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Political Implications of Full Cost Recovery for Land Remote Sensing Systems

While the effect of increased data prices will reduce inefficient uses, it will also shift the distribution of applications away from resource conservation and environmental monitoring in favor of resource development.

Abstract: *Government routinely fund expensive data collection programs (e.g., government maps and airphotos) and then sell the data products for the cost of reproduction and handling. The low price of these items and the wide distribution system make them readily available to all sectors of society. A similar policy was followed in setting the price and availability of weather satellite data. However, a completely different philosophy was used when land remote sensing systems such as Landsat were considered.*

During the past five years, governments have become more insistent on recovering the costs of national land remote sensing programs so as to reduce public subsidization of private sector benefits and to discourage inefficient applications. In this paper, it is argued that there is a benefit to society when private firms use remotely sensed data, as well as when the public sector uses these data. More importantly, the increased price of remotely sensed data has a differential effect on the user community. The resulting shift in access to information will have an associated shift in the balance of political power. This shift in power tends to reduce applications research and development in all areas, tends to favor resource development activities, and tends to disfavor resource conservation and environmental monitoring activities. As a result, a change in the price of government produced remote sensing products, such as Landsat data, should be viewed as a public policy decision and not simply as an economic one. Society, having developed the technology and now having control over the facilities, has a stake in the dissemination and continued development of remote sensing products and technology. The same policy used in setting the price and availability of government maps and airphotos should be used in setting the price and availability of Landsat data.

Introduction

There is an old Spanish saying, "Saber es poder," i.e., "knowledge is power." Alternatively stated, information is a source of power—whether it be the buyer who knows more about a section of land than the seller, the environment department with sufficient water quality information to prosecute a polluter, or the United States being able to predict the failure of the Russian wheat crop from the analysis of a January satellite image. The process of generating information from remotely sensed data has political implications that will affect both the effectiveness of technology transfer and the welfare of society.

Until recently remote sensing technology and products, in particular Landsat imagery, were

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heavily subsidized. This was justified on the grounds that it was in the public interest that the technology be developed to the point that it could be profitably marketed. After considerable debate, the decision was made to recover most of the costs of the government-sponsored Landsat program. This has increased the cost of Landsat image products from the EROS Data Center by about two and a half times (USGS, 1982). The change was justified on the grounds that the user should now be expected to pay the full cost of the imagery because it is the user who benefits. If the benefits did not exceed the costs, then the application was inefficient. Insistance on full cost recovery was intended to discourage inefficient applications and reduce public subsidization of private sector benefits.

The previous statements assume that all the benefits accrue to the user and that there is no cost to *not* having the information. This contention will be examined. It will be argued that it is in the interest of society to continue to subsidize remote sensing technology development and products. In part this is because there is often a benefit to society when private firms use remotely sensed data as well as when the public sector uses the data. Perhaps more importantly, as the price of remotely sensed technology and products increase, the distribution of types of applications change. This shift in accessibility due to financial constraints has associated with it a shift in the balance of political power among different sectors of society as well as between rich and poor nations. A pricing policy that substantially reduces the ability of poor nations to acquire imagery in effect subverts the 'Open Skies Policy' according to which these data should be available to all nations of the world. Society, having developed the technology and now having control over the facilities, has a stake in the dissemination and continued development of remote sensing products and technology.

The cost recovery argument is also inconsistent with existing government policies. Governments routinely fund expensive data collection programs such as government maps and airphotos and then sell the data products for the cost of reproduction and handling. The low price of these items and the wide distribution system make them readily available to all sectors of the society. A similar policy was followed in setting the price and availability of weather satellite data. However, a completely different philosophy was used when land remote sensing systems such as Landsat were considered. The current price structure is already severely restricting the data market (Lillesand 1983).

It will be argued that the low price and easy access to Landsat data should be considered as beneficial to society as the availability of government maps, airphotos, and weather satellite data. Land remote sensing satellite data, such as Landsat data, should be made available at a price that encourages wide useage and experimentation with the data.

The User Community

A discussion of the effects of price changes for remotely sensed technology and products should logically begin with the user, for it is the nature of the user community that will determine these effects. The term "user" or "user community," as generally employed in remote sensing, seems to refer to a large heterogeneous assemblage of individuals or small groups with diverse needs for natural resource information. These "users" tend to be treated as apolitical individuals, primarily interested in the efficient allocation and wise use of natural resources. They are assumed to have clearly defined data needs to be met at minimum cost. However, users are often unable to clearly articulate information needs because these natural resource specialists may be unfamiliar with remote sensing methods. User groups also differ in their range of financial resources and political views.

To illustrate some of these political implications, five classes of remotely sensed data users will be described, and then the implications of price changes will be examined with reference to them. The term "remotely sensed data" will here be taken to mean all types of image data (photographic and non-photographic) and both visual and digital analysis techniques.

