SOME FACTORS ATTRACTING NEW ARRIVALS
IN THE URBAN FRINGE AREAS:
A Case Study of Sinduadi, Mlati, Sleman,
Yogyakarta, Indonesia

by
Hadi Sabah Yunos

ABSTRACT

In the discussion on any urban development, one can not neglect the so-called centrifugal and centripetal forces causing the flow of either people and functions from and to the inner parts of the city or the fringe. These two forces constitute the dynamic drive for the development of the city concerned. One of the aspects of urban development is a change in physical performance of the city itself and the operating process of urban features in the surrounding countryside. The study is carried out in one of the portions of the fringe area of the City of Yogyakarta that is receiving many arrivals either from the inner parts of the city or from the more remotely located areas. The discussion is mainly focused on one of these broad aspects, i.e., movement of people either coming from the inner parts of the city and coming from the more remotely located hinterlands. One of the subdivisions, located next to the municipal boundaries is chosen as a case study and the respondents are selected randomly among new migrants in the last ten years. The result shows that nine reasons constitute attracting factors to the fringe areas. Centrifugal movement is pronounced by those who are looking for more spacious space for living and the lower price of land whereas centripetal movement is predominant by those who are approaching their place of work.

INTRODUCTION

Urban fringe areas have been widely studied by many scholars from various disciplines because of their peculiarities. Such areas depict a transition between urban and rural character. The discussion of such area can not be separated from the discus-
sion of urban areas as separate entities and rural areas as different entities. This is the reason why urban fringe areas have attracted many scholars who are interested in urban and rural study as well. Some writers see urban fringe areas as a battle ground between urban and rural front and without any governmental interference, rural front is always defeated. The expansion of urban land use and the retreat of rural land use is the evidence of the process. Slowly or fastly rural areas in the surrounding countryside will change into urban land.

In their manifestations, the transition from urban to rural landscapes can be gradual or distinctive in character. On the gradual transformation one can not identify sharp boundaries between urban and rural character even in terms of physical expression. Non-physical appearances such as economic, social and cultural behaviour are much more complicated and very unclear. Frequently, such non-physical urban values have infiltrated much further into rural areas. As a geographical entity, urban fringe areas can be viewed from many different angles. For better elaboration is suggested to study the works of Wehrwein (1932), Andrews (1942), Kroll (1942), Fory (1944), Rodina (1947), Dewey (1948), Blum (1948), Rappaport (1951), Bogos (1956), Clow (1962), Center and Pick (1960), Crenshaw (1963), Pyry (1968), Hudson (1973), Hassan (1975), Bryant, Breslin and McCubin (1992).

Since the discussion of this article is not to chase the root where urban land ends and where rural land starts, these various perspectives on the characteristics of urban fringe areas are not presented in depth. This article is only to focus its analysis on the attracting factors of the urban fringe areas. In order to facilitate the analysis, the writer adopts the concepts of centrifugal and centripetal forces as proposed by Cobey (1933). Although this concept is uncentered in character (Johnson, 1974) that does not comply with the analysis of metropolitan study anymore, but for small to medium cities where the growth of urban development is still predominated by single business district the Cobey's concept can still be referred to.

TOWARDS AN APPRECIATION OF COBLY'S CONCEPT

The theory was firstly launched in 1933 when he wrote an article entitled "Centrifugal and Centripetal Forces in Urban Geography". He stated that urban land use pattern is constantly changing through alteration of the already established function and the addition of some new ones (Murphy, 1978). The development of urban land use pattern is governed by two kinds of forces, i.e. centrifugal and centripetal forces. These forces, according to the theory, are playing a decisive role in the land use change process within the urban territory and in the urban fringe areas as well.

Centrifugal forces are manifested by a combination of upstream impulses in the central zone and attractive qualities of the peripheral areas (Figure 1). Factors that are encountered in the central zone act as push factors, whereas factors that are existing in the peripheral areas are called the pull factors. The combination of these two factors are creating the centrifugal movement of people and functions. On the other hand, the flow of people and functions coming from the peripheral areas to the inner parts of the city represents the so-called centripetal movement. Centripetal movement comes into existence because of the operation of centripetal forces and these forces are made up of a combination of push factors or propelling factors existing in the peripheral areas and the pull factors existing in the central part of the city. The interaction

Figure 1: The Cobdy's Model (M.H. Bartow and R.G. Newton, 1971: 387)
between these two factors has created centripetal movement of either people or functions from the outer parts of the city or the peripheral areas that are flowing into the inner parts of the city.

