The Indonesian Journal of Geography Vol.21, No.62,
December 1991, pp. 1 - 8

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

by
Hadi Sabari Yunus*

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 doers 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 sprawling process of urban features in the surrounding countrysides. The study is carried out in one of the portions of the fringe areas 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 merely focussed on one of these broad scopes, 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 subdistricts 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 predominated by those who are looking for more spacious place/space for living and the lower price of land whereas centripetal movement is predominated 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-

* Hadi Sabari Yunus is a lecturer in Geography of Urban Settlement at the Faculty of Geography, Gadjah Mada University

sion of urban area 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 interferences, 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 countrysides 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 its 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 farther into rural areas. As a geographical entity, urban fringe areas can be viewed from many different angles. For further elaboration is suggested to study the work of Wehrwein (1942), Andrews (1942), Klow (1942), Firey (1946), Rodehaver (1947), Dewey (1948), Blumenfeld (1954), Reeder (1955), Bogue (1956), Clawson (1962), Gertler and Hindsmith (1962), Crerar (1963), Pryor (1968), Hudson (1973), Russwurm (1975), Bryant, Russwurm and McLellan (1982).

Since the discussion of this article is not to chase the tract 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 focuss its analysis on the attracting factors of the urban fringe areas. In order to facilitate the analysis, the writer adopts the concepts of centripetal and centrifugal forces as proposed by Colby (1933). Although this concept is unicentered 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 Colby's concept can still be refered to.

TOWARDS AN APPRECIATION OF COLBY'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 functions and the addition of some new ones (Murphy, 1974). 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 uprooting 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 area 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

DYNAMIC FORCES AFFECTING URBAN PATTERNS CENTRIFUGAL AND CENTRIPETAL FORCES

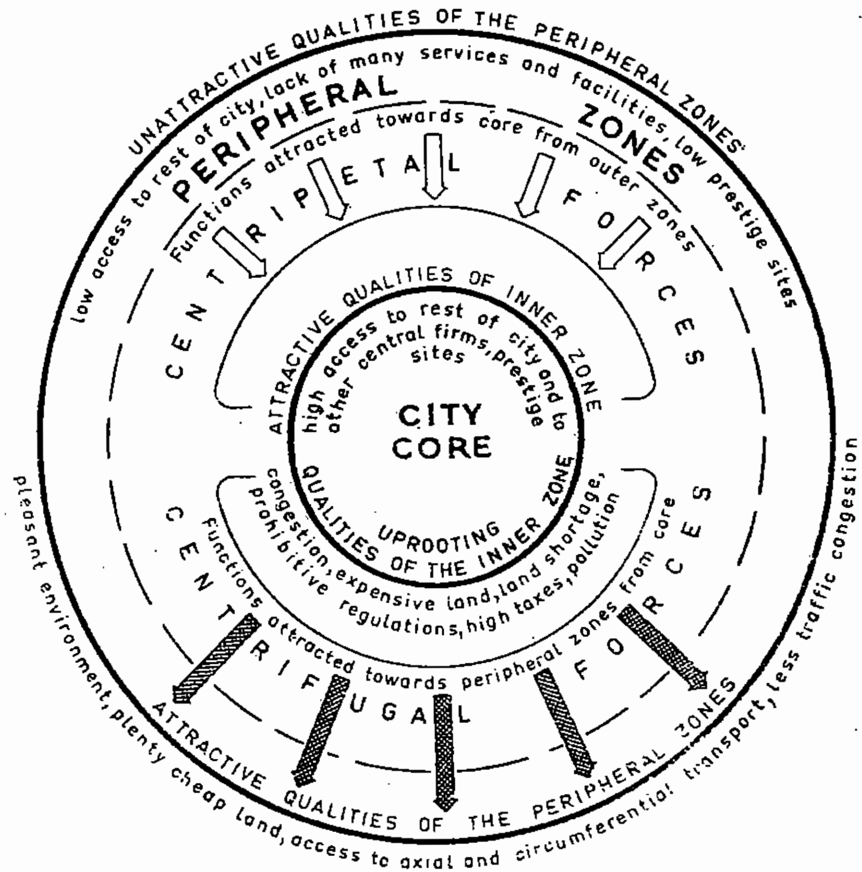

Figure 1 The Colby's Model (M.H. Barlow and R.G. Newton, 1971 : 382)

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 occupance, 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 magnetism force; (4) functional prestige force; (5) human equation force. These two sets of forces viz. centripetal and centrifugal 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 from the interaction between centrifugal and centripetal forces, but will only focuss 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 aspects of life. Within the last ten years, the growth rate of its population is about 2.65 percent (Musiyam, 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 was only 280.72 ha and it increased to 281.18 in 1986. Agricultural lands decrease from 280.30 ha in 1985 to 278.36 ha in 1986. For the time being, agriculturalists have decreased from 815 (1985) to 563 (1986) and non agriculturalists have increased from 5644 in 1985 to 6398 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 reasons why they are attracted to settle in the fringe areas. Nevertheles, of the entire answers, the respondent 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, 1933), i.e. six combined forces for centrifugal forces and five combined forces for centripetal forces. Anyhow, these forces can not be fully applied to analyse 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

