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## **ECONOMIC AND ENVIRONMENTAL FUTURES OF THE BLACK HILLS: A DELPHI TECHNIQUE STUDY\***

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**Abstract.** *The future economic and environmental changes in the communities of the Black Hills were examined through the use of the Delphi technique. The study utilized a panel of 80 experts on the wide range of land-use issues and conflicts in the Black Hills. The panel identified 14 future land-use conflict issues: mining, grazing, timbering, outdoor recreation, wilderness areas, tourism, legalized gambling, second home development, Native American claims, fire management, water management, landfills, traffic management, and the US Forest Service's policies of land-use management. The panel predicted when certain events concerning those 14 issues would occur. Their predictions were then related to the economic and environmental vitality of Custer, Deadwood, Edgemont, Hot Springs, Newcastle, Rapid City, Spearfish, and Sturgis for the next 20 years.*

Land use in the Great Plains is continually changing. This change is very evident in the Black Hills of South Dakota and Wyoming, where vested interests coupled with finite resources lead to land-use conflicts (Fig. 1). The major landholder in the Black Hills is the United States Forest Service via the Black Hills National Forest (BHNF). Historically, the Forest Service adopted a multiple land-use policy. The agency's management philosophy is based upon one universally accepted definition of "conservation," that of maintaining the greatest good for the greatest number over the longest period of time. The BHNF's numerous management plans are the result of many years of trying to balance the multiple uses of grazing, timbering, mining, and outdoor recreation. Yet land-use conflicts continue both within and adjacent to the BHNF.

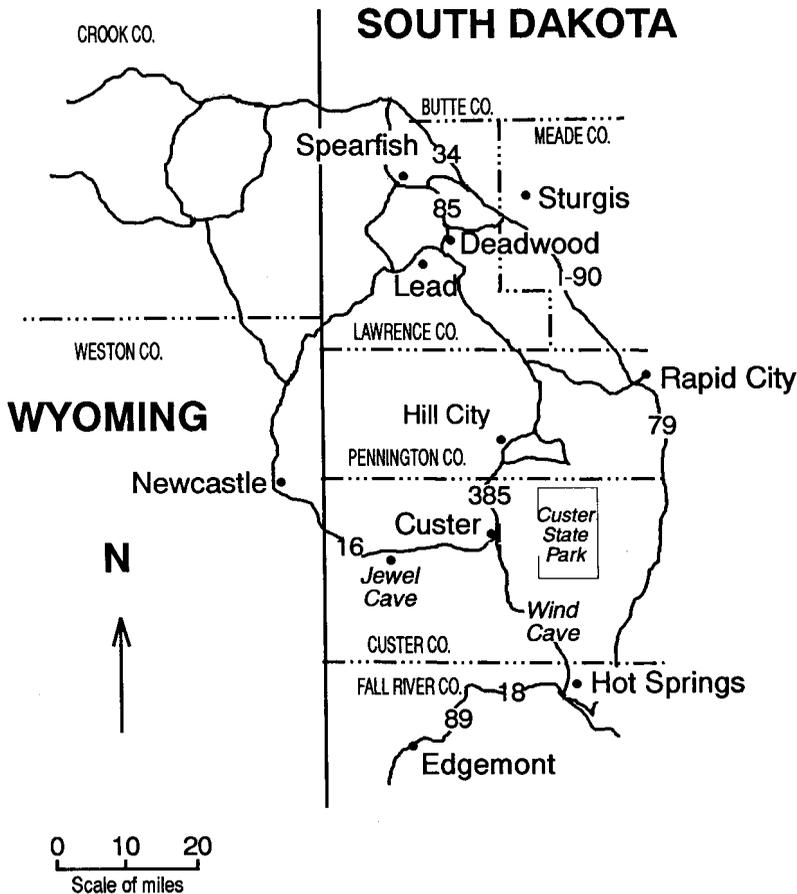


Figure 1. Generalized Map of the Black Hills. Major highways identified by number. Prepared by Patrick L. Jochim.

Despite mandates and efforts to concentrate solely on its own lands, the BHNHF finds itself involved in external land-use conflicts. Land-use decisions by the BHNHF directly and indirectly affect the citizens of the area. For example, the loss of forest recreation in one area of the BHNHF would probably have repercussions on the tourism industry in the Black Hills. The land-use conflict between forest recreation and forest production (grazing, timbering, and mining) is just one of the numerous land-use conflicts in the Black Hills.

Initially, this research focussed on the simple question of the future land-use conflict between forest production and forest recreation in the BHNF. However, preliminary evidence showed that these activities were not only interrelated but also related to other internal and external land-use conflicts. To examine the future relationship between forest recreation and forest production, an investigation was needed of the major future land-use conflicts likely to occur in the Black Hills.

