Land use change on the urban fringe

R. D. Hill

Until recently, much of the research done on urban areas has treated the city as a contained entity, having a well-defined perimeter beyond which the countryside could be said to begin. Increasingly, however, studies like those conducted under the MAB-SCOPE programme on 'Urbanization and Environmental Change', are emphasizing the dynamics of urban growth. One aspect of this is the loss of rural land to urban sprawl and the other mixed land uses which seem to characterize this twilight zone. Ron Hill's article examines the changing profile of the urban fringe in different parts of the world, and gives some examples drawn primarily from South-East Asia of how this problem is being managed.

One of the most visible results of an urbanizing world is the spread of cities over previously rural landscapes. The dynamics of urban growth are most evident at the urban-rural fringe, especially where the built-up area is continuous.

Some cities, of course, do not have a rural fringe. The walled city of yesteryear certainly did not (basically for military reasons), though in Europe and Asia cities commonly developed an *extramuros* beyond the walls during late mediaeval times. In our day, legal 'walls' may curtail the development of an urban fringe as effectively as a physical one, and this is particularly the case in socialist countries or where, as in Hong Kong, the state owns the land peripheral to the city and stringently controls its use. In such cases the city stops, and the countryside starts, giving extremely sharp land use and population density gradients.

The geometrical shape of the urban fringe is highly variable. It is much indented where urban uses sprawl out along highways, or quite regular often nearly circular in other instances. The factors influencing shape include slope, particularly as this affects building costs, the risks and costs of potential and actual flood damage as well as zoning and other building regulations and, of course, their enforcement The optimal size of plots of land available to developers may also be important, for the unit cost of dwellings or standard design factories is usually lower in large estates than for single units.

Though the precise delimitation of the urban fringe may be problematical, there can be little doubt that worldwide fringe areas are growing, even if the larger the area of a city, the less the proportionate growth of its urban fringe. Imagine a circular city covering 50 km². If its area grows by 1 km², the periphery will grow by only 0.25 km. Similarly, a city of 100 km² growing by 1 km² will extend its perimeter by only 0.20 km. This is exemplified by the Malaysian capital, Kuala Lumpur shown in Figure 1. The changing relationship of area and fringe shown here for lack of other data, as a perimeter rather than a zone, is given in Table 1.

TABLE 1. Changes in area and perimeter of Kuala Lumpur, Malaysia, 1895–1974

Year	Area (km²)	Perimeter (km)
1895	1	5
1903	21	20
1924	46	43
1954	96	46
1974	247	92

(After Aiken and Leigh, 1975)

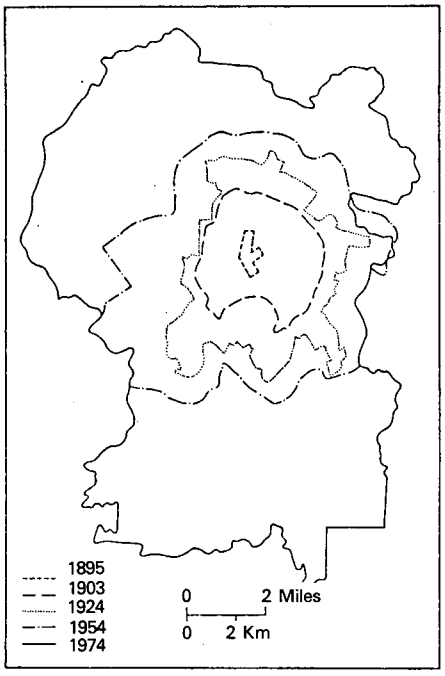

FIG. 1. Changes in the boundary of Kuala Lumpur, Malaysia, since 1895. Such boundaries are indicators, often not very good ones, of change in the extent of the urban fringe.

The expanding urban fringe

The extent of the urban fringe increases in several different ways. The first is by simple expansion around the periphery without any major change in the city's shape Usually this is accompanied by some changes in shape with 'capes and headlands' of urban uses advancing along major roads where transportation and other services may already exist, but leaving behind embayments of rural or partly-rural uses where such facilities do not yet exist The result is convoluted 'coastline' at the urban margin. Subsequently such 'embayments' may fill in as diseconomies of transportation and other services make themselves felt, or as zoning restrictions begin to bite and infilling between major routes takes place. In the Kuala Lumpur of 1924 the urban 'coastline', the urban fringe, was very convoluted but was sub-

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In the Soviet Union, such models of the dynamics of ecosystems on the basis of repeated aerospace photography have been built for different natural and artificial conditions. At first, models of an ecological trend were calculated for simple ecosystems, according to a number of measured states made on the basis of photographs taken at different years. These trends could be extrapolated for eight to sixteen years ahead. Thus, in agricultural areas, repeated aerospace photography has made it possible to predict the dynamics of arable lands and the critical year when the reserve of arable lands would be depleted or reduced due to the exploitation of land for non-agricultural purposes. In rangelands, such an ecological model made it possible to predict the availability of forage, and in particular to predict an increase in the area of encroaching sands due to overgrazing. In an irrigated area it was possible to predict increased desertification of river deltas due to the use of river water for irrigation. Dynamic mathematical models of complex areas are also based on repeated aerospace photography. Some regional dynamic models, built with this method, show the process of urbanization, others the restoration of ecosystems or the stabilization of agricultural use. The latter is reflected in a dynamic model of agricultural lands of the Middle Latvian region based on repeated photographs from 1938, 1956 and 1974. In this model, all elements of the agricultural ecosystem are linked by the probability of one element transforming into another. An analysis of this model makes it possible to produce an eighteen-year forecast, predicting, for example, complete drying up of bogs, a certain increase in the age and productivity of forests, an almost complete disappearance of wet pastures, and low productivity of meadows and scrublands. The accuracy of such a short-term ecological prediction based on repeated aerospace photography and the help of a mathematical model, is about 80 per cent.