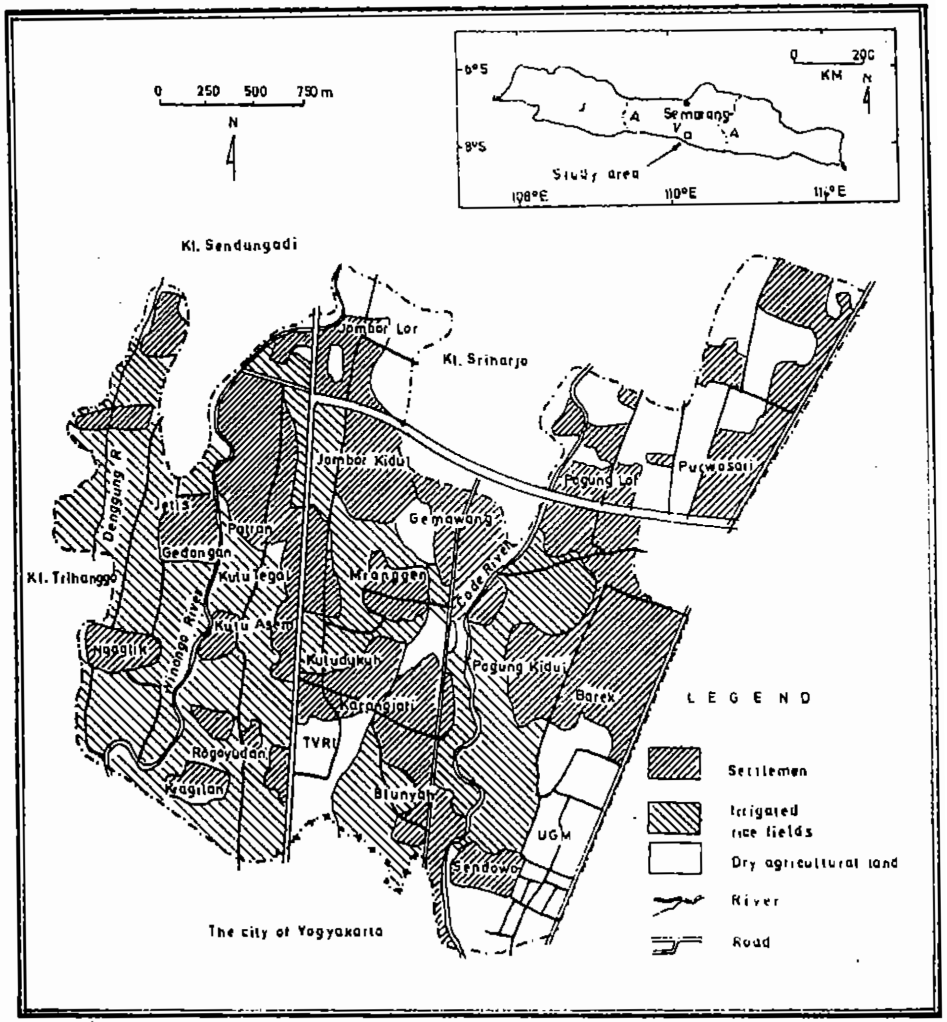

Figure 2 The Study Area

adopted. The reason is that these five combined forces regard the place of destination is the central part of the city whereas the study focusses 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 proximily 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. These 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) investation; (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 cheap" posits the highest percentage for migrants coming from the inner parts of the city (centrifugal 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 comfortable atmosphere, building his/her own house and investation are the second largest group for centrifugal movement and they make up 16.1%, 14.7% and 13.3% respectively. Since the existing attracting factors in the place of destination is reflecting 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, 1983). These groups are inclined to look for better accomodation 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" (16%) and "investation" (20%). 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 comodity in the fringe areas and so forth. These phenomena should generate sceptisism among urban and regional planners that the intrusion of new arrivals in the fringe areas can give rise to chaotic situation of land use unless they interfere and manage the land development in the fringe areas themselves.

Table 1. THE MAIN ATTRACTIONS OF THE FRINGE AREAS AS RELATED AS RELATED TO THE PLACE OF NEW ARRIVALS' ORIGIN

Pull Factors the Fringe (the main attractions of the fringe areas)	The place of new arrivals' origin			
	inner parts of the city		meore remotely located areas	
	n	%	n	%
1. Looking for more spacious land because of low price	22	29,3	-	-
2. Approaching the place of work	4	5.3	29	38.6
3. Looking for a place free from pollution	7	9.3	-	-
4. Obtaining a service house	5	6.7	4	5.3
5. Investation	10	13.3	15	20.1
6. Looking for comfortable atmosphere	12	16.1	2	2.6
7. Builts a house	11	14.7	9	12.0
8. Approaching public facilities	1	1.3	12	16.1
9. Obtaining land heritage	3	4.0	4	5.3
Total	75	100.0	75	100.0

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 squater settlements and slums.
(5) Spatial force, situational force and the force of social evaluation play an important role in the centrifugal movement of people whereas site force, sosial evaluation force and the functional convenience force are decisive in the centripetal movement.

REFERENCES

Andrew, R.B., 1952. 'Element in the Urban Fringe Pattern' *Journal of Land and Public Utilities Economics* 18.