Specifically, centrifugal forces (push and pull factors) are manifested in six combined forces, i.e. (1) spatial force; (2) site force; (3) situational force; (4) the force of social evaluation; (5) the force appearing from the status and organization of occupation; and (6) the human equation force. Centripetal forces, he said are made up through a combination of five forces, i.e. (1) site force; (2) functional convenience force; (3) functional cohesion force; (4) functional prestige force; and (5) human attraction force. These two sets of forces viz. centrifugal and centripetal forces are constantly in conflict over time (cf. Murphy, 1974).

As a matter of fact, the operation of these two forces has very broad implications because they involve push and pull factors existing in the area of origin and in the place of destination. In order to limit its scope, this study will not discuss the whole aspects appearing in the interaction between centrifugal and centripetal forces, but will only focus its analysis on the pull factors existing in the fringe areas.

RESEARCH METHODOLOGY AND THE STUDY AREA

The research is carried out in one of the subdistricts located next to the boundaries/municipal boundaries of the city of Yogyakarta (Figure 2). Due to its proximity to an urban center i.e. the city of Yogyakarta, the area receives a lot of urban influences in every aspect of life. Within the last ten years, the growth rate of its population is about 2.5% per year (Munir, 1988). Like other urban fringe areas, the encroachment of urban land uses into agricultural land uses is very pronounced. The decrease of agricultural lands and the increase of non-agricultural lands is the evidence of this process. In 1985 for example, the residential areas were only 280.72 ha and it increased to 281.18 in 1986. Agricultural lands decrease from 280.70 ha in 1985 to 276.36 ha in 1986. For the time being, agriculturists have decreased from 915 (1980) to 563 (1986) and non-agriculturists have increased from 3644 in 1980 to 6298 in 1986 (Statistical Records of the Subdistrict). Respondents are those who come and settle in the study area within the last ten years. The data collection is carried out through a direct communication technique with the respondents who have been selected randomly.

THE FINDINGS

Based on the collected data, each respondent has more than one reason why they are attracted to settle in the fringe areas. Nevertheless, of the entire answers, the respondents can identify the main or strongest attractive force. This study will only deal with the main reason why the respondents have made up their mind to move to the fringe area and settle there. As mentioned in the previous paragraph, that both centrifugal and centripetal forces are manifested in eleven combined forces (Colby, 1950), i.e. six combined forces for centrifugal forces and five combined forces for centripetal forces. Anyhow, these forces can be fully applied to analyze the urban fringe areas. For the six combined forces causing centrifugal movement, they can be used for reference but the other five forces causing centripetal movement can not be
adopted. The reason is that these five combined forces regard the place of destination is the central part of the city whereas the study focuses on the urban fringe area as the final destination of the movement. Nevertheless, centripetal movement can still be traced because the people migrating from the more remotely located areas are inclined to get in closer proximity to the urban center, and thus they are in the tract of centripetal route.

There are nine main reasons why new arrivals tend to choose urban fringe areas as a place to settle. Those reasons are (1) looking for more spacious land because the price of land is still not expensive; (2) approaching the place of work; (3) looking for a place that is free from pollution; (4) obtaining a service house from the place of work; (5) investment; (6) looking for more comfortable atmosphere for living; (7) building his/her own house; (8) approaching public facilities; (9) obtaining land heritage. Of these nine reasons, "looking for more spacious land because the price of land is still cheaply" posted the highest percentage for migrants coming from the inner parts of the city (centripetal movement) whereas "approaching to the place of work" makes up the highest percentage for those who are coming from the more remotely located areas (centripetal movement) (Table 1).

Looking for a comfortable atmosphere, building his/her own house and investment are the second largest group for centripetal movement and they make up 14.7% and 12.3% respectively. Since the existing attracting factors in the place of destination is reducing the opposite situation of push factors in the place of origin, so by comprehending the aspiration of new arrivals in the fringe areas one can reveal the situation prevailing in the place of origin. As indicated by many studies, the growth of cities is followed by vertical mobility of the lower and the middle income family from the so-called bridge header to become consolidator and even the status seekers (Turner, 1968; Edwards, 1963). These groups are inclined to look for better accommodation for living and they tend to settle in the fringe areas that offer better atmosphere for living as compared to the living situation in the inner parts of the city.

Urban rural interaction is indicated by the findings where the greatest portion of people who are moving into the urban fringe areas is attracted by the proximity of the area to the place of their work, it makes up 38.7 percent. Those who formerly live in the remotely located area or in the rural area are inclined to get closer to the city where they work. The second largest group is "approaching public facilities" (9.3%) and "investigation" (9.3%). From this table one can reveal many aspects of life that needs further elaboration in the urban-rural relation context. Like for example, the considerable number of people who are investing in the fringe areas can lead to the questions whether the living standard of rural people has increased recently, whether they know that land can be a good commodity in the fringe areas and so forth. These phenomena should generate scepticism among urban and regional politicians that the intrusion of new arrivals in the fringe areas can give rise to chaotic situation of land use unless they intervene and manage the land development in the fringe areas themselves.