### **Methodology**

To identify and predict possible future economic and environmental conditions and land-use conflicts in the area, the Delphi technique was used in 1989-1991. The technique is named after the oracles of Delphi, whom ancient Greek leaders consulted to learn the future fated by the gods. In America, the modern Delphi technique was first developed by the Rand Corporation in 1948 as a qualitative forecasting tool for eliciting expert consensus on possible futures (Miller 1990). The technique focuses on the strength of personal insight by well-informed individuals rather than on forecasts derived from theory. The projection of future events, including that of public policy, can be realized by combining the expertise of a panel of experts into group consensus. Numerous rounds of prediction (mailed questionnaires) provide systematic feedback of information to the panel of experts as they converge toward consensus (Stynes 1983). Modified Delphi techniques have been utilized in a variety of situations worldwide (Hudson 1974; Masini 1989; Smith 1980; van Doorn and van Vught 1983), including rural development (Smith 1978).

#### **Panel of Experts**

The Delphi's use of a panel of experts allows for independent yet consensus-building identification of the important future land-use conflicts. Through the use of a series of mailed questionnaires to the panel, the Delphi sought consensus on future land-use conflicts and when certain events concerning those conflicts will occur in the Black Hills. If consensus was not

reached on the timing of some events, then that information was not considered to be a conclusion.

The panel was composed of persons knowledgeable of readily identifiable land-use conflicts in the Black Hills. Through personal interviews, telephone calls, and a review of the literature an original list of 125 persons eligible for the panel was compiled. A proposed panel of experts was created, attempting to balance public, private, and other interests. The panel was to have as equal representation as possible from the public sector (elected officials, federal, state, and local employees), the private sector (mining, grazing, timbering, commercial recreation/tourism), and quasi-public or other categories (Native Americans, environmental organizations, writers). In addition, a conscientious effort was made to balance the panel between known viewpoints and vested interests. This requirement reduced the number of possible panel members to 100 persons, who were invited by mail to be on the panel of experts. They were promised anonymity and confidentiality.

Eighty people agreed to be on the panel of experts. The composition of this 80-person panel was reviewed to ensure a reasonable cross-section of interests in and expertise on the Black Hills. Some panelists by the nature of their education and professional work represented more than one viewpoint or expertise. For instance, a county commissioner could also be a cattle rancher, or a forest service employee could be an outdoor recreation planner and an active participant. Some panelists earned their living with companies that had a combination of interests, such as mining, grazing, outdoor recreation, and timber. Thus one cannot accurately categorize or label all panelists. The representation was approximately as follows: county/local government, 18; state government, 15; federal government, 13; grazing, 2; mining, 8; timber, 3; commercial recreation/tourism, 6; environmental organizations, 9; writers, 2; Native Americans, 2; and others, 2. It is assumed in the Delphi technique that, when promised anonymity and confidentiality, the person's label becomes less important than their knowledge and interaction with the rest of the panel through the feedback/commentary sections of the questionnaires. It should be noted that it was easy to enlist willing participants from the production industries, but far more difficult to identify Native Americans with both the necessary expertise and a willingness to serve on the panel.

At each stage of the process, the panel was considered to be in consensus on any answer if 75% or more of those panelists responding to the question agreed on the likely timing of an event (Smith 1980). At the end of the study, the panel had reached consensus on approximately 80% of the 102 final questions.

Land-use conflicts in the Black Hills have a highly charged nature. Many panelists needed the security of anonymity and confidentiality. By request, in certain cases mailed questionnaires were sent to homes and not business addresses. Thus no identification of nonrespondents was attempted for follow up purposes. A follow-up reminder to nonrespondents might have seriously jeopardized the future response rates and thus the study. Since we did not know who had responded, no panel member was dropped from the study due to a failure to respond to that round of the study. Two panelists, for different reasons, did ask to be removed from the panel and were obliged. Two other individuals moved out of South Dakota to other employment. They were removed from the final round. No substitution was attempted. Thus, after four rounds of mailed questionnaires between 1989-1991, a total of four individuals had left the panel. This rate of attrition did not represent any discernible pattern or trend.

### **The Questionnaire Rounds**

In round one, an open-ended questionnaire asked each expert to identify the most important land-use conflicts in the Black Hills. They were instructed to consider only those conflicts that they felt comfortable in discussing. They identified the following fourteen major land-use conflicts: water management, fire management, traffic management, waste management, tourism, legalized gambling, outdoor recreation, wilderness areas, Native American claims, the US Forest Service's land-use policies, grazing, mining, timbering, and second home developments. The rate of return was 80%.