Barlow, M.H. and Newton, R.G., 1971. *Patterns and Processes in Man's Economic Environment*. Sydney: Angus and Robertson Pty. Ltd.

Blumenvelt, H., 1954. 'The Tidal Wave of Metropolitan Expansion' *Journal of the American Institute of Planners* 20.

Bogue, D.J., 1956. 'Metropolitan Growth and the Conversion of Lands to Non Agricultural Uses' *Studies in Population Distribution* No. 11. Oxford: Scripps Foundation.

Bryant, C.R., Russwurm, L.H., Mclellan, A.G., 1982. *The City's Countryside: Land and Its Management in the Rural Urban Fringe*. New York: Longman.

Clawson, M.C., 1962. 'Urban Sprawl and Speculation in Suburban Land' *Land Economics* 38.

Colby, Charles, C., 1933. 'Centrifugal and Centripetal Forces in Urban Geography', *Annals of the Association of American Geographers*, Vol. 23.

Crerar, A.D., 1963. 'The Loss of Farmland in the Growth of the Metropolitan Regions in Canada' *Resources for Tomorrow*. Ottawa: The Queen's Printer.

Edwards, M., 1983. 'Residential Mobility in a Changing Housing Market: The Case of Bucaramanga, Columbia' *Urban Studies* 20.

Firey, W., 1946. 'Ecological Consideration in Planning For Ruruban Fringes' *American Sociological Review* 11.

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

Hudson, J., 1973. 'Density and Pattern in Suburban Fringes'. *Annals of the Association of American Geographers* 63(1).

Johnson, J.H., 1974. 'Geographical Processes at the Edge of the City' in James H. Johnson (ed.)., *Suburban Growth: Geographical Processes at the Edge of the Western City*. New York: John Wiley and Sons.

Klow, R.C., 1942. *The Park Ridge-Barrington Area*: A Study of Residential Land Pattern and Problem in Suburban Chicago.

Murphy, R.E., 1974. *The American City*. New York: McGraw-Hill Book Company.

Musiyam, M., 1988. Perubahan Kondisi Fisik Rumah di Kelurahan Sinduadi, Kecamatan Mlati, Kabupaten Sleman, Yogyakarta Tahun 1977-1986. Skripsi S1. Yogyakarta: Fakultas Geografi UGM.

Pryor, R.J., 1968. 'Defining the Rural-Urban Fringe' *Social Forces* 47.

Reeder, L., 1954. 'Industrial Decentralization as a Factor in Rural-Urban Fringe Development' *Land Economics* 31.

Rodehaver, M.W., ... 'Fringe Settlement: A two Direction Movement' *Rural Sociology* Vol. 12.

Russwurm, L.H., 1975. 'Urban Fringe and Urban Shadow' in Bryfogle, R.C., and Krueger, R.R., (eds.) *Urban Problem* (rev. eds.). Toronto: Holt, Rinehart and Winston.

Turner, J., 1968. 'Housing Priorities, Settlement Patterns and Urban Development in Modernizing Countries' *Journal of the American Institute of Planners*. Vol. 34.

Wehrwein, G.S., 1942. 'The Rural-Urban Fringe' *Economic Geography*. No. 8.

g. Padjadjaran University, Institute of Ecology, Bandung. Emphasis on Ecological Studies (erosion, etc.) with a qualified staff of 5.
h. BIOTROP-SEAMEO, International Center for Biological Studies, Bogor. Vegetation studies with remote sensing; qualified staff of 5; IBM digital processing facilities..
i. Geological directorate, Bandung. Remote sensing applications in environmental geology, mineral exploration and volcanology; with a qualified staff of 5.
j. Soil Research Center, Center for Agricultural Research, Bogor. Many photo-interpreters and up to 4 staff members trained in remote sensing analysis for resources surveys.

Department and government agencies

a. Ministry of public Works, Center for Digital Remote sensing Analysis, Computer Center, Jakarta. Large remote sensing digital analysis system with a qualified staff of 15. Many photo interpreters. Cocentrates on regional and is associated with many private consultants.
b. Ministry of forestry, Management Programme. In charge of nationwide forest inventories and monitoring. Many photo interpreters. Qualified staff of 5.
c. Central Bureau of Statistics, Jakarta. Application of remote sensing for assisting in agricultural data collection. Qualified staff of 3.

Recently, the Indonesian government realized that past investments made in remote sensing training 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 techniques. 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 Bakosurtanal. It is meant to train personnel from various government agencies (Transmigration, Public Works, Forestry, etc.); foreign trainees also are accepted. Since July 1983 the duration of the course has been 24 weeks and two courses are offered in one year, thirty places are offered at each course.
2. A degree program (S1), it was established in 1977 by the Faculty of Geography and it is run by the Department of Remote Sensing. Its duration is four to five years.
3. A master's program (S2), which runs from two to three years, it was established in the academic year 1983-84 with the help of the Faculties of Geography, Engineering, Mathematics and Forestry, and expatriate experts from United States, France and the Netherlands. Subjects included remote sensing technology and applications and research work.

