USE OF HIGH RESOLUTION SATELLITE DATA (IKONOS IMAGERY) FOR LOGISTIC SUPPORT

by

Tri Muji Susantoro, Adji Gatot Tjiptono and **Suliantara**

I. INTRODUCTION

A. *Background*

Many activities must be done before doing the 3D seismic survey. 3D seismic work needs accurate and precise information to minimize the cost and negative impact, and or dispute with the local people. The data needs information on road for moving instrument, bridge, river and Ancient River. Data of landuse and landcover, building, public facility, demographic and administration are required for estimating compensation. The use of remote sensing is a good alternative to achieve this objective.

The 3D seismic survey will involve an amount of labors in the fields where the survey is conducted. During the survey a number of equipments will be planted and connected by wire. Therefore, the seismic survey will directly make contracts with local people and theirs proprietaries for temporary use or damage compensation.

3D seismic survey can be classified as a complex activities, apart from a large number of labors that are needed to carry explosive and equipments which will be used to comply the survey, social problem must be solved first. Especially when the study area is conducted in a well developed area with dense population, cultivation and other utilities. Considering the previous facts, a well plan operation in the office that is supported by detail and up to date surface map is actually needed.

High accuracy and up to date surface map was considered as a critical basic information for the 3D seismic planning. Remote sensing technology with the high spatial resolution satellite data can acquire the latest earth surface data with one meter resolution in relatively short time. Ikonos satellite imagery is one of the high spatial resolution satellite imagery can be chosen and utilized as the main source for providing the surface map.

B. *Objective*

- To map the last condition of an area as the basic information for knowing mainly the landuse and landcover, river, bridge and road taken by Ikonos imagery, the result can be used as a guideline for operational activities such as instrument moving, construction of camp and obtaining the permits.
- To spot sensitive and critical areas/zones.
- To descript the land compensation priority based on sensitivity analysis.

II. MATERIAL AND METHODOLOGY

A. *Material*

The Material which is used consists of the topographic map, Ikonos imagery (Figure 1) demographic and administrative data. Using the Ikonos imagery and supporting by demographic, topographic and administrative data we get the landuse and landcover map, road, river, ancient river, building, private and public facility. The Ikonos processing is carried out using Erdas Imagine as remote sensing software and Mapinfo as GIS software.