The second, third, and fourth rounds of mailed questionnaires focused on these 14 land-use conflicts and asked when certain events concerning them would occur: by the years 2000, 2010, 2020, or never. Open-ended commen-

tary about each question was also solicited. The commentaries from round two were summarized and edited for inclusion into round three's questionnaire. Some comments pointed out weaknesses in a few of the questions and the questions were subsequently dropped from the third and fourth questionnaires. The rate of return in the second round was 44%.

Results from the third round of questions indicated that the panel had already reached consensus on a small number of the questions. Those questions and their respective answers were thus omitted from the fourth and final questionnaire. Third round consensus items, however, were included in the final results and analysis. Again, open-ended commentary on each question-answer was encouraged and used. The rate of return from round three was 69%.

Round four was similar to round three. To assist the panelist a summary of comments was provided after each question. This information was to be used by the panelists as they answered the questions. Panel members were asked to consider these comments before indicating their opinion about likely timing of events. The rate of return was 59%.

## **Results**

The panel predicted that developments in seven land-use issues will be realized in the Black Hills by the year 2000.

A regional emergency response team for fires and other disasters (e.g. chemical spills) will exist.

A regional authority for solid waste management and disposal will exist. The number of all types of landfills will have declined.

Deadwood's gaming industry revenues will have leveled off. The town's share of its legalized gambling revenues will have been drastically cut by the State of South Dakota.

Tourism will be the most important industry in the Black Hills. There will be a region-wide system of hiking trails.

Grazing fees will have doubled, and grazing as an economic activity will have significantly diminished. Riparian habitat will be further protected from the impact of cattle grazing.

There will be a limit on the gross acreage that can be disturbed by surface mining.

Deadwood will have a water shortage. Irrigators will receive 25% less water than they do today. There will be an increased usage of the Madison Aquifer by the cities and industries in the Black Hills.

The panel further predicted that the following outcomes in 15 land-use issues would occur by the year 2010.

Rapid City will continue the civic leadership for the Black Hills.

The federal government will have conducted a comprehensive environmental impact analysis.

The US Forest Service will continue its multiple use concept and road closures.

There will be new and very stringent fire and building codes for all rural homes.

Grazing on federal lands will continue, but there will be 50% fewer cattle allowed on public lands. There will be a significant decrease in the number of cattle ranches using public lands. Elk and buffalo habitat will be increased at the expense of grazing interests.

A new National Mining Act will have replaced the 1872 Mining Act; however, surface mining will continue. A reliance on mining will not lead to a severe economic depression in the northern Black Hills.

Native American claims to the "Yellow Thunder Area" of Black Hills National Forest will have been denied by the federal government.

Legalized gambling in Deadwood will continue, but it will not replace family-oriented tourism.

The rails-to-trails program will be completed. At least 100 miles of old railroads will be turned into walking and bicycling trails. Outdoor recreation on public lands will require a user fee. The tourism industry in the Black Hills will be more important than the tourism industry along the Missouri River. Skiing at the Terry Peak Ski Area, mountain biking, snowmobiling, and trout stocking in the streams will continue. The Black Elk Wilderness Area will continue as wilderness.

New homes will be constructed outside city limits yet within the Black Hills. All-weather year-round access on publicly maintained roads to second homes will become a serious tax issue.

There will be a Black Hills Regional Planning and Zoning Authority. The drilling of new private domestic wells will continue. Private septic systems in shallow soil layers over fractured rock will be prohibited.

Federal sales of timber will continue. It will be 50% more expensive to log commercially. There will be less than five commercial logging companies and 50% fewer sawmills. There will be insect epidemics. Devastating forest fires of over 15,000 acres will be possible.

The highway traffic load will increase by 25%. There will be a four-lane highway between Spearfish and Deadwood. There will continue to be billboards along state highways.

South Dakota will prohibit large scale landfills.

Water management will be the number one conflict. There will be a Black Hills regional authority for water usage. Rights will have been issued to more water than is available. The mining industry's share of the available water will be restricted. The price for domestic water in Rapid City will double.

### **Impact on the Cities**

These predicted futures suggest profound changes as early as the year 2010 in the economic and the environmental health of the BHNF and thus in the eight largest cities in the Black Hills (Fig. 1). Each city will experience

impact differently. Custer, located in the center of the Black Hills, will experience an increase in tourism but a decrease in the timber and grazing industries. Based on the increase in tourism, there will be an increase in highway traffic through the city. Custer's domestic water supply does not come from the Madison aquifer, but attempts might be made to tap into the Madison via a pipeline.

Deadwood, in the center of the northern part of the Black Hills, will continue its rapidly growing tourism industry, especially if there is a four-lane highway between Spearfish and Deadwood. However, the total gambling tax revenues collected by the city will level off. Property tax revenues will increase. There will be a decline in surface mining employment. Deadwood's utilities will be modernized and thus will be very cost-effective; nevertheless, the panel believes that the city will experience a water shortage. Today, Deadwood receives about one half of its domestic water supply from the nearby Homestake Mining Company with the other half coming from the Deadwood formation. A water shortage might make the piping of domestic water from the Madison aquifer a possibility.

Located on the southern edge of the Hills, Edgemont might be allowed a small solid waste landfill. However, any major landfill will likely be prohibited by the state. Grazing will diminish. Edgemont will continue to meet its domestic water needs through the use of the Madison aquifer.

In Hot Springs, approximately 20 miles northeast of Edgemont, tourism and its associated highway traffic will increase. As at Edgemont, grazing activities will diminish. The springs of Hot Springs are from the Madison aquifer and the city will likely continue to use it as the sole source of its water supply.

Lead, located near Deadwood, will experience an increase in tourism, but there will be a decline in surface mining employment. Environmentally, Lead's air quality will improve and there will be less chance of severe pollution of nearby water resources. In a unique arrangement, the Homestake Mining Company provides all of Lead's and some of Deadwood's domestic water supply. Acquisition of water from the Madison aquifer is always a possibility.

Newcastle, Wyoming, will experience an increase in tourism. The site-specific timber and grazing industries will likely decrease. The city will probably continue to make use of the Madison aquifer. The future of the oil refinery in Newcastle was not addressed by the panel's predictions.

Rapid City, the largest city in the Black Hills area, will experience an increase in tourism and highway traffic. It will also be the site of the many new regional authorities. The declines in the timber, grazing, and mining industries will be felt in Rapid City. The city will continue its recent utilization of the Madison aquifer, but the cost of water will double.

Spearfish, presently experiencing an economic boom, will find an increase in tourism and highway traffic (there will be a four-lane highway between Spearfish and Deadwood). The grazing, mining, and timbering industries will probably diminish. The city will continue to use the Madison aquifer, though it utilizes Spearfish Creek for over one half of its water supply.

Sturgis will mirror Spearfish's experience: tourism will increase, while the grazing, timber, and mining industries will decline. The city will continue its use of the Madison aquifer (as well as the Minnelusa aquifer) for its water supply.

### Conclusions

According to the panel of experts, tourism will be the leading economic force in the Black Hills in the future, with or without legalized gambling. This economic reality will be further encouraged by the predicted new highway between Spearfish and Deadwood.

The grazing, timbering, and surface mining industries will decline over the next 20 years. But consolidation, where possible, will occur. However, the economic declines and consolidations will be site specific, setting the stage for more intense changes in the Black Hills.

Three major environmental changes will have a direct impact on the local cities. First, limiting surface mining activities will likely lead to a cleaner environment in the Lead-Deadwood area. Second, the demise of the grazing, timber, and surface mining industries will lead to fewer multiple demands on the land. And, finally, the increased use of the Madison aquifer by communities and industry is an admission that the Black Hills area cannot supply

enough water to meet its demands. Communities outside the Black Hills area may resent Madison aquifer water being piped a great distance to the Black Hills communities, water that they may need in the future. The potential for interregional conflict is apparent.

Based on the panel's forecasts, Custer, Edgemont, Hot Springs, and Newcastle will suffer economic disruptions due to the regulation or decrease in extractive industries. Yet Deadwood, Spearfish, Sturgis, and Rapid City will prosper due to the increased tourism and legalized gambling in the northern part of the Hills; Rapid City will also be the site of the newly constituted regional authorities. The city, however, will feel some impact from the decline of the mining, grazing, and timber industries.

This study points to several areas for further research. Investigation should be made of the type and strength of the relationship between land-use values of forest recreation and forest production in conjunction with the future land-use conflicts in the Black Hills. Applied land-use theories would frame the research.

The economic and environmental land-use conflicts of the Black Hills should be compared to those experienced in regions with similar situations, such as Lake Tahoe and Virginia City, Nevada. Both the Black Hills and the central Sierra Nevada region have a long and well-documented history of forest production and forest recreation, and as well have experienced the impact of legalized gambling. Regional land-use planning was introduced in the Lake Tahoe Basin over 10 years ago (White 1991 personal communication), whereas there has been minimal regional planning in the Black Hills. The comparison would lead to important pointers to the planners and managers in the Black Hills, and would highlight issues in the study of regional planning processes and conflict resolution.

\* SD Agricultural Experiment Station Research Paper No. 2604.

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