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

CONSTRAINTS

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- Pekayon Landsat receiving station, opened in 1984 by LAPAN, still does not provide any catalog to users.

Equipment

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 DIPIX system in PUSPICS and Bakosurtanal are notorious. Maintenance is major constraint for centers equiped with mainframe computers.

Because micro-computers are common, easily maintained, and not very expensive, digital procesing facilities based on micro-systems provide an interesting opportunity for decentralizing remote sensing activities. This is the strategy of IPB and BIOTROP in Bogor and Gadjah Mada University and Bakosurtanal 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, 1.2 Mb disk drive, 640x480 pixel high-precision monitor, color printer, 26x38 centimeters digitizing tablet) can be locally purchased with only $US 6,500.

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 (Gastellu-Etchegorry, 1988) with the aid of the Geostationary Meteorological Satellite (GMS) and Landsat data. For all land areas, interative factoral analyses grouped GMS-derived pixels with similar cloud cover profiles into 18 classes (Figure 1). Statistics of Landsat and SPOT images, grouped by class, were used to quantify temporal profiles of probability for acquiring remotely sensed data with less than 10

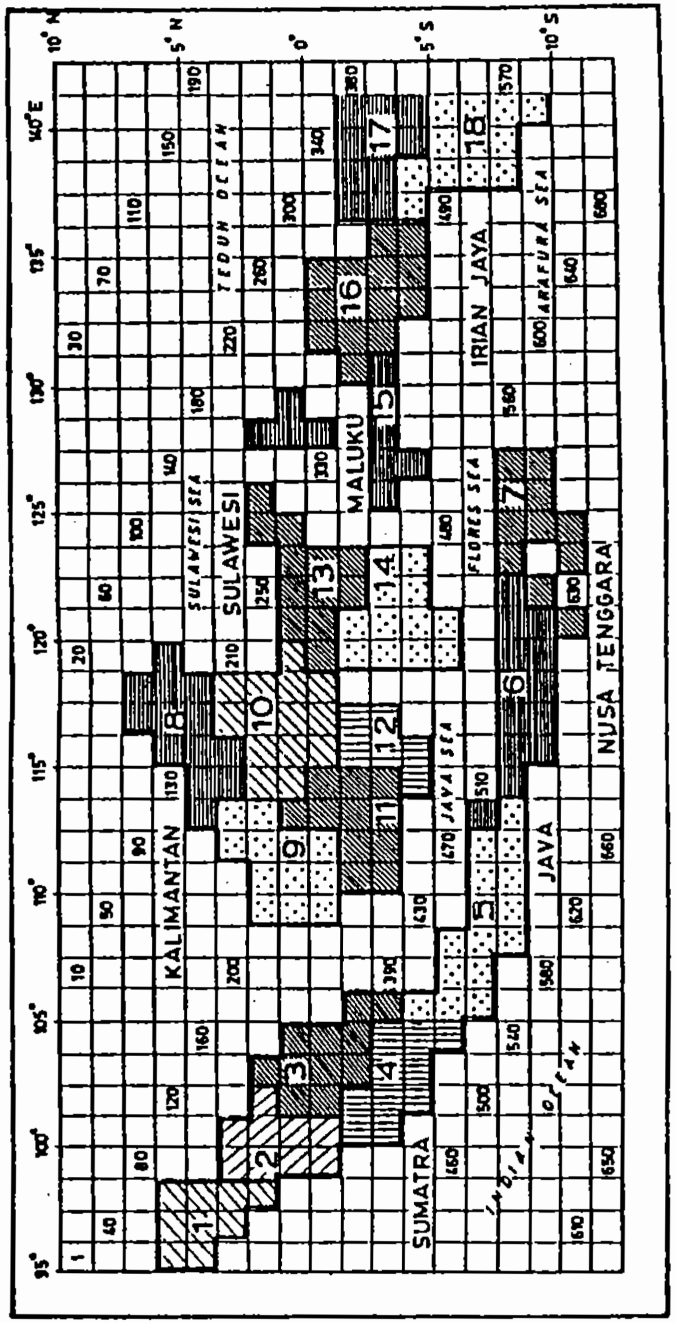

Figure 1. The 18 cloud-cover zones of the Indonesian archipelago

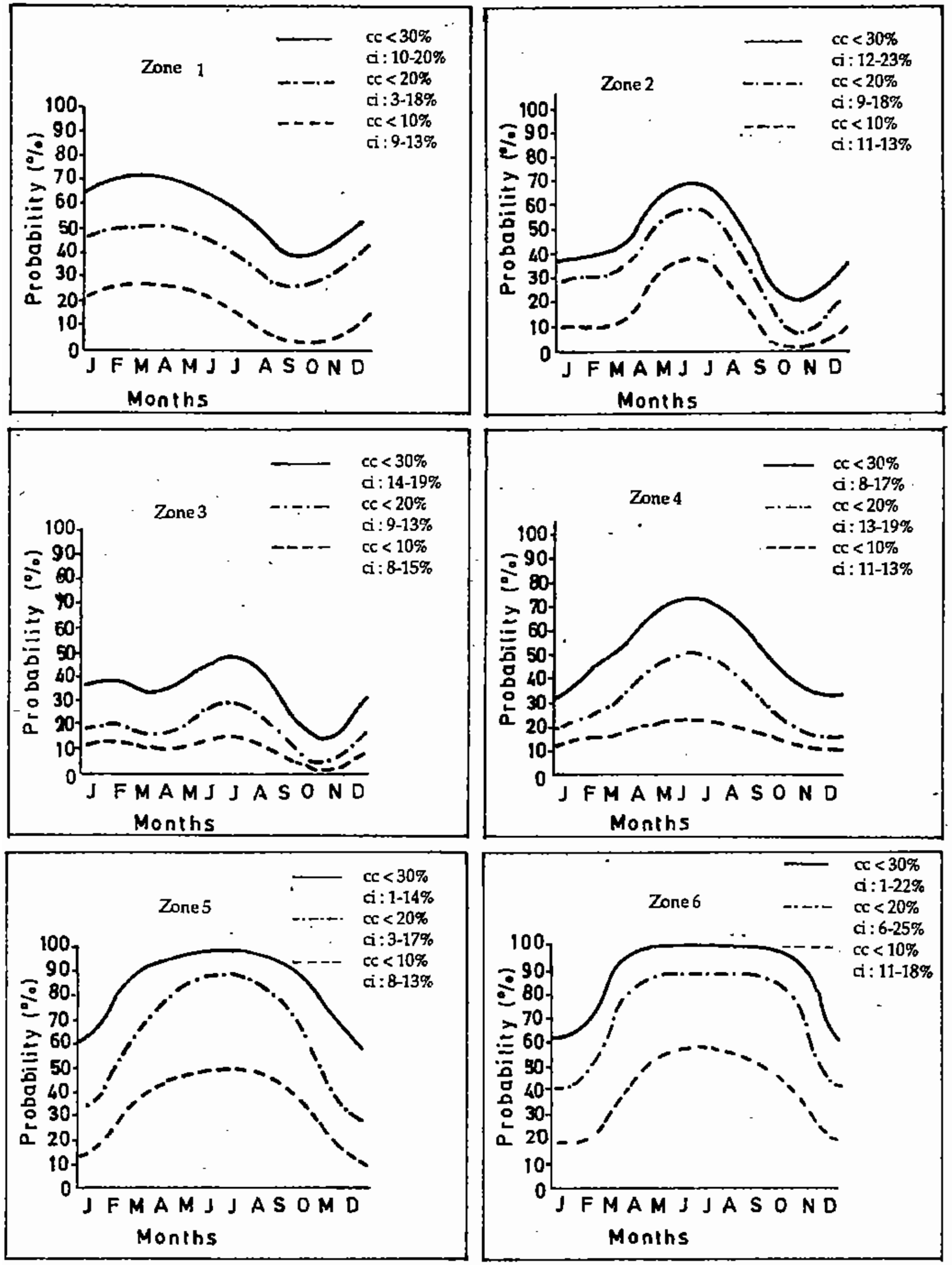

Figure 2. Probabilities for Acquiring Remotely Sensed Data of Zones 1 to 6 with cloud cover (CC) less than 10 percent 20 percent and 30 percent, if it is Possible to have 8 Acquisitions per Month (case of SPOT satellite. Ci represents the mean values of the confidence intervals).

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 remotely 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 Nusa 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 Nusa 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 radiances 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-Etchegorry, 1988) was initiated for quantifying atmospheric influence within satellite images of Indonesia. Results were derived from SPOT-XS 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 radiances, atmospheric upwelling radiances were very important: 30 percent-80 percent in band XS1, 20 percent-70 percent in band XS2, and 15 percent-45 percent in band XS3 (near infrared radiations), and to a lesser extent band XS2.
b. Atmospheric radiances were characterized by an important heterogeneity that was both spatial (up to 40 percent within a single image) and temporal.

Values of upwelling atmospheric radiances were used for obtaining atmospherically corrected spectral characteristics of landscape 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 identical 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.

Agro-forest Systems

The small size, complexity, and dynamic nature of Indonesian agroforest 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 homogeneous 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 discriminition 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 stresses that for features with a "length/width" ratio equal to 4 (R%>70%):

a. Landsat-MSS (TM) 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 hectare).

Because of the small size of most Indonesian land cover units (70 percent of rice fields have areas between 0.01 and 0.5 hectare with a 0.08 hectare average area; average area of dry fields is 0.2 hectare, usually between 0.01 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 1:50,000 are considered.

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

1. Numerous land-cover units/subunits, 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", "settlement", "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.