Pollution

Pollution of the atmosphere and hydrosphere is one of man's more serious impacts. Increased concentrations of solids in clear waters, which normally look dark on photographs, produce a considerably lighter image. Moreover, there is a direct exponential relation between the brightness of water surface and the concentration of suspended solids, making it possible to determine the amount of pollution by the density of the image. Furthermore, remote techniques help trace chemical, heat and biological pollution of waters. Atmospheric smoke and dust on conventional photographs in the visible spectrum are seen as elongated jets, plumes and streams (normally of a dark grey tone with diffused borders) masking the Earth's surface pattern. Some smoke plumes can be traced for tens of kilometres on photographs. Natural dust and smoke clouds are traced from their source for hundreds and even thousands of kilometres. It can be seen that sources based in one country pollute the air of neighbouring states situated on the down-wind side. For example, judging from aerospace photographs, industrial enterprises in the United States can pollute the air of Mexico and Canada, and British plants – of Norway, etc. Similarly, upstream states can pollute the waters of downstream ones. This is true of the Danube and the Rhine. Even accelerated erosion processes produce international ecological effects. For example, desertification due to overgrazing in North Africa and the Middle East affect optical properties of the atmosphere over Europe which is reached by dust streams in the middle layers of the troposphere.

The future

Large-scale and even superlarge-scale low altitude aerial photography for detailed studies of ecosystems is a promising tool for the MAB Programme. Aerospace technology is being constantly improved and will, in the future, make it possible to conduct regular research, on different scales, on a network of key representative areas of the biosphere. Biosphere Reserves, where main methodological experiments and data banks of aerospace information are expected to be concentrated, are called upon to play a major role in the development of aerospace research within the MAB programme. Space photography of ecological systems will be expanded, to generalize and extrapolate data at the regional and biosphere levels on the one hand, and, on the other hand, to monitor short-term ecological processes. In this respect, Biosphere Reserves will provide ground truth for standardization of aerospace imagery and their ecological interpretation and processing. ■

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Squatter huts, 'tin-shed' factories and some surviving agriculture on the outskirts of Hong Kong, 1974. The simple manufacturing units found in the informal sector cost very little, but in aggregate comprise a significant proportion of industrial production.

sequently straightened. Where city growth is uncontrolled, a characteristic of many Third World cities, the urban fringe often widens until it becomes a jumble of squatter huts, low-cost housing schemes, agricultural land-some abandoned, some intensively-tilled or used for livestock small-scale industry and waste-heaps.

Such disorderly development is not inevitable, however, even as cities spread. By effecting land-use controls the fringe can be narrowed, mopped up on its inner side by 'infilling' with urban uses, with growth on its outer side slowed or halted by the 'wall' of regulation. Singapore, during the 1950s and 1960s, was the scene of uncontrolled squatter slums on the urban periphery, but it has now succeeded in controlling growth and has virtually eliminated its areas of informal housing and 'tin-shed' industries.

A further means by which the urban fringe grows is by incorporating peripheral villages and towns, a process of very long standing (London's Hampstead, for example, was once an independent village). This suburbanization of pre-existing settlements is indicated by change in employment structure towards non-farm activities, by increased spatial mobility of residents who commute to the city, by the refurbishing or total reconstruction of traditional village dwellings, and by the grafting on to the settlement core of blocks of dwellings or small-scale industries to form suburbs which are not truly suburbs of the traditional settlement mode but rather are outliers of a perhaps distant city.

The engines of peripheral growth are well-known, although their relative importance varies. The conventional view is that in the burgeoning cities of the Third World, population growth drives urban sprawl, whether by natural increase of existing city residents whose first-generation migrants tend initially to share the high birth-rates of their country cousins, or by large-scale in-migration from small towns and villages. These give population growth rates of the order of five to eight per cent year, at which rates populations double roughly every 15 or 10 years respectively. If, in the face of such massive migration, urban population densities were to remain constant, thus doubling the areal extent of a circular city of say, 50 km^2, the city perimeter (and, other things being equal), the urban fringe would not double but would increase by only around three-quarters of its initial length. In reality, urban population densities may rise, thus tending further to reduce the magnitude of peripheral spread.

This peripheral spread is both spontaneous and deliberate and derives from

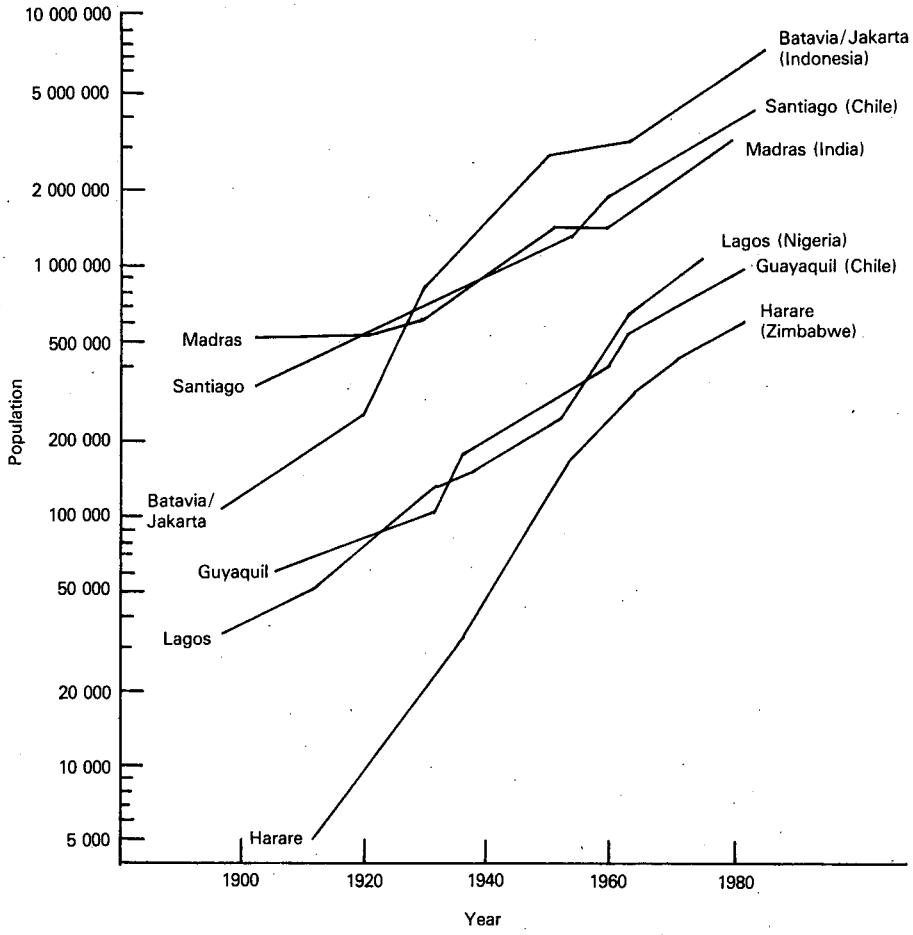

FIG. 2. Population growth of massive proportions is the 'engine of growth' for urban spread. On this logarithmic graph each major division represents a whole order of magnitude of growth for these selected Third World cities.

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several concurrent processes. As British urban geographer Denis Dwyer has noted, upper-class inner city residents move to the periphery where they can obtain less-crowded living conditions, often in Western-style suburbs from which they are easily able to meet the additional costs of transportation. At the same time, some working-class people move to less desirable parts of the periphery in search of low rents and the opportunity to engage in supplementary vegetable-growing and stock-rearing. There they are joined by recent migrants to the city and increasingly, by inner-city residents who have been forced to move there by authorities anxious to redevelop decayed inner-city residential areas.

In the developed world, peripheral growth has long been characteristic of urban areas even though population growth has been slower than in developing countries. This has led to the well-known 'doughnut phenomenon' in which inner cities have generally lost population, notwithstanding the 'gentrification' of some inner city areas, and the periphery has steadily grown as overall population densities have fallen. Many observers think that this phenomenon is of recent origin but Marion Clawson for the United States and Colin Clark for the United Kingdom have shown that central city population loss growth is of long standing and that its alleged recency is partly an artifact of boundary changes. The fact is that the areal extent of cities and consequently the size of the urban fringe has tended to grow more rapidly than population.

But the reality is complex. It is simply not true, as some claim, that in the Third World, inner cities have become more and more densely occupied thus implying peripheral growth at rates lower than those which would exist if inner city population densities fell or remained constant. It is true that major Third World cities have grown rapidly, especially since about 1950, but it is not possible to generalize about the consequences: some population densities have tended to fall, while others have not. In Rangoon (Burma) for example, densities fell from 770 persons per hectare in 1931 to 460 in 1951. In Kingston (Jamaica), the change was from 264 in 1911 to 143 in 1943 with only a slight rise, to 158 by 1960. More recently the population density of the built-up area of Nanjing (China) fell from 231 persons per hectare in 1949 to 168 persons per hectare in 1979 while Hong Kong's urban density fell from 478 persons per hectare in 1960 to 310 by 1980. By contrast, the density in the Indian city of Pune (Poona) rose from 368 in 1881 to 775 in 1953 and even in the developed world, to take just one example in the American city of Springfield, densities in the central area rose between 1950 and 1960. A recent study of major East and South-East Asian cities indicates rising densities over the last two decades but this, like many others, is based upon administrative rather than land-use based definitions of the cities concerned and a significant proportion of such growth is in reality, merely an artifact of successive boundary changes. Certainly Third World city densities are not substantially higher

In appearance a typical rural village, but in reality the suburban home of industrial workers, mainly Malays and Indians. Radin Mas, Singapore, 1973.

than those which have existed until recently in the West. Though it is well over a century since London had a density in excess of 1,000 persons per hectare, Paris had a density of 1,820 persons per hectare as recently as 1931.