B. *Methodology*

Before being analyzed the Ikonos data require geometric correction, so that the geographical condition of the data matches with the one found an earth surface. The geometric correction is done by means of GCP point, taken from the field survey using DGPS to get the highest accuracy of data. The enhancement of the image is done to attained better quality and the result is used for interpretation. From the interpretation, the sensitive zone that requires buffering can be identified.
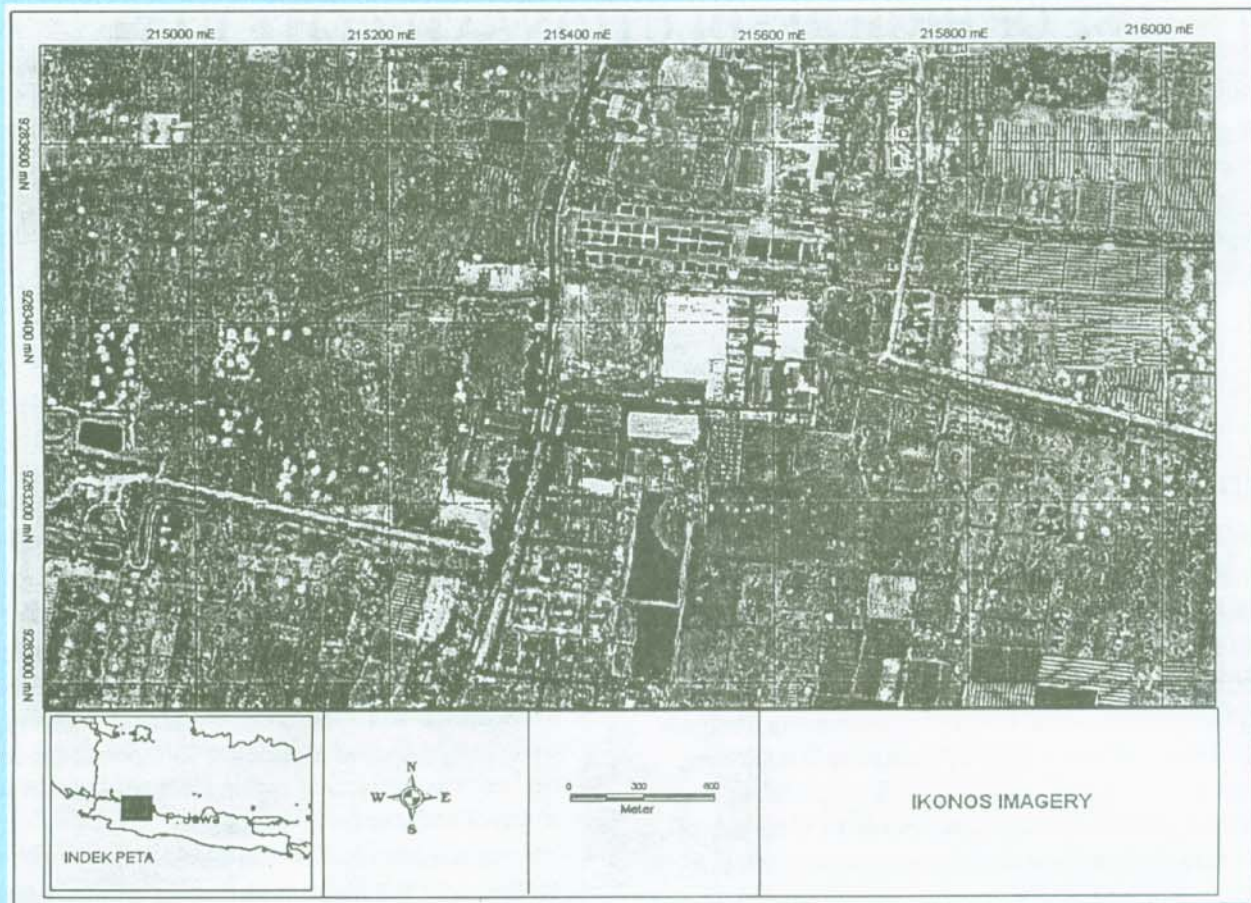
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Figure 1
Sample of Ikonos Imagery

Settlement area requires the analysis of building density using the scoring method, then by overlaying with the shot point position to determine the priority of land clearing. The priority from the land clearance is based on the complexity of the landuse such as land of common law, public and specific facility and their economic value (PPPTMGB "LEMIGAS", 2002).

C. *The interpretation of Ikonos data*

The interpretation of ikonos data is done to produce the landuse and landcover map, road, rivers, bridge, ancient rivers, buildings, public and private facility. The interpretation is made based on the mixing of the color image, pattern, location reflected by Ikonos data (Lillesand and Kiefer. 1979).

The key reference mentioned in Table 1 is used for this interpretation then will be checked with the actual situation in the field.

D. *Data Analysis*

3D seismic survey has to avoid area which is socially sensitive and operationally causes complex problems. The required area is localized by buffering. Every object has a different buffer depending from the characteristic and the type of the object. Beside that, it is also based on influence, which is made by object if damage happened. Object that buffer as sensitive contains: Settlement, Cemetery, Dirt Road, Power line, religious building, main road/highway, oil facilities and Dam. The buffer distance can be seen at Table 2.