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

TABLE 1.
MEAN P PERCENT AND R PERCENT FOR VARIOUS PIXELS AND FIELD SIZES

Length (m)	Width (m)	Area (ha)	Landsat-MSS 80 m		Landsat- TM 30 m		SPOT-XS 20 m		SPOT- P 10 m	
			P%	R%	P%	R%	P%	R%	P%	R%
450	450	20	62	91	84	97	89	98	95	99
	225	10	45	87	76	95	84	97	92	98
	112	5	11	76	62	92	75	94	87	97
	56	2.5	0	61	32	85	54	90	76	95
300	300	9	45	87	77	95	84	97	92	98
	150	4.5	25	81	66	92	76	95	88	98
	75	2.3	0	69	45	88	62	92	84	96
	32	1.1	0	43	7	78	32	85	65	93
150	150	2.3	13	74	57	90	70	93	84	97
	75	1.1	0	63	40	86	56	90	76	95
	37	0.6	0	41	7	76	30	84	62	92
	19	0.3	0	20	0	57	0	70	32	85
100	100	1	1	66	40	85	57	90	77	95
	50	0.5	0	44	15	77	40	86	66	92
	25	0.3	0	24	0	65	7	76	45	88
	12	0.1	0	10	0	47	0	57	7	78
80	80	0.6	0	56	31	81	50	88	72	94
	40	0.3	0	37	10	73	28	82	60	91
	20	0.2	0	16	0	57	0	70	35	85
	10	0.1	0	9	0	30	0	47	0	72
60	60	0.36	0	43	15	75	35	84	63	91
	30	0.18	0	25	0	65	11	76	47	88
	15	0.09	0	12	0	44	0	61	15	80
	7.5	0.05	0	6	0	21	0	35	0	64
40	40	0.16	0	25	2	67	15	75	50	88
	20	0.08	0	12	0	52	0	65	28	82
	10	0.04	0	6	0	28	0	44	0	70
	5	0.02	0	3	0	13	0	21	0	47
30	30	0.09	0	16	0	56	0	70	35	84
	15	0.05	0	8	0	37	0	55	11	76
	7.5	0.02	0	4	0	16	0	32	0	61
	3.8	0.01	0	2	0	9	0	15	0	35
20	20	0.04	0	5	0	40	0	56	15	75
	10	0.02	0	1	0	21	0	37	0	65
	5	0.01	0	0	0	10	0	16	0	44
	2.5	0.05	0	0	0	5	0	9	0	21
15	15	0.02	0	2	0	25	0	43	5	69
	7.5	0.01	0	0	0	12	0	28	0	55
	3.8	0.006	0	0	0	6	0	12	0	32
	1.9	0.003	0	0	0	3	0	6	0	15

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 Kennard, 1984):

1. The finer the spatial resolution, the larger the number of pure and predominantly pure pixels, and the better the accuracy of classifications.

2. The finer the spatial resolution, the larger the number of detectable subclass elements. This implies wider within-class spectral variance of classes associated with landcover units, with decreases spectral separability and results in less accurate classifications.

Accordingly, the implicit assumption of low local variance of conventional spectral classifiers, which is verified for Landsat- MSS in most environments, becomes less valid with the fine spatial resolution of SPOT and Landsat-TM. Classifications are improved only for environments where the decrease of the number of mixed pixels outweights the increase of within-class variances. New algorithms of classification must be developed. It must be noted that spectral classifiers well adapted to environments such as the wide agricultural systems of the Great Plains may not be valid for small Indonesian systems.

In short, the difficulties for having constant spectral characteristics over a single SPOT image and also for determining pure pixels of local landscape units are especially limiting factors for computer-assisted mapping in Indonesia. Two types of methodologies partly solve this problem (Gastellu-Etchegorry and Ducros-Gambart):

1. Automatic, computer-aided mapping by considering textural and contextural information. At this time such methodologies are being developed but are not yet readily operational.
2. Semiautomatic mapping with inputs from the operator (pattern recognation, etc.) and computer (geometric correction, image enhancement, etc.). Its implantation on locally available micro-computer-based systems is a major advantage of this technique.

LOCAL OPERATIONAL ACHIEVEMENTS

All studies that are briefly presented were achieved at PUSPICS (Gastellu-Etchegorry, 1988), Yogyakarta, with readly available micro-computer-based systems and supplies. They were intended for testing the operational use of satellite data in a center without large computer facilities. The SPOT system was particularly considered because it now appears to be the best adapted satellite system for many application in Indonesia.

Cartographic Aspects

One requirement of satellite data for use in monitoring small agroforest ecosystem management operations such as those in Central Java is that remotely sensed data can be precisely registered with sources of local data. With this requirement in mind, a study was conducted to provide a basic assessment of SPOT cartographic accuracy, compared to local cartographic documents; i.e., 1:50,000 Transverse Mercator (TM) topographic maps.

Simple bilinear transformation of level-1B SPOT data led to imagery with standard deviation accuracy better than two pixels: 1.77 and 1.34 pixels for longitu-dinal and latitudinal directions, respectively. Moreover, in a first approximation, SPOT imagery could be considered as the result of a rotation, enlargement, and linear shift of 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 (60x60 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 a 17^0 angle of incidence, as in the present study.

SPOT was tested as an operational data source for up-dating the 1:50,000 TM map of a 20x20 kilometers area in Central Java. This map was 50 years old, without any revision in 20 years. During this period a major change occured, 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 superimposing 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 3.5 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 taht achieved at PUSPICS. This is special importance in Indonesia where most 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 constraint a major point was noted, especially for computer-aided approaches: when fine spatial resolutions are used it may be impossible to consider broad land-cover units as classes. 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 variances for most environments (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 semiautomatic and layered, textural/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 depends largely on the characteristics of these and of surrounding features. Second and third levels were obtained in this study. With the aid of field checking, an average 90 percent accuracy was found for SPOT derived land-cover maps. This mapping was undoubtedly cheaper than with aerial photographs; this is clearly confirmed by Bakosurtanal, which considers than surveys with SPOT. This suggests than in Indonesia SPOT has the potential of a amjor data source for deriving land-cover mapping down to 1:50,000/100,000 scales.