Mineral Extraction Industry Users

This user group consists of a large number of medium to large firms. It has the financial capability to invest in sophisticated remote sensing technology and expertise. In fact, the petroleum and mineral exploration industry is the largest private sector purchaser of Landsat Data (Henderson, 1984; OTA, 1984). The objectives by which the technology's benefits are defined are the identification, evaluation, and development of economically valuable petroleum and mineral deposits. The costs of using remotely sensed data must be justified in relation to the economic benefits which accrue to the company as a direct result of the use of the data. The cost of the remote sensing equipment and materials is low relative to the total budget available for the project.

Planning Consultant Users

Firms in this user group tend to be small relative to the petroleum and mineral-extraction industry user group. They include such fields as transportation planning; site location and development planning; urban development planning; and environmental monitoring, assessment, and inventory. The budget available for acquiring information is more restricted in this group than in the previous one, because the cost of the equipment and materials represents a higher investment relative to the total budget of a project. It also represents a higher risk if it fails, not only because it represents a higher investment but also because this group of users generates information (e.g., plans and specifications) as its final product. A failure of the remote sensing-based information system is not only a loss of the investment in the process, but can also have an adverse effect on the company's credibility and thus its future success. The criteria by which the technology's benefits are defined are primarily those dealing with the identification and evaluation of surface and subsurface conditions (e.g., soils, vegetation, and water quality).

LARGE GOVERNMENT AGENCIES: THE U.S. GEOLOGICAL SURVEY (USGS) AS EXAMPLE

Among the responsibilities of this agency is the mapping of the country's geology, and the identification of economically valuable minerals. The agency is large and relatively well funded, with a well-defined role, and the stability and influence that come with a long history. The criteria by which the benefits of remote sensing technology are defined are those pertaining to the accuracy and cost of identifying and mapping geologic resources and land use. Experimentation with a new system can be justified as work leading to the development of a better data acquisition procedure or investigation of the general capabilities of the new system. Benefits are considered to accrue to the public both in the potential for better resource information and in the development of a new information process. Though it may be politically difficult to obtain the funds for acquisition of remotely sensed data and interpretation equipment, the funds can be made available, and the agency as a public institution does not bear the risk of financial failure. The benefits and the benefactors are less clearly defined for this group than for the previous two, and while the costs may be high the financial risk is low.

SMALL GOVERNMENT DEPARTMENTS: THE WILDLIFE HABITAT INVENTORY UNIT OF ALBERTA FISH AND WILDLIFE AS EXAMPLE

This group has the responsibility to conduct and guide the inventory of wildlife habitat in the Province of Alberta. The group was small (three individuals in 1982), newly formed (one year old), and had a relatively small budget (e.g., $100,000 for the 1981-82 fiscal year (Stelfox, 1982)). While the objectives of the group are well defined, the beneficiaries of the information are diverse and occur both within and outside government programs. It is difficult if not impossible to estimate the benefits of the information in monetary terms. The costs of using remote sensing technology are well-defined and, relative to the total budget, are expensive. Thus, the consequences of failure would seriously compromise the group's success. Acquisition of equipment and expertise (e.g., additional employees) is severely limited by budget and policy constraints.

THE ACADEMIC COMMUNITY

This user group has a dual responsibility, teaching and research. The two responsibilities are so closely related that they must be considered together. Research projects provide students with the opportunity to gain 'hands-on' experience in remote sensing, provide teaching materials for courses, and keep the universities at the 'cutting edge' of new developments in the field of remote sensing. The academic community depends on public and private sector funding to undertake research.

The beneficiaries of research and teaching activities are diverse. The universities provide personnel, trained in the use of remote sensing technology, to both the public and private sectors. The universities are also a major source of remote sensing information and support, playing an important role in the development of new technology and applications of the new types of data produced, and in the transfer of this technology to other users in the private and public sectors. The Office of Technology Assessment (OTA) noted that, without continued experimentation with applications of MSS and TM data, the market for data and data products will not develop and the potential benefits of sensor systems such as these will not be realized (OTA, 1984).

The cost of imagery relative to teaching and research budgets is high. Steeply rising prices of Landsat data and reductions in research funding have caused some universities to severely reduce their remote sensing teaching and research programs (OTA, 1984). My own informal discussions with professors indicate that the current cost of one MSS computer compatible tape (CCT) from the EROS Data Center represents the course materials budget for one to two university courses. One professor reported to the OTA that a single CCT of TM data can represent a professor's total teaching budget for four years.

Differential Effects of Price Increases

These five user groups are not meant to comprise an exhaustive classification, but collectively they do include most of the users. As noted previously, a rise in the cost of remote sensing products has been justified in terms of cost recovery. In this case, the decision is a public policy decision, and as such should be examined not only in terms of efficient use of resources but also in relation to the social acceptability of the resulting allocation. ". . . efficiency, the main accomplishment of competitive markets, is only one contributor to social welfare. And even if the economy operates with perfect efficiency, we are assured only that we reach an allocation of goods and services such that no one can be made better off without sacrificing another's welfare. We are given no assurance as to which allocation, which point on the possibility frontier, we will actually reach." (P. 292, Stokey and Zeckhauser, 1978).

One effect of increasing the price of remotely sensed data may be that economically inefficient uses will be reduced. However, some of these economically inefficient applications have important social benefits. Another effect will be to change the relative distribution of types of applications. Referring to the five user groups previously discussed, a rise in prices will tend to reduce economically inefficient use within each group. However, it will not do so evenly. Large firms and public agencies, for which the data costs are a small proportion of the total project costs, will tend to be less affected than smaller firms and agencies, and universities for whom the data costs take a relatively large portion of the budget. Perhaps more importantly, the user groups that are less affected tend to be involved in the assessment and development of economically valuable resources. The end products tend to be economically valuable physical products (e.g., minerals, lumber) or direct information about such resources (e.g., a geology map). In contrast, the user groups most affected, such as the second, fourth, and fifth groups, tend to be engaged in planning, inventory, and monitoring activities or teaching and research.

Often, the quality of the analysis results is limited by the cost of the information. In the case of the user in the fourth group noted above, there is no precise way to define an accuracy requirement for the habitat data. If, for example, Landsat data could aid in the habitat assessment, the decision of whether to use Landsat data plus aerial photography or the aerial photography alone may be a function of cost alone, even if the Landsat data do improve accuracy. Similarly in the second user group, a significant increase in the cost of Landsat data would preclude aesthetic applications (such as making a roadway "better fit" into the regional landscape) before it would preclude an engineering application (such as finding the least expensive route for that roadway).

The non-commercial or 'soft values' (i.e., those related to improving environmental quality and the quality of life (see Tribe *et al.*, 1976)) tend to be the first ones compromised when remotely sensed Earth-resources data-costs are increased. It is these soft values that have the greatest positive externalities (spin-off benefits). Society, as well as the individual user, benefits from better planning. These soft values, precisely because they are not easily quantified, are most easily undervalued or deleted from cost-benefit considerations (Kelman, 1981; Tribe *et al.*, 1976). The more commercial or "harder" values, such as reduced costs of mineral exploration or timber-volume prediction, are also of benefit to society, but the benefits are more easily quantified and more clearly reflected in an economic market. In adopting the policy of full cost recovery for remotely sensed Earth-resources data, a decision is being made to allow the data to be allocated by a market system. Two implications of this decision will now be examined. First, can this market function as a free competitive market, and second, what are the social implications of allowing the allocation to be market-determined?

ALLOCATION OF REMOTELY SENSED DATA BY A MARKET SYSTEM-SOME IMPLICATIONS

Remotely sensed data have never been exchanged in a free competitive market, largely due to the peculiar economic characteristics of information. The value of information is heavily influenced by who else has the information. Knowing there is oil under a unit of land will be far more valuable if no one else knows about it. The high costs of acquisition have usually required the government to be the major producer of remotely sensed data (e.g., aerial photography as well as Landsat data) for reasons of economic efficiency (one producer instead of many) and the public good (its availability is in the public interest). However, this also means that the government, as the largest producer of image data, heavily influences the market price. (The price that the private sector can charge will be influenced by the cost and quality of comparable government products.) Finally, there is a multitude of positive and negative externalities (as noted previously) associated with the availability of remotely sensed data. The above mentioned conditions are those of market failure; namely, few suppliers, where an individual supplier has a substantial influence on the price of the product, and where the price does not reasonably reflect the actual costs and benefits of the product (Stokey and Zeckhauser, 1978; Schultze, 1977). Hence, the exchange of remotely sensed data cannot be considered as being in conformity with a free competitive market system.

Given that remotely sensed data cannot be treated as a commodity in a free market system, the decision to raise the price of Landsat data products should be viewed as a public policy decision with specific social implications. What, then, are some of the implications of increasing Earth resources data prices?

One result will be some reduction in all applications of these data due to substitution of other data sources, or a decision to do without the data. However, the result that the writer considers the most important is that there will be a shift in the distribution of applications away from those that enhance "soft" values in favor of those that enhance "hard" values. A shift in the balance of information will also result in a shift in the balance of political power both within a country and between countries. As the price of remotely sensed data increases, the less wealthy nations will find it increasingly difficult to continue to acquire and analyze imagery. At some point the price will become high enough to substantially reduce the ability of these nations to acquire image data, in effect subverting the Open Skies Policy of providing non-discriminatory access to remotely sensed data.

In the natural resources field, increases in image data costs would tend to make the data more accessible to firms engaged in resource development than to those engaged in resource conservation, management, and environmental monitoring. For example, as prices increase, the data become relatively less accessible to financially squeezed government agencies responsible for environmental monitoring (public sector). Should the public sector, having paid the high cost to develop this system, find its own use of the system constrained by the price of data? The political implication is that relatively greater accessibility of the data to the resource development group also gives that group a political power advantage.

Summary and Conclusion

The price of publicly-available remotely sensed data should be viewed as a public policy decision. Associated with the utilization of the data are both positive and negative externalities. The positive externalities tend to be related to non-commercial values, while the negative externalities are related to shifts in the balance of information, with concomitant shifts in political power and a reduction in the level of research and development effort. While the effect of increased data prices will reduce inefficient uses, it will also shift the distribution of applications away from resource conservation and environmental monitoring in favor of resource development. Price increases will also in effect reduce the availability of data to less developed nations.

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