Density analysis of building is conducted by counting the number of building per settlement area (Muta'ali, 2000). The calculation can be grouped into 3 categories. This work is conducted automatically using the GIS software (MapInfo). The categories are as follow:

- Low Density

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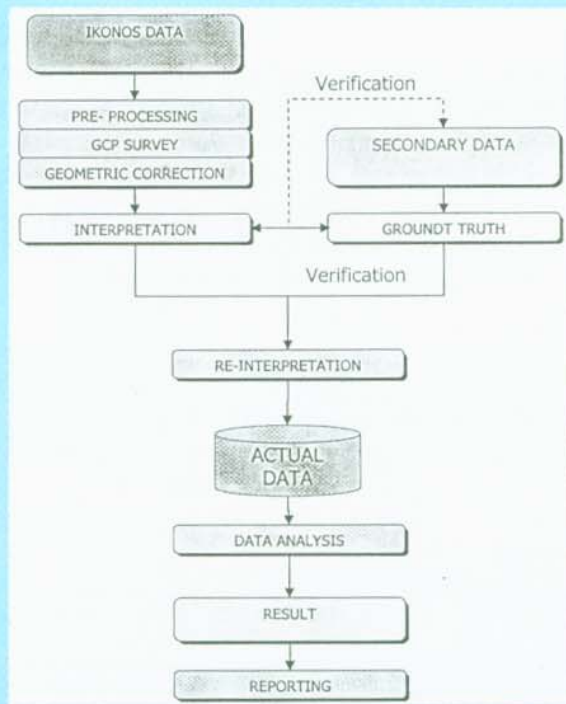- Moderate Density
- High Density

Compensation priority analysis of land is conducted by considering several factors, i.e.: density analysis of building, public and private facility, source line, etc. The calculation used is quantified, so that the highest score and lowest score is known. Priority class for land compensation can be divided into 3 classes, i.e.; first priority, secondary priority and third priority.

III. RESULTS AND DISCUSSION

The Ikonos imagery interpretation yields important information on the logistic support for 3D seismic survey. The logistic support is important because the transportation of the instruments and other materials for working is influenced by the logistics. For example, if there is a bridge we have to find a route of detour because the way is blocked by the big river. We should cutdown the trees in a dense forest as well.

Table 1

The key reference of Ikonos interpretation (PPPTMGB "LEMIGAS", 2003)

No.	Code	Land use	Color	Texture	Pattern	Distribution/Association
1	BL	Bare Land	Bright white	Fine	Irregular	Near river and hill as mining
2	Bs	Bush				
3	Cm	Cemetery	Green to dark	Coarse	Regular	Around of settlement and among of paddy field and or farm
4	DP	Dried Paddy	Bright white	Fine	Regular	Near settlement and warehouse
5	Fm	Farm	Reddish to yellowish	Medium to coarse	Regular and irregular	Not definitely, sometimes overlapped with teakwood
6	FY	Farm Yard	Reddish-Green and yellowish	Medium to coarse	Irregular	Distribute around settlement
7	MP	Mangoes	Green	Medium to	Regular	Irregular, usually around paddy field
8	OF	Oil Facility	Bright white to reddish	Coarse	Regular	Very contract compare with its surrounding
9	St	Settlement	Red, green, blue	Fine-coarse	Regular	Usually lies near road
10	PF	Paddy Field	Reddish-Green and yellowish	Fine-coarse	Regular and irregular (square pattern)	Widely distributed, close to the road, rivers and settlement area
11	PFNI	Paddy Field non-irrigation		Fine-coarse	Regular and irregular (square pattern)	Widely distributed, close to the road, rivers and settlement area
12	Sb	Sandbar	Green	Fine-coarse	Regular with definite or specific line	Near paddy field
13	SC	Sugar Cane	Green	Fine-coarse	Regular with definite or specific line	Near paddy field
14	SF	Sport Facility	Green - reddish	Fine-	Regular	Around of settlement
15	TF	Teak Forest	Green to dark green	Medium	Regular (show as certain pattern) and irregular	At most lies in HPH location and people-cultivated forest.
16	Vg	Vegetation	Green	Fine-coarse	Irregular	Irregular, usually around settlement and burial place.
17	RL	Range land	Reddish-Green and yellowish	Medium to coarse	Irregular	Irregular
18	WB	Water body	Yellowish	Fine	Irregular	Locate in river or especially as Dam.