Agricultural-suburban Interface

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 Yogyakarta, Central Java.

Because no detailed vegetation discrimination was required, 1:50,000 black and white prints of level 1B-SPOT-P data proved to be particularly useful for providing accurate mapping of settlement-agricultural interfaces. 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 stereo-plotting of 1:30,000 NIR aerial photographs (1987). Results derived from aerial photographs and SPOT appeared to be consistent. Only consistent overall acreages 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 Yogyakarta was very much modified (Table 2). The acreage of urban/suburban areas nearly doubled, whereas the acreage of agricultural lands decreased significantly.

TABLE 2.
PERCENTAGE OF SETTLEMENT (VILLAGES AND MIXED GARDENS), URBAN AREAS, CULTIVATED AREAS AND OTHERS (ROADS, RANGE LAND) WITHIN A STUDY AREA (400 SQUARE KILOMETERS) AROUND YOGYAKARTA.

Year	Settlements	City	Cultivated areas	Other
Photo, 1965	26	6	62	6
Photo, 1981	40	9	46	5
Landsat, 1983	43	9	42	6
SPOT-XS, 1986	43	12	38	7
Photo, 1987	45	11	37	7

Forestry

Forests are Indonesia's most valuable potentially renewable resource and the most important non oil export commodity. Slightly less than two-thirds of the land area is forested totaling between 800,000 and 1,200,000 square kilometers depending on definition and estimates. Today, concern is increasing that this resource is being depleted rapidly rather than being managed for sustainable long-term benefit. Present deforestation is mainly due to forest logging and shifting cultivation. Moreover, access improved by logging roads encourages shifting cultivation. Consequences of forest degradation and/or destruction are often catastrophic for the environment: i.e., soil erosion, floods, and the like.

Consequently, forest management is of special importance for Indonesia. This activity requires repetitive surveys that cannot be routinely achieved with the conventional means of field checking and/or aerial surveys. In this context, remote sensing has the potential of a major data source for forest monitoring. Accordingly, a study (Laumonier et al., 1987) was initiated for assessing SPOT's capability to handle specific problems related to vegetation identification and monitoring.

Basic photointerpretation an digital processing techniques emphasized the usefulness of SPOT data for the aprasial of tropical vegetation at medium scale. This way particularly striking for the swampy vegetation types including mangroves, and for the secondary vegetation. It appeared that 20 meters ground resolution of SPOT-XS is still not sufficient to provide information on primary forest patterns, or to identify properly slightly logged areas. Nevertheless, several degrees of depletion of the forest and serial growth stages were identified. This undoubtely shows considerable progress when compared with previous remote sensing systems. In short, results of this study suggest that for tropical vegetation mapping at medium svale, SPOT is undoubtely a very good alternative to aerial photographs at 1:100,000 and 1:50,000 scale. Moreover, SPOT data partly solve past difficulties for extrapolation between the general data provided by Landsat-MSS and detailed information of large-scale aerial photographs.

Soils and Geology

The geology and soils of central Java were mapped (1:50,000- 100,000) with SPOT (Gastellu-Etchegorry et al., 1988). The main power of SPOT proved to lie in high spatial resolution, combined with stereocapability. 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 geological factors.

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 map. Moreover, SPOT derived map were achieved much faster. However, when SPOT stereospairs were not available, small structural features could not be observed. The opportunity to derive and correct medium scale geologic and soil maps is very valuable in a country like Indonesia where the geology and soils of many areas still poorly mapped or not mapped at all.

Finally, it was shown that SPOT-XS and SPOT-P data can come close to taking the place of 1:100,000 and 1:50,000 aerial NIR photography, respectively. This is especially interesting when one considers the added advantages of being able to analyze digitally data for special problems and applications, including quantifying components of land use, determining the area occupied by each such components and developing numerical discriminations 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 SCOT CONSEIL (1988) at BPTT'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 interest of remote sensing technology because it is used in operations embracing two distinct economic approaches:

1. The market economy, that aims at realizing short-terms 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 realization of a project and its indirect effects. Such is the case of decision making whose accuracy is due to the synoptic 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 Bozz-Allen & Hamilton (1987), is presented.

TABLE 3.
REMOTE SENSING DATA ACQUISITION COMPARED WITH PROJECT COSTS
(Percentage)

	Total cost of project	Cost of study using R.S.	Cost of R.S. as % of the study	Cost of R.S. as % of project
Agriculture	100	10 - 30	2 - 3	0.2 - 0.6
Forestry	100	20 -30	2 - 3	0.4 - 09
Land use	100	10 -15	3 - 5	0.3 - 0.75
Water resources	100	5 - 40	5 - 7	0.25 - 2.80
Engineering	100	3 - 5	3 - 7	0.09 - 0.35
Cartography	100	100	3 - 10	3 - 10
Environemnt	100	30 - 80	3 - 10	0.9 - 8
Exploration	100	5 - 15	1 - 2	0.15 - 1.40

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, EC, etc.) and the list of development projects whose census was made by the Ministry of Development (BAPPENAS). These project were analyzed during meetings with a number of Indonesian ministries and bodies. General tendancies, 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 new 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.
POTENTIAL DEMAND IN THE PUBLIC SECTOR FOR REMOTE SENSING DATA

	Total number of images per year	Number of images per year for projects already financed
Mapping	765	350
Geology	135	20
Planning	160	10
Urban study	30	5
Regional development	230	60
Forest	630	455
Irrigation	175	90
Agriculture	125	105
Total per year	2,250	1,095

As seen in this 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 to come.