It is not surprising that deconcentration and peripheral growth should be near-universal for transportation technology by bus, subway, train, jeepney, Mammy wagon, private car or bicycle. Even for the poorest people, for whom all of these means are too costly, there is always the alternative of free-loading or walking. In some Third World cities, studies have shown that on-foot journeys to work of up to 10 km each way are not unusual. Thus on the margins of all cities, in developed and developing countries alike, the urban fringe has steadily grown, although for lack of data, not to mention problems of delimitation, it is not yet possible to accurately quantify such growth.

Some effects of peripheral spread

The spread of urban areas into the countryside to form an ever-expanding fringe has a large range of effects upon the environment, upon agriculture, upon transportation, upon architectural types and life-styles. They are essentially irreversible excepting only that agricultural land, once abandoned, can be put back into cultivation, even if it rarely is. These effects are also interlocking in often complex and unexpected ways. Here the focus will be on two main areas of change: periurban agriculture and the encroachment of non-agricultural uses.

Except in North America and parts of Western Europe, agricultural areas near cities tend to comprise some of the nations' best lands not only because flat, well-drained lands are equally attractive for urban or for agricultural pursuits, but also because such lands have been made highly productive by generations of farmers supplying the city with perishable foodstuffs. When such lands come under pressure for conversion to non-agricultural uses, agriculture makes a number of different responses which seem quite universal. One response is the further intensification of agriculture, usually by increased capitalization. Marketing chains may change somewhat as farm zones become accessible to city-dwellers, and direct off-farm sales gain importance. This type of response, which may have a 'public amenity' component, is often hindered by concurrent changes at the national or international level involving reduction in the advantages of proximity to the city by such technological advances as improved refrigeration or the development of varieties of fruits and vegetables with long shelf-lives. In any event, unless land use controls are particularly effective, lands under such intensified cultivation eventually succumb to urban uses.

Akin to the intensification of existing agricultural practices is the development of new agricultural areas in the urban fringe. In developing countries these may include a subsistence component as im-

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migrant farmers, whether full-time or part-timers because also engaged in urban occupations, come to settle within easy reach of the city. Amongst recent migrants, the desire to ensure subsistence or at least to provide the domestic economy with supplementary foodstuffs from home gardens, seems remarkably persistent and is almost certainly a factor in choosing a peripheral location in which to live. Thus around the fringes of Goroka, Papua New Guinea, for example, is a zone of comparatively recent agriculture which includes the cultivation of basic staples such as sweet potatoes, vegetables for self-consumption and for sale, as well as coffee, which is a fully commercial crop.

A further response to pressure from the city is maintenance of existing agricultural land use at roughly the same intensity but with a change of the household economy. Small farms near cities can often be maintained by substituting capital for labour on the farm and by obtaining urban employment, either full-time or part-time, in order to balance the domestic budget. This is particularly the case in Western Europe where former peasant farms on city margins (or at a distance) are maintained as going concerns by high levels of mechanization even though this may be 'uneconomic' from some points of view because of often very low utilization of machines. Productivity on such farms, in terms of labour and area, is often just as high as on larger farms in fringe zones.

Another response is disintensification – a somewhat ugly term that refers to the lowering of levels of labour or capital input while maintaining some form of agriculture. This is particularly the response in areas beyond the reach of daily commuting but within reach of the weekender. Livestock requiring daily care such as chickens or dairy cattle are replaced by grassland with easily-maintained stock such as dry cattle, horses or sheep, or by crops not requiring frequent attention such as wheat, vines or fodder. This type of change is by no means confined to the capitalist world. In Hungary, for example, it is a common objective for city-dwellers

'Informal' housing in this 'permitted area' of Hong Kong is provided with minimal services including water (from standpipes). Similar areas now house about 400,000 of Hong Kong's 5.3 million people.

to have a second country home with a hectare or two of vines or fruits trees.

A further change may involve the taking in of other city-dwellers as temporary boarders on the farm as farms become 'service farms' rather than strictly agricultural farms; but whatever the economic change may be, agricultural land uses and thus the public amenity value of agricultural landscapes are maintained and in many developed countries this is seen as a socially-desirable objective.

But economic and political forces often conspire to lead to the abandonment of farming which in turn may lead to land lying unused. Land taxes raised to finance suburban improvements may rise to levels which farmers can no longer pay. The differentials between farm profits and urban wages may rise so high that farming is no longer an attractive proposition. While periurban areas which have quick and easy access to urban employment become suburbanized, perhaps with their agriculture changing in character if it survives, those areas without such accessibility may be abandoned as former farmers move to the city.

Such is the case in Hong Kong, for example. Once agricultural lands begin to be abandoned, even if not immediately taken up for urban uses, problems emerge. Abandoned lands quickly become reservoirs of pests and diseases. The increased spatial fragmentation of farming areas can lead to increased transportation and other service costs. A spur road with ten dairy farmers along it may be an economically interesting proposition for a haulage contractor, whereas one 'survivor' surrounded by houses or factories may not. This is but a specific case of the 'threshold' problem in which a sufficient number of farmers is a necessary precondition for maintaining delivery and pick-up services for farms, irrigation systems, paths and access ways. Basic to this scenario is the factor of uncertainty as to the timing of increased taxes, as to an irresistible offer to buy, as to zoning decisions. If the farmer has a high fixed investment, in buildings or in an orchard, he may tend to hang on as long as possible in order to amortize his investment, whereas if he has an easily-moveable investment such as a dairy herd he will tend to move more quickly. On the contrary, it has been suggested that those types of farms (such as cropping) requiring relatively small investments tend to persist in the urban fringe since these farmers can easily pick up and move at any time, whereas highly-capitalized farms will settle in locations where the future of farming is more certain. Certainly, the age of farmers is also highly significant, as studies for the environs of Bangkok show. Younger people, if they are determined to continue as farmers, tend to move away from urban pressures, otherwise they succumb to it and enter the urban work-force. Older farmers tend to continue farming, but soon retire and allow their lands to be converted.

Those who stay may also experience environmental problems–heavy metal pollution near busy highways for example, drainage and sedimentation problems

Market gardens on the urban fringe, Singapore, 1970.

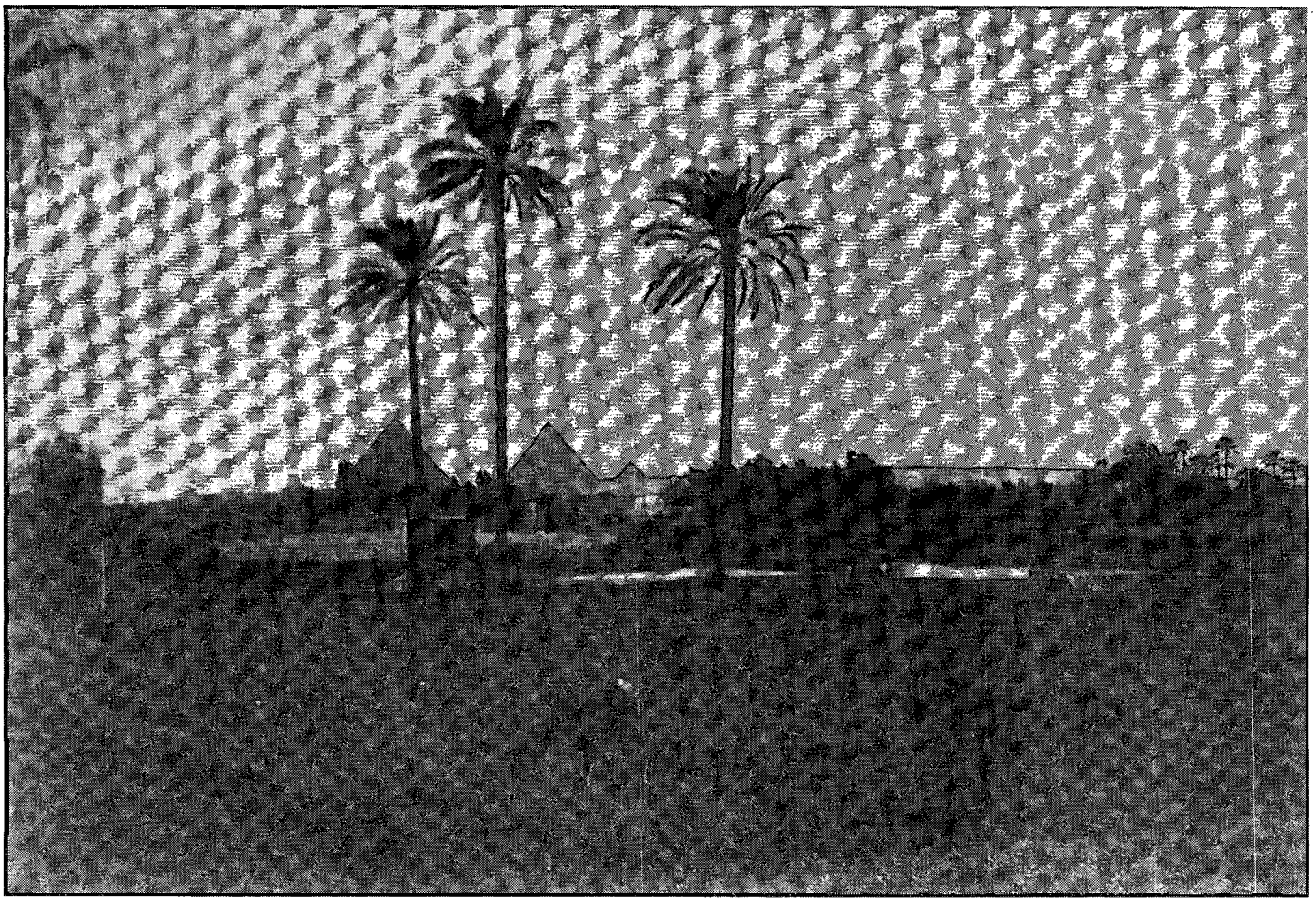
from earthworks for suburban developments, physical damage to gates and fences from urbanites trespassing on their land, theft of crops or livestock and the dumping of rubbish. They may also come to be accused of creating pollution problems, such as noise, bad odours, and effluents. These may be harmless enough to country folk living at comparatively low densities, but become offensive to the ears and noses of sophisticated urbanites.

Conversion of agricultural land to suburbs

The conversion of agricultural land to suburban uses, some of which may include a significant formal or informal industrial component, is of major importance not so much in terms of the total area of land involved, but in terms of its social and economic effects. Few subjects concerned with conservation and the amenity values of rural landscapes have generated so much heat and so little light. Some decades ago, a British authority observed that at the then prevailing rates of land conversion, the whole of Britain would be covered by bricks, mortar and asphalt by the twenty-first century.

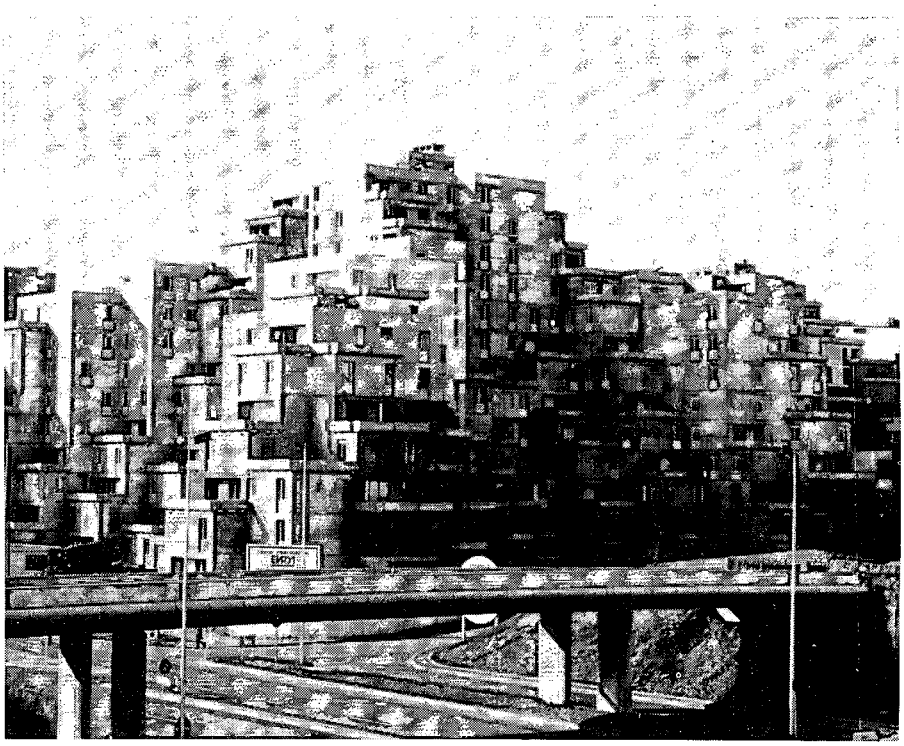
This is much exaggerated, for rates of land use change ought not to be extrapolated to infinity. Others expressed concern that agricultural production would fall as land was 'sterilized' by urban growth. In most countries, however, loss of agricultural land in one area may be compensated for by expansion elsewhere or by increased productivity on the remaining area. In the OECD countries, for example, while the loss of agricultural land to urban uses ranged from about 0.10 per cent to about 1.23 per cent each year for the 1960s, agricultural output increased between 1 and 3 per cent annually. In the United States, to take a striking example, increasing productivity has led to an increase in the output of major produce by about 50 per cent over the last two decades, and this despite an average annual decrease of 2 per cent in the amount of agricultural land. Such is the increase in productivity brought about by pesticides alone, that United States agriculture would require roughly two-and-a-half times as much agricultural land as it now has were yields per hectare to revert to those of the 1950s.

Nevertheless, it cannot be stated with any certainty that trends in agricultural productivity will continue at the same rate as in the past. Complicating the issue in many developing countries is the fact that while technological innovations may be well-known, many farmers may not be in a position to implement them. In such circumstances, productivity increases are minimal and the effect of land conversion may actually lower total production. Of equally serious concern is the fact that while the total supply of agricultural land may be adequate and land conversion may be small in relation to that total, not all agricultural land is the same. Unlike money for which uses are easily substitutable agricultural land is not interchangeable. This is one reason why in major regions, such as Egypt's fertile Delta region, where Cairo is beginning to sprawl, and



This picture of the highly fertile Nile croplands between Cairo and the Pyramids was taken thirty years ago. Today, the whole agricultural area has been lost to housing blocks and urban amenities extending to the very foot of the Egyptian monuments. (Photo: M. Batisse.)

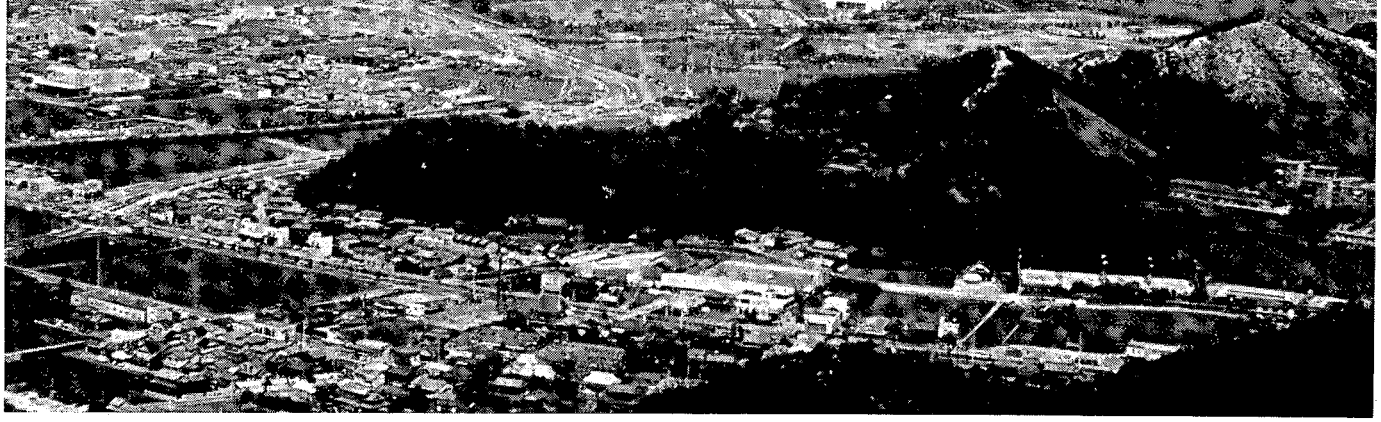
High-density housing like these apartment blocks on the fringe of Paris, France, are generally more cost-effective than low-density suburban developments, because public services such as water, sewerage, or mass transportation networks reach more people at less cost per capita. Besides the economic benefits, such constructions may save land for agriculture or amenity purposes.



Canada's Ontario province, control of urban expansion and preservation of peri-urban agricultural lands is being attempted.

Governmental officials and students of land may also be concerned about other related issues. Regional and national self-sufficiency in food and other agricultural products may not be espoused as firm policies in most capitalist countries as they are in many socialist ones. Nevertheless, there must always be concern on strategic grounds should a nation's best lands, as is often the case, be sterilized by urban sprawl.

Again, as urban incomes rise so, generally, do working hours decrease with a corresponding increase in leisure and



spending upon recreation. In many developing countries, rapid urban growth often with minimal control or planning, has led to a significantly lower proportion of intraurban open space than in most Western cities outside their dismal expanses of nineteenth and early twentieth century workers' suburbs. Consequently, the urban fringe comes under pressure from a multiplicity of recreational uses–places to sit, walk and run, places to get away from the urban jungle for a few hours or a few days. Hong Kong, as a territory ranking at the upper end of the developing country scale, is an illuminating example. In 1978–79, just over 5 million people visited the 41,000 hectares of gazetted country parks in the urban fringe. By 1984–85 the number of visitors had risen to 9.2 million and in the more commonly-visited sections even the soil itself had begun to deteriorate from the trampling of many feet. Additionally, the demand for holiday camps and second residences has burgeoned and put pressure on farming, although as mentioned earlier, such recreational demands may, in some circumstances, help farming to survive. Where it does not, and farmers abandon their lands and their rural villages in the urban fringe, there emerges the problem of how to maintain the amenity value of agricultural landscapes for visitors from the urban areas. The Swiss, more than a century ago, tackled this problem for their scenic mountain regions by offering farmers subsidies, but such an option is rarely open to developing countries, where other priorities apply.

One of these problems is urban sprawl, leading to suburban land conversion, and which in many developing countries is proceeding at an unknown rate. Sprawl is of concern, not so much because it may gobble up good agricultural land (or land that is not suited to agriculture), but because of its great costs. From the economic viewpoint sprawl costs a great deal. One kilometre of tar-sealed, urban two-lane highway costs much the same anywhere. In low-density suburban developments characteristic of the United States or Australia, which house around 40–50 persons per hectare, a kilometre of road may serve only a few hundred or even only a few score of people. By contrast, in Hong Kong's high-rise housing estates, a kilometre of road will serve several tens of thousands of people. Other services, such as water, electricity, gas, sewerage, or public security, are proportionately cheaper per person in areas of dense population. High densities also permit capital-intensive mass transportation networks–like surburban railways to give high frequencies of service at low cost. Since such public services do not directly create wealth or add to a nation's productive capacity, it is in their interests to keep densities high and not to fritter away capital by dispersing services in low density areas. Whether the costs of servicing low-density suburbs are met by private individuals or by governments, they are nevertheless costs which in reality end up being met by the community. This, rather than the loss of agricultural land, is the real reason for objecting to urban sprawl.

Two views of the urban fringe: at left, Mizushima, Japan, where limited controls on land use have produced a mosaic of mixed industrial, agricultural and residential zones; at right, walk-up public housing, wasteland and squatter shanties on the outskirts of Bombay.

But is sprawl avoidable or at least controlable? On the margins of the developed world's cities where spread derives largely from decreasing overall densities rather than from rapid population growth, the answer is probably in the affirmative. A number of writers have pointed out that the particular structures of local government and its fiscal policies, together with preferential lending to buyers of new homes–most of which come to be built on the urban fringe–lead to sprawl. In some countries, there is practically a national 'consensus' that suburban living is part of being a 'true' American, Australian, New Zealander or whatever. A high price is paid for this idea, despite the fact that significant proportions of suburban-dwellers (about one-sixth in one New Zealand survey) do not really wish to live there, but would prefer a higher-density, inner-city environment were that environment to be as safe and as pleasant as suburbia. Perhaps policies and attitudes will change.

In the developing countries there can be little doubt that sprawl is virtually uncontrollable. Most have poorly-developed bureaucratic infrastructures and heavy financial commitments to keep national economies functioning and if possible, growing. Control is therefore neither politically nor economically feasible. The best that can be hoped for is for some upgrading of so-called squatter, informal or spontaneous settlements on the urban fringe. They result from demographic and economic transformations of unprecedented magnitude. There is no stopping them. But there is hope. In the first place, such informal settlements (e.g. *favelas, bidonvilles*) are in many cases of quite high density, certainly of the same order as many housing estates in such cities as Hong Kong or Singapore. This means that services, as they gradually come to be provided, are delivered at a comparatively low cost per person. In the second place, rapid population growth does not last for ever. Within a generation, if not sooner, migrants to the city adopt urban fertility patterns leading to slower growth, even though demands for land may not slow at the same pace because of higher rates of household formation (a shift from extended to nuclear families, for example) and because of demands for greater personal space as incomes rise. Even rural-urban migration will eventually slow and there is already some evidence that rates of migration to large metropolitan cities (Bangkok is one) are beginning to slow while medium-sized regional centres still have high migration rates. As population growth slows and where rising incomes enable governments to exercise greater control over the spatial growth of cities, there is every likelihood, as in Singapore, that the chaotic mixture of land uses, geographers term the urban fringe, may narrow or even disappear. In the meantime, they would dearly wish to know the spatial dimensions of land use change at the urban fringe, not from mere curiosity but because such knowledge would aid understanding of a near-universal phenomenon. ■

Bulletin of the Man and the Biosphere Programme

Scientific Advisory Panel for Biosphere Reserves

There has been considerable development in the concept and implementation of the international network of biosphere reserves, particularly concerning the role they can play in rural development and in the participation of local peoples in management of biosphere reserves. These were among the conclusions of the first meeting of the Scientific Advisory Panel for Biosphere Reserves held from 2 to 6 September 1985 in Cancun, Mexico. The meeting was jointly sponsored by Unesco and MAB-Mexico with the co-operation of the Consejo Nacional de Ciencia y Tecnología (CONACYT), the State of Quintana Roo and the Centro de Investigaciones de Quintana Roo.

The Panel was established after the approval of the Action Plan for Biosphere Reserves by the MAB-ICC at its 9th session. Its role is to review and assess the criteria for selection and management of biosphere reserves, to evaluate the effectiveness of the biosphere reserve network and to provide guidance in the implementation of the Action Plan. The first Panel meeting was presided over by G. Halffter, the ICC Chairman, with the following experts in attendance: M. Batisse (France), G. Francis (Canada), W. Gregg (USA), W. Lusigi (Kenya), G. Mann (Chile), M. Soule (USA), H. Synge (U.K.), J. McNeely (IUCN), B. von Droste (Unesco), J. Robertson (Unesco), J. Janik (Czechoslovakia), C. Palmberg (FAO), A. Gomez Pompa (Mexico).

The Panel meeting provided several directions for the implementation of the Action Plan for Biosphere Reserves. These concerned the elucidation of the core and buffer zone concepts, the establishment of common criteria and research themes and the further development of traditional land use in biosphere reserves.

The Panel reaffirmed the standard characteristic of biosphere reserves – that they include one or more protected core areas consisting of ecologically representative samples of natural or minimally disturbed ecosystems, where natural evolutionary processes occur and where the conservation of genetic resources is ensured. Such core areas should have clear boundaries although they need not be contiguous, as in the cluster concept of biosphere reserves. This core area is then surrounded by a transition zone which serves several functions including its role as a buffer to help ensure the core area's conservation function. The transition zone also includes any one or some combination of the following types of areas:

(a) areas suitable for manipulation, experimental testing and application of ecological research to develop, assess and demonstrate management practices for sustainable development;
(b) examples of harmonious landscape for traditional landuse;
(c) modified or degraded ecosystems suitable for rehabilitation.

In addition, the transition zone may include a larger and not necessarily delineated area where co-operative activities between researchers, managers and local people are undertaken to ensure appropriate physical planning and sustainable development in the region. This multiple use zone forms the area of co-operation, or zone of influence of the biosphere reserve.

While reaffirming that conservation was the primary objective of biosphere reserves, the Panel underlined that the important distinction of biosphere reserves from other kinds of protected areas is their dual role in both protecting natural resources on the one hand, and furthering research, education and sustainable land management on the other. They thus contributed to economic development on both a local and national basis as well as to global research and monitoring.

Another theme discussed by the Panel was that of maintaining traditional land use systems in biosphere reserves. In many areas of the world, the "natural" landscape is one that has been formed and is maintained by man. The introduction of modern agricultural technology can completely destroy this balance, not only through the introduction of pesticides and fertilizers, but also by introducing new species. The Panel, therefore, proposed that research in biosphere reserves should concentrate on the role and importance of traditional use systems in maintaining the stability of ecosystems as well as their more obvious role in maintaining the social and cultural stability of people living in and around biosphere reserves.

Noting that this was a period of improvement and development of the international network of biosphere reserves, it was recommended that national working groups be set up to help ensure these two processes. A clear set of definitions, criteria and common directions of research in biosphere reserves was needed. The establishement of national working groups could also help remedy several shortcomings of the network, namely by improving: the information links between reserves; communication and understanding among both scientists and decision makers of what a biosphere reserve is and does; application of criteria for the "structure and function" of a biosphere reserve; the global coverage of major ecosystem types.

The next meeting of the Advisory Panel, with support from the Nature Conservancy International Programme, is scheduled to be held in Bolivia in the summer of 1986.