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Figure 2
Methodology of Ikonos processing
and analysis data

Table 2
Object and Buffer Distance
(PPPTMGB "LEMIGAS", 2003)

Settlement	80 Meter
Cemetery	40 Meter
Dirt Road	20 Meter
Electrict Building/Telkom Building	60 Meter
Religious Building	100 Meter
Main Road	40 Meter
Oil Facility	200 Meter
Dam	200 Meter

Landuse is described as the use of the land which is related to people activities on the specific land. For example; land on edges town is use for family housing, but based on detail information/map, the land is settlement area. Landcover is described as land surface which is related to appearance kinds (Sutanto, 1994). For example; building land, vegetation land etc. The interpretation re-

sult is shown in Figure 3. Landuse and landcover map are used to determine the total cost of land compensation on a 3D seismic survey implementation and to determine the permission required. The permission is submitted to government and other agency depend on the landuse area, for example; plantation, industry and forest. Each of which has a specific property right.

The ikonos imagery interpretation of road describes real condition; it includes type, width and class (Figure 4). The description is supported by field survey and secondary data. It can be used as guideline for instrument moving or to know of road capability. If the location does not has a road, we can plan the road. In the ikonos imagery, road appearance is shown with bright color and fine texture. The road classified into four classes; asphalt road, dirt or stone road, soil road and pathway.

The building interpretation can show building as house, school, office, market and husbandry etc (Figure 5). The building identification is more important for 3D seismic planning, because the dynamite location must avoid this location.

The river appearance in ikonos image is shown in blue color - blue to dark and possible green to dark, fine texture, irregular pattern (Figure 6). Ancient river is area of extinct river flow which formed because scrap processing and sedimentation of at rivers material. This area is indicated as high ground water concentration. The ancient river is usually used as agriculture or settlement (Figure 7).

Ancient River appearance in ikonos image is shown with very clear color with rather smooth texture. Pattern of ancient river is irregular and looks like several river channel boundary with river side seen clear. In several places of Ancient River flood still happen. The ancient river interpretation give benefit to water reserve.

The ikonos imagery interpretation can identify public and or private facility. After it is supported by field survey and secondary data. The public facilities are identified as cemetery, school and market. The private facility are identified as husbandry, industry and oil facility (Figure 8). For Indonesian cases, several object have a specific characteristic, i.e: color, pattern, site and building form, It is easy to interpret. For example market; its shape in the form of building association, regular, the building is dense. The school, its shape as a building forms, a rectangle and possible length building with field in the centre. The cemetery, its shape as big trees association in paddy field, farm or edges of settlement. The interpretation is usefull to avoid social conflict, because

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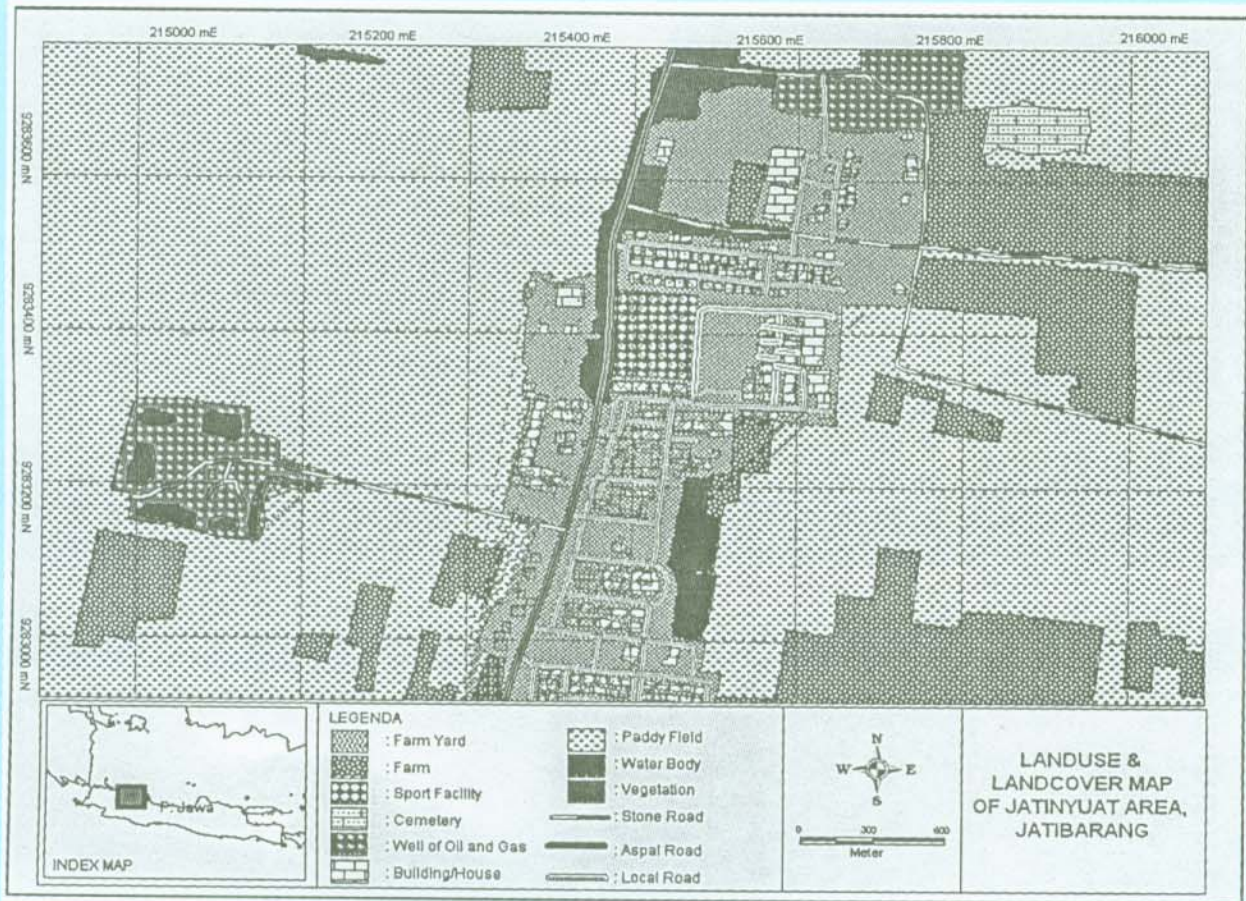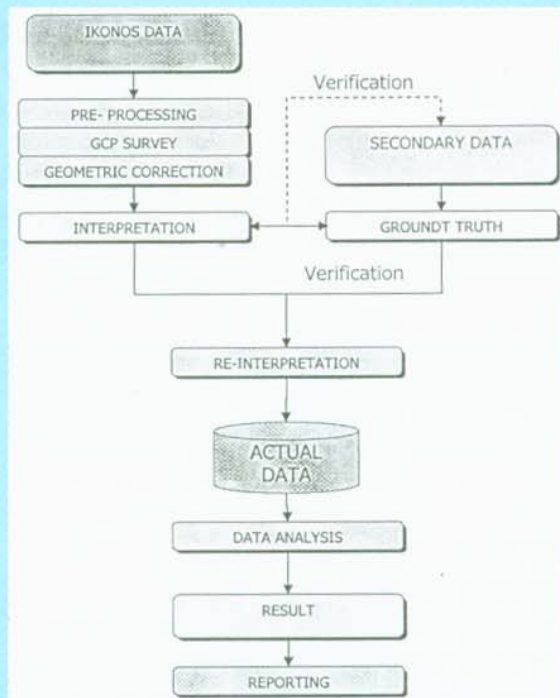VOL. 28. NO. 2, OCTOBER 2005: 29 - 45

Figure 3
Landuse and land cover map

Figure 4
The Road resulted of Ikonos interpretation

Figure 5
The Building resulted of Ikonos interpretation and
its supported by secondary data and field survey

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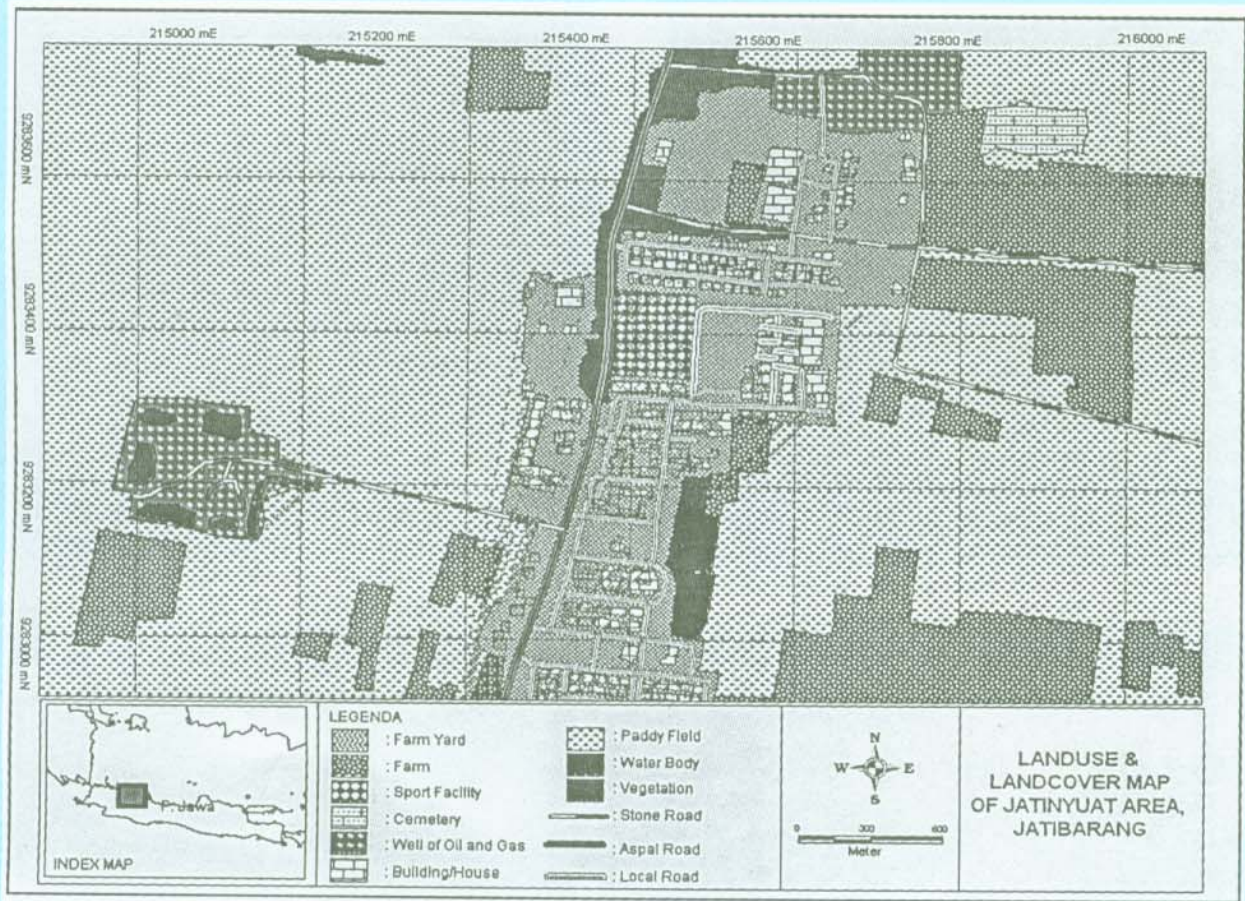VOL. 28. NO. 2, OCTOBER 2005: 29 - 45

Figure 3
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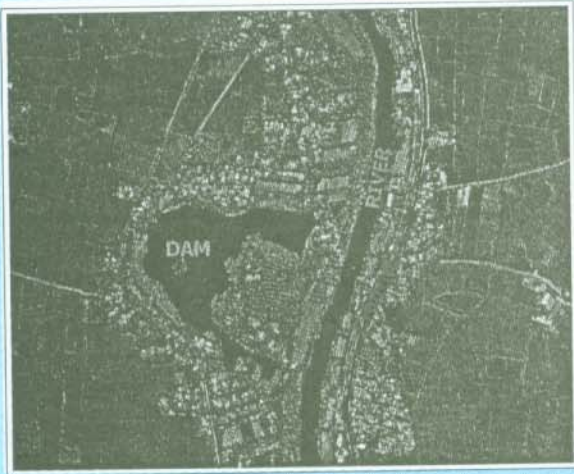its supported by secondary data and field survey

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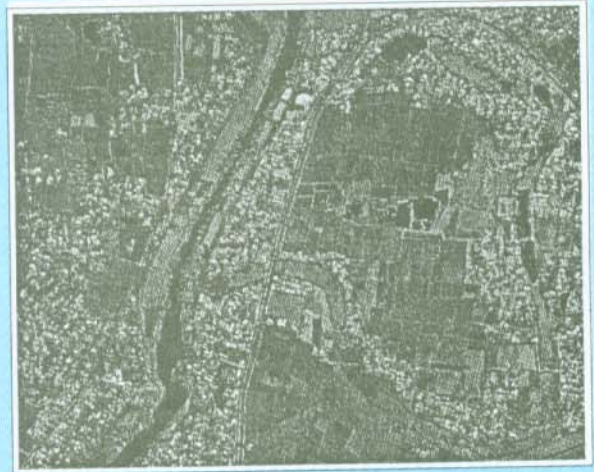TRI MUJI SUSANTORO, et al.

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Figure 6
Sample of river interpretation

Figure 7
Sample of ancient river interpretation
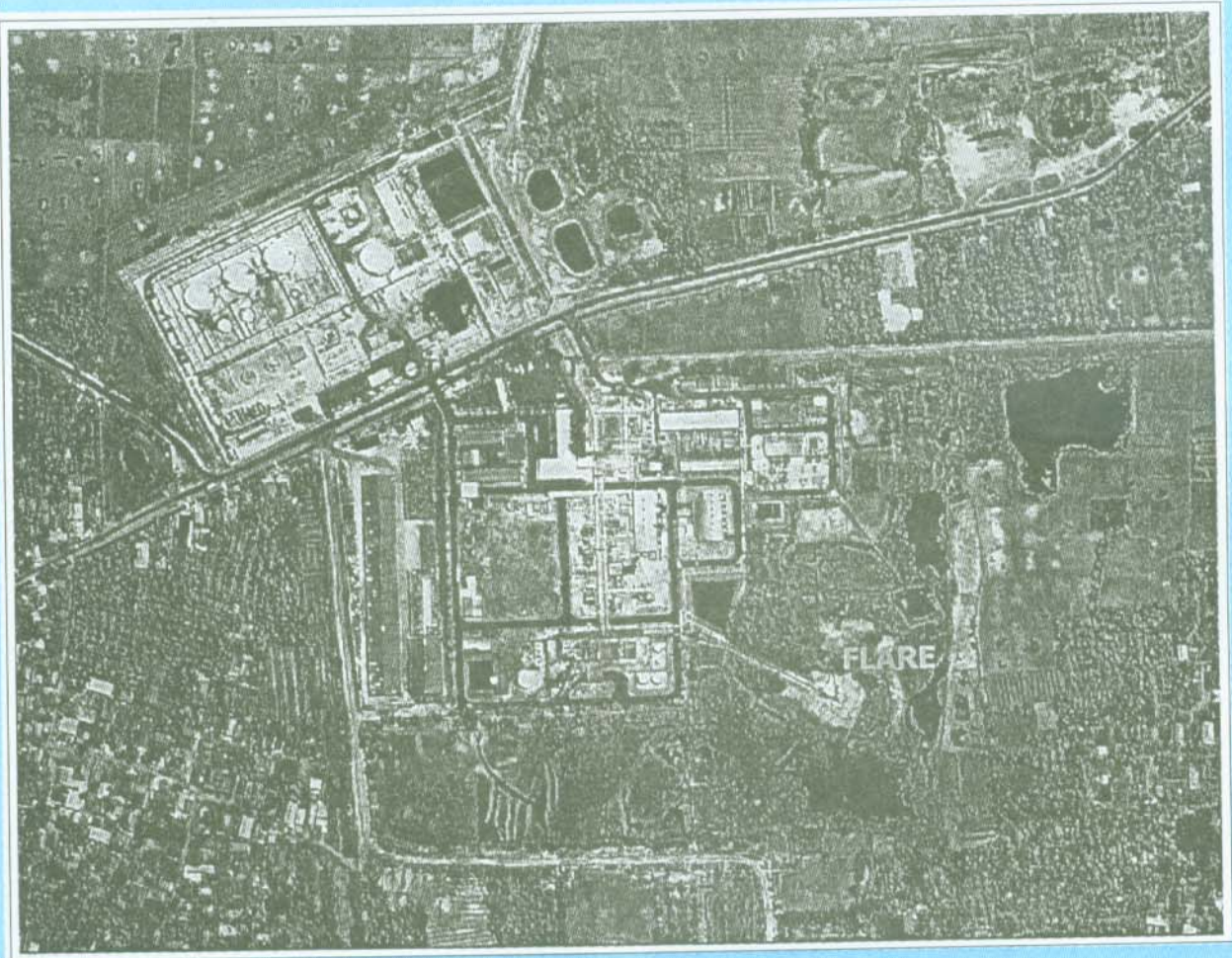
Figure 8
Sample of oil facility

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some places is full of human activities, hence it is susceptible to conflict.

The Analysis mentioned above yields buffer map, density map and priority map. Sensitive zone is the area of susceptible conflict. The zone must be avoided for shot point location. Sensitive zone is the center of human activities and is represented by building, public and private facility, dam, and road. Sensitive zone shall be buffered. 3D Seismic has a detail shot point position and it must not go through a sensitive zone. The shot must be shifted to other area.

The calculation of building density is based on total building per settlement area. It is used to calculate the land compensation priority. Whereas the land compensation will involve many self-interest and is possible to become social conflict of land compensation.

The result of this calculation is used as the first opinion for land compensation. The sensitive area of conflict in the land must be first compromized before the other.

IV. CONCLUSION

The final result of this paper is to provide alternative way for determining certain area which is favorable for 3D seismic survey activities. This area namely, logistics support area, is a proposed area with most high sustainability for seismic survey. This map is needed to minimize damage claim during seismic activity.

Map can be overlaid to produce logistic support area. This overlaying map can influenced seismic activity, i.e. all area or region inside the intersection of all thematic maps, and this area or region can be separated. As an impacts, the chosen area, which is relatively safe for logistic support lies outside the area. Hence, the area for seismic survey also lies outside the buffered area. For geophone plantation, the preferred area is outside the buffered area, also in ancient-river area. This is necessary, since ancient-river has high water-content and better conductor for seismic wave. Recommended area for base-camp is near river area, since seismic activity needs water to supply both survey and field operation.

Logistic support is meant as the product maps of information that is created from interpretation of IKONOS imagery and related field observation for helping planning the seismic survey. It will protect from the dangers of seismic activity, such as: house damages caused by explosion. Particularly, the interpretation is

carried out to produce land use/land cover mapping of the present status with high accuracy.

Several consideration must be taken into account;

- If the array of shot points or Geophone location is dense: In the case of a dense village, city and settlement and local holy or cemetery area or an archeology area, the placement of shot hole should avoid those areas to minimize damages or land clearance or release.

- Daily mobilization – demobilization of heavy equipment or crews are frequently happened. This job needs accessible roads and its apropriate requirement.

- The temporary base camp location. It will be located near river or water bank area since water is needed to supply seismic survey and field operation.

- The area of an ancient river. This area is suitable for water aquifer and will be concerned to plant the geophone or shot hole location.

- Warehouse and dynamite storage location: If accidents happen in this location, the impact should not cause a great affect to the surrounding area and it must be easy to recover or handle.

V. ACKNOWLEDGMENTS

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