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 better cartographic accuracy, these latter should be preffered 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 won 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 prerequisite to be authorized by the authorities 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 explicity 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 INKINDO, a body embracing the consultants that intervene in Indonesia. In this connection, the Indonesian Ministry of Research and Technology, through BPPT, 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 constraints 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 implantation 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.

REFERENCES

Anderson, J.,R., E.E. Hardy, J.T. Roach and R.E. Witmer, 1976. *A land use and land cover classification system for use with remote sensor data*, U.S. Geological Survey Professional, pp. 28.

Booz Allen & Hamilton Inc., 1987. *Report*, Paris Nov., 1987.

Denis, P., 1987. *Metric applications of SPOT's lateral stereoscopy, in SPOT Symposium*, Paris, pp. 1267.

Denis, J., A. Grotte, J. Populus, E. Dutrieux, 1987. Application of SPOT imagery for oil spill contigency planning, *Procceding of Symposium SPOT 1, Image Utilization, Assessment, Results*, Paris, Nov. 1987, pp. 1069-78.

Gastellu-Etchegorry, J.P., 1988. Cloud cover distribution in Indonesia. *International Journal of Remote Sensing*, No. 7, pp. 1267-76.

Gastellu-Etchegorry, J.P., 1988. Predictive models for remotely- sensed data acquisition in Indonesia. *International Journal of remote Sensing*, Vol.9, No.7, pp. 1277-94.

Gastellu-Etchegorry, J.P., A. Husson, J.P. Antikidis, 1988. *A SPOT/LANDSAT Receiving Station in Indonesia, an Economical Investigation of SPOT's Use and Receiving Station Configuration*, SCOT CONSEIL report.

Gastellu-Etchegorry, J.P., D. Ducros-Gambart. Computer Assisted Land Cover Mapping with SPOT in Indonesia, *International Journal of Remote Sensing*, ed. accepted.

Latty, R.S. and R.M. Hoffer, 1980. Computer-based classfications accuracy due to the spatial resolution using per-point versus per-field classification techniques, in *Machine Processing of Remotely Sensed Data Symposium*, West Lafayette, IN.

Laumonier, Y., U.R. Djailany, J.P. Gastellu-Etchegorry and R. Barkey, 1987. Assessment of SPOT satellite based system in humid tropical vegetation identification, classification amd monitoring, in *Proceeding of Symposium SPOT Image Utilization, Assessment, Results*. Paris, November 7, pp. 613-22.

Malingreau, J.P. and Sutanto, 1986. Remote Sensing in Indonesia. *ITC Journal*, No. 3, pp. 206-16.

Markham, B., L. and J.R.G. Townshend, 1981. Land cover classification accuracy as a function of sensor spatial resolution, *Proceeding of the 15th International Symposium on Remote Sensing of Environment*, Ann Arbor, pp. 1075-90.

Sadowski, F.G., J.E. Malila, J.E. Sarno, and R.F. Nalepka, 1979. The influence of multispectral scanner spatial resolution on forest feature classification, in *Proceeding of the 11th International Symposium Remote Sensing of Environment*, Ann Arbor, MI, pp. 1279-88.

Toll, D.L., 1983. Preliminary study of information extraction of Landsat TM data for a suburban/region test site, in *Proc. of Landsat-4 Science Characterization Early Results Symposium*, Goddard Space Flight Center, Greenbelt, MD, pp. 387-402.

Toll, D.L., and R.E. Kennard, 1984. Investigation of SPOT spectral and spatial characteristics for discriminating land use and land cover in Prince George's County, Maryland, in *Proceeding of SPOT Symposium*, pp. 165-170.

Woodcock, C.E., A.H. Strahler, and T.L. Logan, 1987. Stratification of forest vegetation for timber inventory using Landsat and collateral data, *Procceding of 14th International Symposium on Remote Sensing of Environment*, San Jose, Costa Rica, pp. 1769-87.

The Indonesian Journal of Geography Vol. 21 No. 62,
December 1991, pp. 27 - 33

RURAL BASIC SERVICE DEVELOPMENT: An Operational Approach

by
Agus Sutanto *

ABSTRACT

Approach on the study or rural service development is often both development indicators are interchangeable. However, the two studies are closely related and could 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 be seen can clearly, 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 Thunen, rank size rule developed by Felix Auerbach, and the Christaller central place model and its extention by August Losch (Hagget, 1972). By inventorying 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 Sutanto, MSc. a yunior staff member of the Department of Rural and Regional Development Planning, Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia.