January 2006. The program cost over 1.5 Million Euros and support 2600 families as direct beneficiaries.

At the time of this report there remains an estimated 26,000 ha (260 sq km) of agricultural land which cannot be cultivated due to heavy deposits of sand, silt and debris blanketing the land, and blocking the irrigation channels and drains. In places the deposits can be up to 50cm thick and heavy equipment is required to assist the farmers to clear the land and restart agriculture. The TRWMP has used numerous spatial data sets, including the case study data set, to locate areas in greatest need of land clearance, and to work with farmers and community leaders to demark field boundaries, canals and drains.

The case study data is also used as a primary mapping tool to determine areas and potential volumes of waste that must be moved and to prepare clearance plans. This information is critical for preparation of heavy equipment contracts required for land clearance. The case study data is critically used primarily for project planning, operation, and monitoring and evaluation and is estimated that it would cost approximately 200,000 Euro to obtain the same information from different sources. There were some minor issues with the case study data being affected by cloud cover.

6 Design and Delivery of Questionnaire

The questionnaire 0 was designed to retrieve information from the case study data users to determine answers to the following study questions:

Study Qu. 1. Which category of organisation were the main users of the case study data?

Study Qu. 2. What type of project required the case study data and how was it used within projects?

Study Qu. 3. At which phase of the project life cycle was the use of the case study data most significant?

Study Qu. 4. What was the benefit of using the case study data?

Study Qu. 5. What were the problems with the case study data set?

The following section outlines the design of the questionnaire, the aims of the questions within the questionnaire and details how, and to whom, the questionnaire was delivered.

6.1 Design of the Questionnaire

The questionnaire design was intentionally simple to encourage a high completion and return rate. The respondents were encouraged to respond by providing clear examples of responses to the majority of questions and where possible a number of predetermined responses to questions were included. In questions with multiple responses a clear ranking of the responses was required and explained. The questionnaire was tested and modified before being finalised, translated into Bahasa, Indonesian and distributed.

The design of the questionnaire showing the logical flow of responses is presented in Figure 2, with the English version of the questionnaire being presented in 0 Only four of the eleven questions were expected to be completed by all primary data users, as noted by the shaded boxes in Figure 2.

One of the following four outcomes were expected from each questionnaire distributed to the primary case study data users:

Outcome 1: No response

Outcome 2: Case study data set was acquired by user but not used in project

Outcome 3: Case study data set was acquired and used by user but its use was not critical to the successful completion or operation of the project

Outcome 4: Case study data set was acquired and used by user and its use was critical to the successful completion or operation of the project

From outcome 2 the respondent would only complete five questions: 1, 2, 3, 10 and 11. From outcome 3 the respondent would complete nine questions: 1,2,3,4,5,6,7,9,11, and from outcome 4 the respondent would complete ten questions: 1,2,3,4,5,6,7,8,9,11.

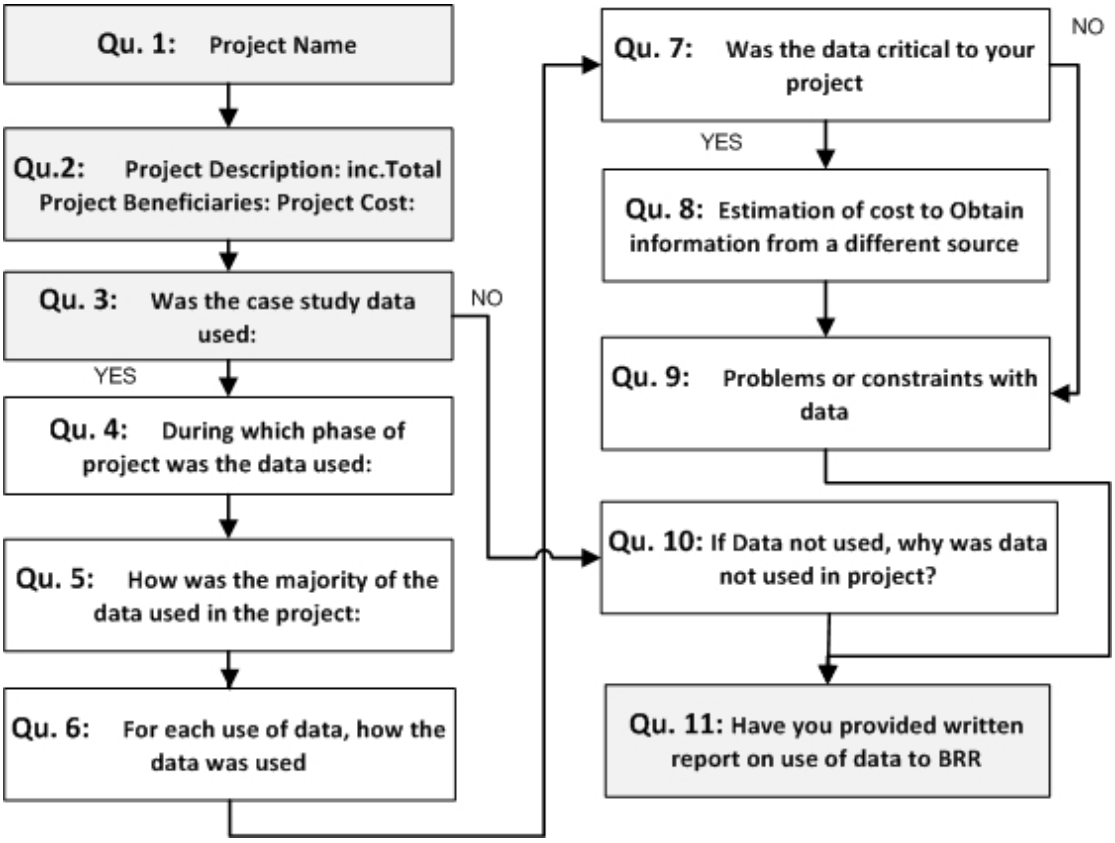

Figure 2 Questionnaire Design, showing logical flow of responses

6.2 Question Objectives

With the exception of self explanatory questions this brief section provides an overview of the objectives of the questions contained in the questionnaire 0:

Question 2: Aimed at retrieving a short narrative about the project, its' aims and objectives, and specifically requested details on the total number of project beneficiaries, the area (sq km) covered by the project, the project duration (months), and the total project costs (expressed either financially or in terms of months of effort allocated to the project).

Question 3: Determines if the case study data was actually used within the project.

Question 4: Aimed at retrieving information during which of the standard five phases of the project lifecycle (i.e. project initiation, planning, operation, monitoring and evaluation and project closure) was the data used. If the data was used in more than one phase, then a ranking of importance of use (most important 1, least important 5) was requested.

Question 5: Determined if the majority of the case study data was used either as map products or was integrated in a GIS, and requested the frequency of the use of these products.

Question 6: Aimed at retrieving a more detailed narrative on the actual use of the case study data in the project, with a ranking on the importance of the use of the data, as in question 4, being requested.

Question 7: Determined if the case study data was critical to the operation of the project, or just used as a supporting ancillary data set. The use of the case study data

set was deemed to be critical if without the case study data set the project would not run, or the project would not be effective.

Question 8: Where the case study data set was critical to the project, this question aimed at retrieving a narrative on how the information acquired from the case study data set would have been obtained if the case study data set was not available. The respondent was also required to provide an estimate (either financial, or in months of effort) of the cost of obtaining the information from the alternative source they described.

Question 9: Aimed at collecting feedback concerning any problems or constraints with the case study data set.

Question 10: If the case study data set was not used in the project, this question aimed at retrieving the reason why the case study data was not used. For ease of completion five predetermined reasons were provided.

Question 11: The final question was included to prompt all registered case study data users that they were required (by the data user agreement signed upon receipt of the case study data), to provide feedback on the use of the case study data to the BRR.

6.3 Delivery of the Questionnaire

In assessing the benefit of the use of the case study data set, only primary users were contacted as these projects were likely to have made fuller use of the case study data rather than the secondary users. The questionnaire and covering letter, providing an overview of the aims of the questionnaire, were delivered by e-mail to the registered user[10] of the case study data set. Considering the broad spectrum of both national and international agencies recorded as primary data users both covering letter and questionnaire were provided in both Bahasa Indonesia and English.

The questionnaire was created as an MS office word document with dedicated free text fields for responses, and respondents were required to return the completed questionnaire as an MS office word document. All respondents were also required to provide complete contact details to ensure follow up was possible if required.

From the initial 81 case study set primary users, as noted in 4.1, only 48 of the primary users (as recorded in their data user agreement) had valid, functioning e-mail addresses. Of the remaining primary users 23 had bad or invalid e-mail addressed which could not be traced[11] and 10 did not have, or had not provided, e-mail addresses. The questionnaire was delivered to 48 primary users, the respondents being allowed two weeks deadline to respond. Two weeks after the submission deadline a reminder for responses was provided to all who had not responded.

[10] As recorded in the data user agreement between the user and the SIM-Centre

[11] With a large number of consultants working on short duration of contracts within both national and international agencies there was a high turnover of staff in the rehabilitation and reconstruction community, leading to a large number of work related e-mail addresses having a limited duration validity.

7 Summary of Results from the Questionnaires on the use of Orthophotos in Rehabilitation and reconstruction

The following section presents the analysis of the results of the questionnaires that were delivered to primary users of the case study data set.

After looking at the response to the questionnaire, answers to the study questions presented in section 6 are delivered.

7.1 Response to Questionnaire

After follow up with the 48 primary users to whom the questionnaire was successfully delivered, 23 completed questionnaires were received giving a response rate of 48%. All of the respondents stated that their project had used the case study data set to support their project activities in some manner.

A breakdown of the responses received by organisation and project type are presented in Table 8 and Table 9.

Organisation	Percentage Requested data	Percentage Questioned	Percentage Response
GOI	37.0 %	35.4 %	26.0 %
DONOR	7.4 %	6.3 %	8.7 %
IO	6.2 %	4.2 %	17.4 %
NGO	27.2 %	31.3 %	34.8 %
UN	13.6 %	16.7 %	8.7 %
Others	8.6 %	6.3 %	4.3 %
Total Number	**81**	**48**	**23**

Table 8 Responses received by organisation type

Although the largest percentage of the questionnaires were sent out to Government of Indonesia Agencies, the largest percentage of the questionnaires that were completed and returned came from International Organisations and NGO's. The UN Agencies also showed a relatively low return of completed questionnaires.

DAC5 Usage (Code)	Note	Percentage Requested data	Percentage Questioned	Percentage Response
Agriculture (311)		1.23	2.1	4
Basic Health (122)	Malaria Monitoring	1.23	2.1	-
Data Provider		1.23	-	-
Forestry (312)	Reforestation	1.23	2.1	-
General Environmental Protection (410)		16.05	20.8	22
Other Multisector (430)	Urban and Rural Planning	48.15	47.9	52
Project Planning		7.41	6.3	4
Reporting		3.70	4.2	-
Research		4.94	4.2	4
Transport and Storage (210)	Road Construction	6.17	8.3	13
Unallocated/Unspecified		4.94	-	-
Water Supply and Sanitation (140)	Water Supply Systems	3.70	2.1	-
	Total	**100%**	**100%**	**100%**

Table 9 Responses received by project categorisation

The percentage of questionnaires sent to various project types and the percentage of questionnaires received from project types are very similar. The notable exceptions being that no responses were received from projects focusing on basic health, forestry and water supply and sanitation.

7.2 Data Users

Study Question 1: Which category of organisation were the main users of the case study data?

As shown in Table 8 the largest percentage of requests for the case study data came from the Government of Indonesia Agencies, but the results from the questionnaire can only confirm that the GoI were a main user group of the data and that NGO's were the largest user of the case study data set.

7.3 Data Usage

Study Question 2: What type of project required the case study data and how was it used within projects?

The percentage break down of the types of projects that requested and used the data, as shown in Table 9, are very similar. The case study data has been mainly used for Urban and Rural planning purposes, and general environmental protection projects, but the range of projects supported vary from Agriculture, Research, and Transport projects.

The type of activities that were undertaken with the case study data were wide and varied, as demonstrated by the examples presented in section 5. The questionnaire requested a detailed description of the type of activity that was undertaken with the case study data set. The frequency of the use of a number of keywords in the description of the activities were used to analyse the responses, these are shown in Table 10. Only the six most frequent keywords are shown.

Keyword	Occurrence[12]	Percentage
Maps	10	22
Survey	7	16
Identification	6	13
Planning	4	9
Report	4	9
Site Selection	3	7

Table 10 Types of activities undertaken with the case study data set

It is clear that the case study data was used largely for mapping, surveying or identification of features relevant to the projects. From specific responses to question 5 of the survey 95% of the respondents claimed to use the case study data to produce maps, with over 300 uses of the maps, and a further 65% claimed to integrate the case study data within a GIS.

7.4 Timeliness of Data Usage

Study Question 3: At which phase of the project life cycle was the use of the case study data most significant?

The case study data was used across the entire five standard project phases i.e. project initiation, planning, operation, monitoring and evaluation and project closure. The percentage usage of the case study data in the project phases and the relative importance of the use of the case study data (1 important, 5 not important) is presented in Table 11.

	Project Phase				
	Initiation	**Planning**	**Operation**	**Monitoring and Evaluation**	**Closure**
Percent Usage	74	92	87	70	78
Average	3.1	1.6	1.3	2.5	3.1

Table 11 Use of case study data in project phases and relative importance (1 important, 5 not important) of usage of case study data in each phase

[12] Although only 23 questionnaires were completed, each respondent detailed a number of activities. A total of 45 activities were explicitly mentioned.

It is clear that almost all the projects used the case study data in the planning and operational phases of the project, and that the operational and planning phases were where the case study data was of most importance to the projects.

7.5 Benefit of Data Usage

Study Question 4: What was the benefit of using the case study data?

Two methods were used to quantify the benefit of the use of the case study data set. The first method, described in section 7.5.1, uses an attribute from the project to assess the overall benefit of the project and then determines if the use of the case study data was critical to the successful completion of the project.

The second method, described in section 7.5.3, looks at what information was derived from the use of the case study data set and determines the real cost to acquiring that information from another source. This was only calculated where the use of the case study data set was deemed to be critical to the successful completion or operation of the project.

7.5.1 Determination of benefit of the use of the case study data set based on project attribute

The second question of the questionnaire was designed to enable the respondents to provide a number of easily calculated figures, or project attributes, which could be either used directly, or indirectly, to quantify the benefit of the use of the case study data. Respondents were asked to provide the following attributes;

- information on the number of direct project beneficiaries (i.e. number of families, or number of persons, that would receive a direct improvement in their current situation as a result of the completion of the project)
- information on the physical extent and coverage of the project area
- information on the total cost of the project
- information on the duration of the project

Not all respondents provided complete information for the requested attributes. The percentages of responses are shown in Table 12.

Attribute	Percentage Response
Beneficiaries	39
Coverage	74
Duration (months)	91
Cost	87

Table 12 Percentage of respondents providing project attributes

Upon reviewing the responses it was found that the most incomplete and unreliable attribute to determine benefit was that for the number of direct project beneficiaries. As can be seen from Table 12 only 39% of respondents provided this

attribute, and in some cases the responses were overly optimistic; some even claiming that their project directly benefited all the 4,031,589[13] residents in the province of NAD, or all of the estimated 203,998 people who were directly affected by the Tsunami.

It was also found that responses for the attribute of coverage of the project was also unreliable, again, with some responses claiming that their projects had a direct impact on the complete 61,061 sq km of the province, whilst others presented more realistic and verified values.

The attribute for duration of project was the most comprehensibly reported upon by respondents. This attribute was initially included to ascertain if longer running projects had a greater benefit, or if there was a direct link between project duration and project cost. Upon reflection this attribute is very difficult to relate to direct benefit, there is also no direct link between duration of, and cost of projects, and in turn the attribute for duration of project is the most unreliable attribute to use to derive a value of the benefit of the use of the case study data within the project.

Therefore the attribute of cost of project is used as a measure to determine the benefit of the use of the case study data set within the rehabilitation and reconstruction community.

7.5.2 Quantifying benefit of use of case study data by project cost

If the case study data set had been used in the project the project managers were asked to state if the use of the case study data was critical (i.e. without the data the project would not run, or the project would not be effective) to the project, or if the use of the case study data just supported the operation of the project.

From the 23 respondents all projects had used the case study, with 52% of the respondents stating that its use was critical to the operation and successful completion of the project, inferring that the remaining 48% of respondents found that the use of the case study data set supported the completion of their project.

The total cost of projects directly supported by use of the case study data set is provided in Table 13.

Projects Using Case Study Data Set	**Total Project Cost[14]: Millions Euro**
Case study data set critical to project	24.29
Case study data set only supported operation of project	880.59
Total Cost of all supported projects	904.87

[13] BPS, SPAN 2005,

[14] Project costs were identified either as a total financial cost in United States Dollar, (USD), Indonesian Rupiah, (IDR), or Euro, or as a total effort in months. Exchange rates set as daily rate on 08-09-08, see www.xe.com. Only four projects provided project costs as effort. In these cases effort has been cost as 7,000 Euro per month effort (based upon follow up with the project manager, and based on a general average of technical and managerial staff cost)

Cost of project to provide case study data set	1.43[15]

Table 13 Summary of Costs of projects supported by Orthoimagery

7.5.3 Determination of benefit of the use of the case study data set based on cost to obtain same information

All respondents that had stated that the use of the case study data set was critical to the completion of their project were asked to estimate how much it would cost to obtain the same information they retrieved from the case study data set from another source.

The methods to derive the information ranged from traditional geodetic surveys, the acquisition of topographic maps, or through the acquisition and rectification of satellite imagery. The total estimated cost to derive the same information from other sources for the projects that deemed the use of the case study data set to be critical is provided in Table 14.

Case study data set critically supporting completion of projects	**Total Cost: Millions Euro**
Cost of project to provide case study data set	1.43
Cost to obtain same information from alternate source	3.46

Table 14 Cost to obtain same information

It must be clearly stated that Table 14 does not represent the cost of obtaining the same information as contained in the case study data set for the complete 6249 sq. km extent of the case study data set from alternate sources. Rather it just represents the cost of obtaining that information over the extents of the projects that reported they critically used the case study data set.

7.6 Orthophoto Constraints

A number of issues were highlighted in the use of the case study data set. There were a total of 16 constraints noted about the case study data from the 23 respondents. The main points, grouped into six categories, are highlighted in the following sections.

7.6.1 Availability of case study data:

Case study data set suffered from a long delivery time from image acquisition to availability within the rehabilitation and reconstruction community. This led to the data not being available for the project planning phase of projects starting before August 2006.

7.6.2 Data not up to date:

The case study data, acquired in June 2005, was out-of-date by the time it was delivered to the rehabilitation and reconstruction community. This was especially

[15] See section 3.3

noted given the quick developments in rehabilitation and reconstruction in tsunami affected areas

7.6.3 Coverage of Case Study Data:

There were a number of sections of Tsunami affected costal areas that were not included in the coverage of the case study data set.[16]

7.6.4 Spatial Accuracy of Case Study Data:

The case study data set did not meet the spatial (vertical or horizontal) accuracy specifications for all the projects that attempted to use the case study data set[17].

7.6.5 Visual Quality:

Minor sections of the case study data set were affected by cloud cover

7.6.6 Completeness of GIS data:

The TLM and data sets derived from the orthophotos were found not to be complete. This was especially true of the attribute information for the TLM data and the elevation information.

[16] Some sections of Tsunami affected coastal areas that had been flown in the image capture campaign, were not given Military approval for release, see section 3.1.

[17] Noted only for projects requiring very detailing planning (i.e. 1,1,000 scale detailed engineering design for reconstruction of transport networks) – which was out the scope of the original project design of 1:10,000 scale mapping, see section 3.

8 Summary and Discussion

Of the 10 spatial data capture campaigns initiated as a direct response to the disaster wrought by the Tsunami, (reported in section 2.2), only 50% successfully saw the resulting spatial data being made freely available, at no cost and without restriction, to the rehabilitation and reconstruction community.

The NORAD funded orthophoto campaign was one of those successful projects. The project, titled the "Creation of an emergency GIS for the Rehabilitation and Reconstruction of Nanggroe Aceh Darussalam (NAD) and Northern Sumatera (SUMUT)", was completed in April 2006 and the spatial data generated by the project was provided to the SIM-Centre of the BRR, by Bakosurtanal in August 2006.From August 2006 to July 2008 the data set from the project was provided at no cost (by the SIM-Centre and by Bakosurtanal), to 99 projects within the rehabilitation and reconstruction community in NAD. These projects, with their own GIS and spatial data expertise, formed the primary users of this case study data set. The three main organisation types that requested use of the case study data set were the Government of Indonesia (37%), Non Governmental Organisations (27%) and the United Nations (14%). The four largest usage categories were for Urban or Rural Planning (48%), Environmental Protection (16%), General Project Planning (7%) and Transportation and Storage projects (6%).

Over 635 secondary users of the data set (i.e. those requesting only derived products) were identified. These included over 113 requests for large (A1) map products (>60%) to mainly GOI (43%) and NGO (50%) agencies. A large number (>400) of professional and semi professional spatial data users were exposed to the case study data set during GIS training courses.

The responses to a detailed questionnaire, distributed to the primary users of the case study data, show that the main users of the case study data were NGO (35%), GOI (26%) and IO (17%) agencies. The main projects using the case study data set were rural and urban development (52%), general environmental protection (22%) and transport and storage (13%) projects. Over 95% of the respondents used the case study data in the creation of maps which were used over 300 times, and 65% of the respondents integrated the case study data in a GIS.

The primary users of the case study data users reported that the case study data was most important for planning and operational phases of their projects, with approximately 90% of the primary users using the case study data in both of these project phases.

In this study the benefit of the use of the case study data set for disaster recovery has been quantified by using the attribute of the total cost of the projects supported by the use of the case study data. The case study data set, costing 1.43 million Euro to capture and provide to the rehabilitation and reconstruction community, critically supported the successful operation and completion of projects costing a total of over 24 million Euro, and provided support to a further 880 million Euro of projects.

For those projects which could not be successfully completed without use of the case study data set, it was estimated, as detailed in section 7.5.3, that it would have cost approximately 3.5 million euro to acquire the same information from alternate

sources, such as from traditional geodetic survey or derived from satellite imagery. In addition to the extra costs, issues concerning the quality of alternative data, the timeliness of delivery, format, usability etc., come into question. It is very likely that alternative data sources would not be acceptable to the end user.

The timeliness of the delivery of the case study data to the rehabilitation community by Bakosurtanal, almost a year after the delivery of the imagery to Bakosurtanal by its contractor, as shown in Table 3, and nine months after the delivery of first completed section of orthorectified imagery by the contractor to Bakosurtanal, was noted as the main constraint in the use of the case study data set.

Due to the timeliness of its delivery, the case study data set was not available for many projects at their crucial project initiation stages. For example, the case study data was initially identified as being ideally suited for town planning for which, with over 6% of all provincial villages being damaged by the Tsunami, there was a clear and urgent need. This need was also reflected in the sectoral budget for reconstruction and rehabilitation of housing, being the largest of the 13 reconstruction sectors, representing some 26% of the 5.8 billion dollar reconstruction budget allocated by the end of 2006 Ref [2].

When the case data set was officially delivered by Bakosurtanal to the rehabilitation and reconstruction community in August 2006 over 44% of the 150,000 houses required, see Ref [7], had been completed and handed over to beneficiaries. At the same time a further 14,000 temporary houses and transitional shelters were in place, and the majority, Ref [8], of the remaining housing were in late planning stages. These projects completed or in progress at this time, either did not use any spatial data for co-ordination and planning, or, relied upon the use of the out of date 1978 topographic maps, which led to considerable confusion in coordination of activities within the BRR and reconstruction community.

Once the case study data was delivered to the rehabilitation and reconstruction community the case study data was found to be out of date for a number of reconstruction projects. By the time the case study data was made available, it reflected the ground conditions from at least 14 months earlier, meaning planning and coordination using the case study data was either based on data that did not reflect the current situation or that additional ground survey had to be undertaken to verify the actual current situation.

9 Conclusions and Lessons Learnt

The orthophoto case study data set was requested by 99 different projects across Nanggroe Aceh Darussalam during the period August 2006 to July 2008. The largest percentage of the data usage requests came from Government of Indonesia (GoI) and Non-governmental (NGO) agencies, with the main projects using the case study data set being rural and urban development and general environmental protection. Approximately 90% the primary users of the case study data found the case study data to be most important during planning and operational phases of their projects.

The study quantified the benefit of the use of the case study data set by determining if the use of the case study data set was critical to the successful completion of a project, or merely supported the project. Of the project attributes used to quantify the benefit of the use of the case study data set the project attribute that could most reliably verified, and therefore provide the most confident result, was found to be total project cost.

The use of earth observation data has been shown by this study to be of great benefit in disaster recovery. The case study data set critically supported projects worth over 16 times its actual cost and provided support to projects worth over 600 times its actual cost. Over 635 further secondary users of the case study data set were also clearly identified and their use of the data documented, but no attempt was made to assess the benefit of the use of the case study data to this user group.

The most commonly reported problem with the case study data was the late official delivery of the data to the reconstruction community. The delayed delivery of the case study data set to the recovery community meant that the case study data could not be used for sectors of reconstruction projects that had an urgent and timely need for completion. For example planning and coordination activities concerning housing, the major reconstruction activity in post Tsunami NAD, would have greatly benefited from the availability of the case study data set. Instead these projects either did not use any spatial data for co-ordination and planning, or, relied upon the use of the out of date 1978 topographic maps.

In order to determine and report upon the benefit of the use of EO data in disaster recovery, the following recommendations are offered:

- A robust, straightforward procedure must be in place with the EO data distributor that records simple criteria for each of the data users and related projects
- Disaster recovery projects are very dynamic in nature and the information about the projects changes over its lifetime, so the procedure must take into consideration the need to update the project information on a regular, but limited[18], basis
- The project information that the procedure records must be easily, and externally, verifiable

[18] i.e. project initiation and project closure

- All data user contact details must be confirmed and updated
- There must be a punitive measure in place to ensure that reporting is maintained by the data user throughout their projects lifetime
- Wherever possible international standards, such as the use of DAC5 code for project categorisation, should be included in the method

Whilst this report clearly shows that there is a need for the acquisition of EO data and the creation of spatial data in response to a disaster, a number of lessons have been learnt from the spatial data initiatives between Official Development Agencies (ODA's) and the GoI in response to the Tsunami in NAD. To ensure that the spatial data is used to its greatest benefit, it is specifically recommended that any spatial data campaign (undertaken with humanitarian funding), must also ensure the following, prior to the initiation of the campaign:

- A mechanism must be in place to ensure data is efficiently and effectively delivered to the humanitarian aid community in a timely manner;
- The mechanism must be open and accountable to data providers, donors and recovery community;
- The humanitarian aid and recovery community must have knowledge about the availability of the data;
- The spatial data must be freely accessible, either in terms of no cost, or low cost (i.e. data reproduction only), or in terms of unrestrictive licensing of data, to ensure the humanitarian aid budget is not wasted on the duplication of payment for the same data; and
- Ideally the mechanism should consist of a "one stop shop" i.e. a single point for data distribution and information about the data.

10 References

Ref [1]. Global Earth Observation System of Systems: 10-year implementation plan reference document. GEO 209pp, GEOSS, 2005.

Ref [2]. Aceh and Nias, Two Years After the Tsunami, 2006 Progress Report, BRR and partners, December 2006

Ref [3]. 2nd Tsunami Recovery Indicator Package (TRIP) Report for Aceh and Nias, UNORC- IAS October -December 2007

Ref [4]. Australia Indonesia Partnership for Reconstruction and Development (AIPRD) AusAID, Assessment of Priority Mapping Needs Nanggroe Aceh Darussalam and Nias Island, Northern Sumatra, 25th August 2006

Ref [5]. Master Plan for the Rehabilitation and reconstruction of the Regaions and Communities of the Province of Nanggroe Aceh Darussalam and the Islands of Nias, Province of North Sumatera, Ministry of National Development Planning (Bappenas), April 2005

Ref [6]. Final Report for creation of an emergency GIS for the Rehabilitation and Reconstruction of Nanggroe Aceh Darussalam (NAD) and Northern Sumatera (SUMUT), BLOM INFO A/S, June 2006

Ref [7]. Tsunami Recovery Indicators Package(TRIP) For Aceh And Nias, English Edition, UNORC-IAS, BRR, March 2007

Ref [8]. BRR PUSDATIN, August 2008, Pers Comms.

Ref [9]. IIASA Interim Report, IR-08-048, Banda Aceh - The Value of Earth Observation Data in Disaster Recovery and Reconstruction: A Case Study, 27 November 2008. On-line Report, http://www.iiasa.ac.at/Admin/PUB/Documents/IR-08-048.pdf

Annex A. Orthophoto Deliverables

The following tables record the deliverables provided under the project "Creation of an emergency GIS for the Rehabilitation and Reconstruction of Nanggroe Aceh Darussalam (NAD) and Northern Sumatera (SUMUT)" Ref [6].

Description	Deliverable Area	Quantity delivered
Aerial photography	6000 sq. km	6249 sq. km
DTM	6000 sq. km	6249 sq. km
50 cm. Orthophotos	5500 sq. km	5712 sq. km
25 cm. Orthophotos	500 sq. km	537 sq. km.
1:10000 line mapping	3000 sq. km	3015 sq. km
1:5000 line mapping	450 sq. km	450 sq. km

Table 15: NORAD Orthoimagery Deliverables

Delivery no:	Volume	delivered	accepted
# 1	1.000 digital images (500 RGB+500 CIR)	08/2005	15/08/2005
# 2.1 – 2.n	For every 500 set of RGB+CIR digital images up to 5.000 images (10 partial deliveries)	08/2005	16/08/2005
# 3	Remaining digital images, together with all GPS/INS data, results after AT	21/09/2005	21/09/2005
# 4	DTM and 50 cm orthophotos for at least 2500 sq. km (West Coast)	31/12/2005, 30/01/2006	09/02/2006
# 5	DTM and 50 cm orthophotos for at least 3000 sq.km (East Coast)	15/02/2006, 19/04/2006	25/04/2006
# 6	DTM and 25 cm orthophotos for at least 450 sq.km (Banda Aceh, Lamno)	29/09/2005, 16/11/2005	09/02/2006
# 7	Line mapping 1:10.000 for at least. 2.000 sq. km (East Coast)	25/04/2006	25/04/2006
Final	Line mapping 1:10.000 for at least. 1.000 sq. km (West Coast)	25/04/2006	25/04/2006
	Line mapping 1:5.000 for at least. 450 sq.km (Banda Aceh, Lamno)	22/03/2006	22/03/2006
	Emergency GIS hardware and software		17/05/2006

Table 16 Orthophoto Deliverables to Bakosurtanal

Annex B. Orthophoto Questionnaire

The following questionnaire (translated into Bahasa Indonesia and English) was distributed to all project managers who had been identified as the prime responsible data user in the orthophoto data user agreement signed between the data user and the Spatial Information & Mapping Centre, SIM-Centre, BRR NAD-Nias. The survey was implemented between July 2008 and September 2008.

Orthophoto Questionnaire

Please complete the following questionnaire and return to Richard A. Kidd, Senior GIS & Mapping Officer, Spatial Information & Mapping Centre, BRR NAD-Nias. Please return completed word document by e-mail to richard.a.kidd@gmail.com and copy (cc) sim.centre@brr.go.id

Please provide your contact details:

Name:	Please provide your name
Organisation:	Please provide the name of your organisation
E-mail:	Please provide your e-mail address
Phone:	Please your contact phone number
Date:	

Please answer the following 11 questions in the spaces provided. Responses can be entered in areas marked by the grey highlighted text.

Number	Question	Response
Qu. 1:	**Project Name:**	Please type your project name here
Qu. 2:	**Project Description:**	Please provide a brief overview of your project

	Total Project Beneficiaries:	----------	**Coverage of Project (km^2):**	----------	**Project Duration (Months):**	----------
	Project Cost:	----------		**Unit (USD, IDR, Months Effort):**		----------
Qu. 3:	**Did you use the data (aerial imagery, orthophoto) in the project:**	Please Answer either Yes or No If YES please continue from Qu. 4: If NO please continue from Qu. 11:)				
Qu. 4:	**During which phase of project was the data used:**	**Project Phase**		**Data Use and Importance** **Please state when the data was used and please rank response in order of importance: 1 most important, 5: least important**		
		Project Initiation (i.e. proposal to donor, initial identification of potential project sites)		----------		
		Project Planning (i.e. planning and refining project objectives i.e. site selection)		----------		
		Project Operation (i.e. performing site surveying or land identification)		----------		
		Project Monitoring & Evaluation (i.e. monitoring project progress)		----------		
		Project Closure (i.e. final reporting)		----------		
Qu. 5:	**How was the majority of the data used in the project:**	**Creation, or use, of map products**		Please Answer either Yes or No		
			How many times were the maps used		----------	

		Creation of data sets (i.e. for use and integration in a GIS)	Please Answer either Yes or No
		How many times were the data sets used	----------
Qu. 6:	**For each use of data, as noted in Qu. 4:, please briefly state (one or two sentences) how the data was used**	**Usage** **i.e. project planning: production of field survey documents, project closure: creation of maps to include in reporting to project donor)**	**Rank** **Please rank response in order of importance, most important first.**
		----------	----------
		----------	----------
		----------	----------
		----------	----------
Qu. 7:	**Was the data critical to your project (i.e. without the data the project would not run, or the project would not be effective)**	Please Answer either Yes or No If YES please continue from Qu. 8: If NO please continue from Qu. 9:	
Qu. 8:	**If the data was critical to your project please estimate how much it would cost to obtain the same information from a different, or traditional, source (i.e. acquiring**	Please describe how the information would be obtained	---------- ---------- ----------

	the information from a geodetic field survey or purchase of data from other agency or provider)	Please provide an estimate the cost of obtaining the information for a different source (noting cost in either USD, IDR, or Months of Effort)	---------- ---------- Estimated Cost _____
Qu. 9:	**Please note any problems or constraints of the data (i.e. data not spatially accurate, data difficult to visually interpret, data too old)**	Please note any data problems here	
Qu. 10:	**If not used, why was data not used in project?**	**Please select the most appropriate answer**	
		Original need for data not required	Please Answer either Yes or No
		Data too complicated to use	Please Answer either Yes or No
		Technical problem with data	Please Answer either Yes or No
		Data did not provide required information	Please Answer either Yes or No
Qu. 11:	**Have you provided written report on use of data to Spatial Information & Mapping Centre at BRR**	Please Answer either Yes or No	