### Table 1. The main attractions of the fringe areas as related to the place of new arrivals’ origin

<table>
<thead>
<tr>
<th>Factor</th>
<th>Inner parts of the city</th>
<th>More remotely located areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looking for more spacious land</td>
<td>22</td>
<td>29.3</td>
</tr>
<tr>
<td>Approaching the place of work</td>
<td>4</td>
<td>5.3</td>
</tr>
<tr>
<td>Looking for a place free from pollution</td>
<td>7</td>
<td>9.3</td>
</tr>
<tr>
<td>Obtaining a service house</td>
<td>5</td>
<td>6.7</td>
</tr>
<tr>
<td>Investment</td>
<td>10</td>
<td>16.1</td>
</tr>
<tr>
<td>Looking for a comfortable atmosphere</td>
<td>12</td>
<td>16.1</td>
</tr>
<tr>
<td>Building a house</td>
<td>11</td>
<td>14.7</td>
</tr>
<tr>
<td>Approaching public facilities</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Obtaining land heritage</td>
<td>3</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Source: Primary Data

### CONCLUSION

From the above discussion, few important remarks can be drawn:

1. Urban fringe areas with their peculiar characteristics always attract people to settle either from the inner parts of the city or from the remotely located areas.
2. The ever increasing number of new arrivals can bring about chaotic situation of land use.
3. The ever expanding urban land can significantly influence the price of land and this phenomenon can drive land speculation.
4. The loss of prime agricultural lands due to the encroachment of urban land should be circumvented and residential development planning should be formulated as early as possible in order to prevent the appearance of squatter settlements and slums.
5. Spatial force, situational force and the force of social evaluation play an important role in the centripetal movement of people whereas site force, social evaluation force and the functional convenience force are decisive in the centripetal movement.
REFERENCES


Garret, I.O., and Hind-Smith, 1962. 'The Impact of Urban Growth on Agricultural Land Resources For Tomorrow: Background Papers, Ottawa: The Queen's Printer.


Department and government agencies


Recently, the Indonesian government realized that past investments made in remote sensing technology cannot keep up with the growing needs of the country. There are plans to improve this situation by establishing a strong and appropriate education and training programs. Some already exist in the Faculty of Geography of Gadjah Mada University in Yogyakarta. It is the only such faculty in Indonesia with high level education in remote sensing technologies. There are three programs on education and training:

1. A short course on remote sensing, established in 1976, in a cooperative framework between Gadjah Mada University and Japan International Cooperation (JICA). The course has been successful and attracts around 100 students per year.

2. A two-year program (S2), was established in 1978 by the Faculty of Geography and is run by the Department of Remote Sensing. The program is four years.

3. A master's program (S3), which runs from two to three years, was established in 1983 by the Faculty of Geography and is run by the Department of Remote Sensing. It is four years.

Foreign aid contributed to the development of remote sensing in Indonesia: Deutsch bilateral programs (NUFFIC, ITC), Ford Foundation, World Bank, French bilateral programs (DCSTD, OBSTOM), Japan aid program (JICA), US AID, Canadian aid program (CIDA/IDRC), Agricultural Development Council, etc.
CONSTRANTS

Many constraints disturb the development of remote sensing activities in Indonesia. Most important are related to logistic (quick access to data, easy user access, etc.), equipment and the specificity of the Indonesian environment. For example, the Jakarta-Pulauon Landsat receiving station, opened in 1984 by LAPAN, still does not provide any catalog to users.

Equipeas

Two complementary disturb the development approaches are usually considered for satellite data exploitation: visual image interpretation and computer-based digital analysis. Now, photo interpretation of satellite images is the most common method used in Indonesia. Visual Landsat imagery has already proved useful for global surveys (Malingreau and Sutanto, 1986). Generally speaking, major constraints are the poor quality of color photographic products and the unavailability of reliable mainframe computer equipment, except in some governmental agencies. This latter limitation prevents any widespread processing of digital data stored on computer-compatible magnetic tape (CCTs). Even in LAPAN, the manipulation of a few CCTs may sometimes be a laborious task, and in many institutions and agencies it is not rare to have mainframe computers down for long periods. Malfunctioning of DISP system in PUSPICS and Balisatung as an autorex. Maintenance is a major constraint for centers equipped with mainframe-computers.

Because micro-computers are common, easily maintained, and not very expensive, digital processing facilities based on micro-systems provide an interesting opportunity for decentralizing remote sensing activities. This is the strategy of IPB and PITBOP in Bogor and Gadjah Mada University and Sukahasa for PUSPICS in Yogyakarta; i.e., the use of interactive micro-computer-based systems that combine Geographic Information System Capability and digital image analysis. This technology is simple but both locally operational and cost-effective. It should have a great future in Indonesia. Basic but complete digital processing systems (i.e., IBM-compatible micro-computer, mathematical processor, matrix graphic board, 60 Mb hard disk, 12 MB disk drive, 640x480 pixel high-resolution monitor, color printer, 2x38 centimeters digitizing tablet) can be locally purchased with only $US6,500.

Cloud Cover

An objective assessment of the opportunities for use of remotely sensed data (visible and near-infrared range) requires the consideration of cloud cover. It is well known that cloud cover is the major constraint in Indonesia, but there was no quantitative information about its effect on data acquisition. Accordingly, a study was initiated (Castello-Espegerry, 1988) with the aid of the Geostationary Meteorological Satellite (GMS) and Landst data. For all land areas, interactive factorial analyses grouped GMS-derived clouds with similar cloud cover profiles into 16 classes (Figure 1). Statistics of Landst and SPOT images, grouped by class, were used to quantify temporal profiles of probability for acquiring remotely sensed data with less than 10
percent, 20 percent and 30 percent of cloud cover for any Indonesian land area (Figure 2). Analysis of the spatio-temporal characteristics of local climatic conditions permitted one to explain these profiles and to verify the validity of their seasonal variations for long periods. These profiles were fitted with a seventh-order polynomial for use in computer simulation of predictive models of remote sensed data acquisition.

Finally, Indonesian land areas have very distinct yearly probability profiles for data acquisition with relatively small interannual variabilities; e.g., Java, South Sumatra and Nias Tenggara have a well-defined peak in December-January, whereas such a peak occurs in February-March in North Sumatra. These profiles constitute an easily and quickly readable product and are particularly useful in estimating the time necessary for surveying areas within a defined period of acquisition, in forecasting the feasibility of multidate-studies and in optimizing data acquisition. Moreover, they (Figure 2) indicate which surveys can be conducted with satellite data. For example, crop monitoring in Java and Nias Tenggara can be operational with SPOT acquisition rate up to 8 images of any Indonesian area per month, whereas it is usually impossible in Kalimantan and Irian Jaya. However, there, contrary to what is often supposed, surveys that do not require frequent data acquisition (geology, forestry, etc.) can be conducted with SPOT if it is financially and technically feasible to acquire a sufficiently large amount of images.

**Atmosphere**

Radiometric values of remotely sensed data depend on radiance of targets but also on additional effects that tend to confuse them. These are mainly due to absorption and scattering mechanism of electromagnetic radiations by atmospheric components, i.e., gases and aerosol. They decrease the spectral transparency of the atmosphere and give rise to an atmospheric radiance. Consequently, a study (Gastellu-Escrigorry, 1988) was initiated for quantifying atmospheric influence within satellite images of Indonesia. Results were derived from SPOT-5 data but can be easily generalized to other satellite systems that operate in the visible and near infrared part of the electromagnetic spectrum. Two major points were emphasized:

a. Compared to total measured radiative, atmospheric upwelling radiance were very important: 30 percent-80 percent in band X51, 50 percent-70 percent in band X52, and 15 percent-45 percent in band X53 (near infrared radiations), and to a lesser extent band X2.

b. Atmospheric radiance were characterized by an important heterogeneity that was both spatial (up to 60 percent within a single image) and temporal.

Values of upwelling atmospheric radiance were used for obtaining atmospherically corrected spectral characteristics of land cover units. Because corrections that must be applied are spatially dependant and because areas with constant atmospheric conditions cannot be delineated, it was impossible to define spectral characteristics that are constant over a single SPOT image. The implication is that features may have various radiometric responses, even within the same satellite image. This is an especially limiting factor for automatic classification of remotely sensed data in tropical countries.

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**Figure 2.** Probabilities for Acquiring Remotely Sensed Data of Zones 1 to 6 with cloud cover (CC) less than 10 percent, 20 percent and 30 percent, if it is possible to have 6 acquisitions per month (case of SPOT satellite. Ci represents the mean values of (Ci = c1 + c2 + c3 + c4 + c5 + c6).
The small size, complexity, and dynamic nature of Indonesian agroforestry systems create problems for inventorying and monitoring. Consequently, the author (1988) analyzed the SPOT and Landsat capability for spatial discrimination of land cover units by means of the percentage of pure pixels (P percent) per homogenous land-cover unit and the proportion (R percent) of the dominant land cover unit per pixel. Parameter R percent should be about 100 percent if P percent is large. The larger P percent and R percent, the easier the discrimination and analysis of land-cover units, provided there is a certain contrast between targets of interest; since pixels are very often "mixed," i.e., comprising several land-cover units, parameter R percent is of special importance. For example, narrow features such as roads and rivers, which are usually remotely sensed as mixed pixels, can be easily detected if the value of R percent is not too low; i.e., if there is a sufficiently large contrast with neighboring land-cover units. Table 1 presents that for features with a "length/width" ratio equal to 4 (R>70%): 

a. Landsat-MSS (TMI) data allow analysis of features larger than 5 hectares (0.56 hectares). 

b. SPOT-XS (P) data allow analysis of features larger than 0.16 hectare (0.04 hectares). 

Because of the small size of most Indonesian land cover units (70 percent of rice fields have areas between 0.01 and 0.5 hectares with a 0.09 hectare average area; average area of dry fields is 0.2 hectares, usually between 0.5 and 1 hectare, etc.), only SPOT-P data, and SPOT-XS data to a lesser extent, appear to have a certain potential for spatial analysis such as resolving local units; i.e., whenever scales equal or larger than 1:500,000 are considered.

Three major points must be noted when fine spatial resolutions are used:

1. Numerous land-cover units/substrata, such as bare soil and tree-cover/patches within degraded forests, that are defined as subclass elements with coarse spatial resolutions, must be considered as spectral classes with spatial resolutions.

2. Moreover, these spectral classes may correspond to subunits that are part of different landscape units; e.g., spectral class "bare soil" may be attributed to units "bare soil," "settlements," "degraded forest," etc.

3. At last, land-cover units that correspond to spectral classes with coarse resolution sensors may not correspond to any spectral class with fine spatial resolution sensors. High local variance in an image is indicative of this situation.

Increases in accuracy of classifications due to the introduction of fine spatial resolution sensors have already been observed for different environments (Latty and Heffer, 1980; Sadowski et al., 1979; Tol, 1983).

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**Table 1.**

<table>
<thead>
<tr>
<th>Length (m)</th>
<th>Width (m)</th>
<th>Area (ha)</th>
<th>Landsat-MSS 30 m</th>
<th>Landsat TM 30 m</th>
<th>SPOT XS 25 m</th>
<th>SPOT P 5 m</th>
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<td>400</td>
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<td>200</td>
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<td>30</td>
<td>60</td>
<td>30</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Consequently accuracy of computer-aided mapping combined with conventional spectral classifiers depends on the combination of two opposing factors that vary as a function of the local environment (Markham and Townshend, 1981; Toll and Kovacevic, 1984):

1. The finer the spatial resolution, the larger the number of pure and predominantly pure pixels, and the better the accuracy of classifications.
local TM maps. Thus, if only photographic products are used, as is often the case in Indonesia, adequate rotation and enlargement of readily available SPOT films permit a direct overlay on local TM maps, with a standard deviation accuracy about three pixels for (60×60 kilometers) areas. Better cartographic accuracies are obtained when smaller areas are considered.

Altitude differences within the SPOT scene tested were less than 1,000 m, and it may be that the geometric accuracy of SPOT data will be worse for areas with larger altitude differences. On the other hand, this accuracy should be improved with SPOT data that are acquired with nadir viewing conditions, instead of at a 17° angle of incidence, as in the present study.

SPOT was tested as an operational data source for updating the 150,000 TM map of a 20×20 kilometers area in Central Java. This map was 50 years old, without any revision in 20 years. During this period a major change occurred, with the creation of a reservoir eight years ago. Analysis of a SPOT image, conveniently enlarged, allowed rapid transfer onto tracing paper of lake boundaries, irrigation channels, roads, and villages. Small plots within mixed gardens could not be distinguished, whereas units comprising juxtaposed plots with similar ground-cover conditions could be delineated. Basic knowledge of the area provided the distinction between roads and irrigation channels. Simple superimposition of newly delineated features on TM maps provided an immediate up-dating, with a geometric accuracy of about two pixels. Slightly better accuracy (better than 1.5 pixels) was obtained by digitally correcting SPOT data; apart from a better accuracy, a major advantage of this method is the provision of digitized maps. Map updating was achieved within seven days with photo interpretation and geometric corrections.

Undoubtedly more accurate map updating can be obtained with more sophisticated methods; cartographic agencies (Denis, 1987) have already found that for areas with moderate relief, SPOT average planimetric accuracy is 6 meters (0.6 pixel), whereas topographic accuracy is 5.5 and 7 meters with base height ratios of 1 and 0.5 respectively. However, that type of mapping is much more complex, expensive, and time consuming, and consequently less locally operational than that achieved at PUSPICS. This is special importance in Indonesia where more base maps are very old and outdated.

Land Cover Mapping

The capability of SPOT was investigated for land cover and land use in Indonesia. Apart from the previously mentioned atmospheric constraints a major problem was noted, especially for computer-aided approaches when fine spatial resolutions are used. It may be possible to consider broad land cover units in class. Consequently, hierarchical land cover legend systems must be developed independently of land use in order to exploit the full power of fine-resolution satellite data. This problem does not really arise with Landsat-MSS data because these have relatively low local variation (Woodcock and Strahler, 1987).

SPOT data were tested on several study areas in Java for deriving 1:50,000 land-cover mapping. Both previously mentioned semi-automated and layered, textual/contextual automatic approaches were considered. It was found that the level of categorization (Anderson et al., 1976) of land-cover and land use features with SPOT
The growth of urban areas is generally poorly monitored in Indonesia. Indeed, this rate is very fast, and numerous constraints prevent the use of aerial surveys with sufficient repeat frequency for up-to-date urban planning. For many areas, even in Java, the most recent aerial photographs may be ten years old. Moreover, once they are available, some tedious and detailed tasks must be performed to derive cartographic documents. Accordingly, a study was initiated for testing the potential of SPOT and Landsat MSS for surveying agricultural-suburban interfaces around Yogjakarta, Central Java.

Because no detailed vegetation discrimination was required, 1:50,000 black and white prints of level 18-SPOT-7 data proved to be particularly useful for providing accurate mapping of settlement-agricultural transitions. They are undoubtedly more valuable than SPOT-XS data even if digitally processed, due to the small size of local land-cover units. Mapping with SPOT was faster to better cartographic documents than visual interpretation without base-plotted of 1:50,000 IRS aerial photographs (1989). Results derived from aerial photographs and SPOT appeared to be consistent. Only consistent overall accuracies could be derived from Landsat-MSS data. Land-cover maps derived from photointerpretation of aerial photographs of 1965, 1981, and 1987 and Landsat data of 1983 and SPOT data of 1986 clearly showed that between 1965 and 1987 land use around Yogjakarta was very much modified (Table 2). The coverage of urban/sub-urban areas nearly doubled, whereas the acreage of agricultural lands decreased significantly.

### TABLE 2

<table>
<thead>
<tr>
<th>Settlement</th>
<th>City</th>
<th>Cultivated areas</th>
<th>Degraded areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plos, 1982</td>
<td>35</td>
<td>6</td>
<td>52</td>
</tr>
<tr>
<td>Plos, 1981</td>
<td>43</td>
<td>9</td>
<td>48</td>
</tr>
<tr>
<td>Land, 1981</td>
<td>+1</td>
<td>9</td>
<td>42</td>
</tr>
<tr>
<td>SPOT-XS, 1988</td>
<td>42</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Plos, 1987</td>
<td>47</td>
<td>11</td>
<td>37</td>
</tr>
</tbody>
</table>

The geology and soils of central Java were mapped (1:50,000-1:10,000) with SPOT (Gissel-Carle et al., 1988). The scale power of SPOT proved to lie in high spatial resolution, combined with stereoscopic capability. Spectral analysis is of lesser importance, since geological units are seldom sufficiently exposed, especially in a country like Indonesia. Nevertheless, it should not be completely neglected because there frequently exists a significant correlation between rock type and the spectral signature of the overlying cover type, since land use and soil development is often controlled by geology.

SPOT data compared well to black-and-white infrared aerial photographs (1969; 1:50,000). They proved to be more convenient, reliable, and efficient than aerial photographs for deriving small and medium scale geologic and soil maps. Moreover, SPOT derived maps were achieved much faster. However, when SPOT stereopairs were not available, small-scale natural features could not be observed. The opportunity to derive and correct medium scale geologic and soil maps is very valuable in a coun-
try like Indonesia where the geology and soils of many areas still poorly mapped or not mapped at all.

Finally, it was shown that SPOT-5S and SPOT-7 data can come close to taking the place of 1:100,000 and 1:50,000 aerial Nikkei photography, respectively. This is especially interesting when one considers the added advantages of being able to analyze digital data for special problems and applications, including quantifying components of land use, determining the area occupied by such components and developing numerical discrimination to support and strengthen visual interpretations. It must be noted that whenever smaller-scale information is required, other satellite systems be considered.

ECONOMIC ANALYSIS AND PERSPECTIVES

The following is extracted from an economic investigation that was conducted by SCOTT CONSEIL (1988) at BTRT’s request (Ministry of Research and Technology). Its main purpose was to appraise and possibly to quantify the potential impact of SPOT in Indonesia. It was not an easy task to quantify the economic impact of remote sensing technology because it is used in operations embracing two distinct economic approaches:

1. The market economy, that aims at realizing short-term benefits
2. The public sector, whose criteria are not exclusively economic, and can also cover protection, prospecting, management, and development areas, etc.

Moreover, the importance of remote sensing technology can be assessed in terms of:

a. Direct increase in value: assessing direct increase in value comes down to putting a figure on the cost differences (man/month, logistics, machine time) between projects using remote sensing technology and projects that have been carried out using traditional methods.
b. Indirect increase in value: the indirect value corresponds to the saving derived from the revaluation of a project and its indirect effects. Such is the case of decision making whose accuracy is due to the synthetic vision one can get from using remote sensing (road mapping, etc.) in addition, one can rapidly have the results of a study available, for example, agricultural statistics and/or improve the results of a program. In this connection, a study made by the Economic Bureau of the Asian Development Bank has shown that the use of remote sensing has allowed a reduction ranging from 20 to 42 percent in the total number of unproductive drilling operations (water investigation); this consequently led to a 32 percent reduction in the cost of a productive drilling operation.

It is also worth comparing the cost of remote sensing data acquisition to the costs of feasibility studies and of project performance: finance development and planning projects happens to be much higher than the cost of remotely sensed data. The following table, from the American company Buzz-Allen & Hamilton (1987), is presented.

<table>
<thead>
<tr>
<th>Project</th>
<th>Total Cost of Project</th>
<th>Cost to Date</th>
<th>Cost of US. as % of the Study</th>
<th>Cost of US. as % of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>100</td>
<td>15-30</td>
<td>2.3</td>
<td>0.2-0.6</td>
</tr>
<tr>
<td>Forestry</td>
<td>100</td>
<td>20-30</td>
<td>2.5</td>
<td>0.4-0.8</td>
</tr>
<tr>
<td>Land-use</td>
<td>100</td>
<td>15-25</td>
<td>3.5</td>
<td>0.3-0.75</td>
</tr>
<tr>
<td>Water resources</td>
<td>100</td>
<td>5-40</td>
<td>5.7</td>
<td>0.5-2.40</td>
</tr>
<tr>
<td>Engineering</td>
<td>100</td>
<td>5-15</td>
<td>5.7</td>
<td>0.5-2.40</td>
</tr>
<tr>
<td>Cartography</td>
<td>100</td>
<td>5-10</td>
<td>10.15</td>
<td>2-15</td>
</tr>
<tr>
<td>Geoscience</td>
<td>100</td>
<td>5-10</td>
<td>5-10</td>
<td>2-15</td>
</tr>
<tr>
<td>Exploration</td>
<td>100</td>
<td>5-15</td>
<td>1-2</td>
<td>0.15-1.40</td>
</tr>
</tbody>
</table>

The assessment of the potential market for remote sensing in Indonesia was achieved through the analysis of major development projects in progress or planned, likely to use remote sensing. Information was retrieved from international bodies (World Bank, Asian Development Bank, FAO, IC, etc.) and the list of development projects whose census was made by the Ministry of Development (SAIPENNAS). These project were analyzed during meetings with a number of Indonesian ministries and bodies. General tendencies, such as a strong demand for cartographic products were emphasized. Moreover, as a result of food self-sufficiency, the drop in oil prices, and environmental problems (erosion, etc.), the government has begun to favor transmigration projects and developed cash crops. In the near future, there might be a further evolution in the market because the Ministry of Finance intends to levy a tax on cultivated areas (inventory problems), and because the Ministry of Agriculture aims at intensifying agricultural resources. The Ministry of Environment plans to put into practice some rules about space utilization. In addition, there are important projects of road mapping and mineral exploration.

Consequently, projects that will have to be carried out in the near future and for which remote sensing technology can be useful or even necessary, were analyzed in terms of the number of SPOT images required per year. This number was determined either directly by considering the size of the respective study areas of the projects, and/or indirectly, by combining the type and cost of the projects with usual percentages for acquiring remotely sensed data. The following table presents the potential demand in the Indonesian public sector, expressed in number of images per year and field of application.
**TABLE 4**

<table>
<thead>
<tr>
<th>Potential Demand in the Public Sector for Remote Sensing Data</th>
<th>Number of Images per Year</th>
<th>Number of Images per Year if SPOT is Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping</td>
<td>705</td>
<td>200</td>
</tr>
<tr>
<td>Geology</td>
<td>120</td>
<td>10</td>
</tr>
<tr>
<td>Planning</td>
<td>180</td>
<td>10</td>
</tr>
<tr>
<td>Urban study</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>Agricultural development</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>Forest</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>Irrigation</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td>Agriculture</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>Total/year</td>
<td>7,050</td>
<td>1,185</td>
</tr>
</tbody>
</table>

As seen in the table, there is evidence to suggest that the potential market for SPOT imagery in Indonesia is between 2,000 and 2,500 images a year, with no distinction made among various types of images ( multispectral, panchromatic, stereoscopic, digital or film). It should be stated that this demand is likely to increase in the future.

As a matter of fact, some of the projects considered will not necessarily be carried out, and others will not necessarily lead to remote sensing operations. On the contrary, other projects which have not been taken into account in this study might imply the acquisition of satellite images. Moreover, some projects could be carried out with Landsat-MSS or TM data instead of SPOT data, especially those for small and medium-scale geologic investigations. However, due to the small size of local land-cover units and their moderate cartographic accuracy, these latter should be preferred for most applications.

In the assessment of the potential market, only the public market was taken into account. In fact, the private sector has begun to have an important role in operational remote sensing activities. For example, some private companies were international invitations to tender proposals for projects financed by the World Bank and ADB.

A major concern was expressed by the private sector. It considers that it is more convenient to use remote sensing products. The private companies will not generally take the risk of introducing remote sensing technology into operations whose reference terms do not explicitly refer to this method. There is, consequently, a need to raise consciousness about the economic potential of SPOT imagery among banks and administrations that will benefit from invitations to tender, and even ININDO, a body embracing the consultants that intervene in Indonesia. In this connection, the Indonesian Ministry of Research and Technology, through RAPP, recently appeared as an influential leader for developing remote sensing activities in Indonesia.

**DISCUSSIONS**

After a brief description of major Indonesian organizations dealing with remote sensing applications and training, the most important concerns concerning local exploitation of satellite data have been reviewed:

a. Data diffusion: i.e., the necessity of user services in the receiving stations.

b. Equipment: essentially equipment availability and maintenance. In this respect, micro-computer-based systems are particularly efficient for centers that cannot afford the implementation and maintenance of large computer facilities.

c. Cloud cover: in some regions applications that require frequent data acquisition cannot be conducted with visible and near infrared satellite systems; in these cases other systems, such as radar, should be considered.

d. Atmospheric influence: it is particularly limiting for fully automatic computer-based mapping.

e. Small size and complexity of local land cover units; consequently, satellite systems that are used should have a comparatively small spatial resolution. In this respect, SPOT is presently the best satellite system, especially when it is intended to resolve local land use units.

Locally processed satellite data clearly showed the technical potential of remote sensing as a major and operational data source for many applications in Indonesia. The economic potential was also clearly demonstrated.

Finally, it must be noted that being aware of the potential of this technique for its development activities, the Indonesian government recently decided to go ahead by establishing sound remote sensing education, as well as by establishing convenient satellite receiving and processing facilities.

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RURAL BASIC SERVICE DEVELOPMENT:
An Operational Approach

by
Agus Susanto

ABSTRACT

Approach on the study or rural service development is often with development indicators are interchangeable. However, for two indices are closely related and each contribute one to another. A confusion also exists in the setting up of the concepts of social service and economic service function. As such, the study of service development should have a great care of the study implication in which sectoral action planning should follow-up.

INTRODUCTION

Each people, in principle, demands on a more or less similar basic service to support their life and activities. Only then the quality and quantity as well as variety of services grow differently from person to person and from place to place, in line with their respective level of development. This we soon can classify, for instance, by contrasting service facilities in rural and urban areas, or in developed and less developed countries.

In comparison with urban people, a long list can be made easily on the lack of rural services such as health and education, drinking water supply, electricity, energy, information, road, transport, market and finance institution, etc. Analyzing the cause and effect of the existing diversity and the pattern, have led to the formation of theories such as location theory of von Thanner, rank size rule developed by Pérez Anserbaha, and the Christaller central place model and its extension by August Lesch (Haggett, 1970). By inventories the characteristics of the present services, a hierarchy of regions can be structured, at least three-tiered hierarchy, consisting of regional cities, district towns, and locality towns (ESCAP, 1979).

This article is not meant to go in this hierarchization method nor to concentrate on service centres study, but to assess methods appropriate for identifying the level of basic service development in rural area.

* Drs. Agus Susanto, MSc., a junior staff member of the Department of Rural and Regional Development, Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia.