Public land survey for agricultural education
by Rahelimihajandralambo Adele Gislaine

A thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Agricultural Education
Montana State University

Abstract:
Controversies over public rangeland are contemporary issues not expected to be resolved in the near future. This study was designed to capture factors that bring conflict over the uses of public rangeland with a focus on agricultural education needs as part of the conflict resolution process. Factors included rangeland natural resource importance and condition, livestock grazing and public ranching, public land manager decision-making motives, multiple use philosophy, and actions to improve rangeland conservation and management. The study surveyed ranchers, Forest Service employees and Bureau of Land Management employees involved in federal public rangeland management in Montana. The . survey used a Likert-type attitudinal instrument. Chi square test compared the groups ' attitudes to determine uniformity or discrepancies of perceptions on selected parameters. Borich's method and open-ended questions were applied to capture educational needs. Data revealed that all groups agreed on potential uses of livestock grazing as a natural resource management tool, the importance of public ranching to the community, most factors that affect public land managers' decision-making motives, major sources of conflict over public rangeland uses, and actions needed to improve the management of public rangeland. Between groups statistically significant different perceptions were observed relative to rangeland condition, management behavior of ranchers on public rangeland, impacts of ranching on the cattle industry, and relationships between permittees and public land managers. All groups perceived needs to improve the natural resource inventory process by utilizing significant input from ranchers and to implement flexible grazing management methods. There was a perceived need to implement and/or strengthen coordinated/cooperative/participatory methods in management of natural resources. In conclusion, the study revealed a need to separate out the effects of livestock grazing and other uses on public rangeland. There was a perceived need for the use of scientifically and legally valid recording systems for the management of the natural resource and for educating environmental groups and the general public on the foundations of natural resource conservation and management. The College of Agriculture in cooperation with public land management agencies should deliver education to concerned groups about public land conservation and management.

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APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the graduate committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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Date 06/24/96.

In memory of

* my father who always told me that "education would be my greatest inheritance;
* my grandparents for their love and for teaching me the value of wisdom and righteousness;
* my father-in-law for accepting this project even though it was against his will.

I would like to dedicate this thesis to

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TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

TABLE OF CONTENTS--Continued

LIST OF TABLES

LIST OF TABLES--Continued

LIST OF TABLES--Continued

LIST OF TABLES--Continued

ABSTRACT

Controversies over public rangeland are contemporary issues not expected to be resolved in the near future. This study was designed to capture factors that bring conflict over the uses of public rangeland with a focus on agricultural education needs as part of the conflict resolution process. Factors included rangeland natural resource importance and condition, livestock grazing and public ranching, public land manager decision-making motives, multiple use philosophy, and actions to improve rangeland conservation and management. The study surveyed ranchers, Forest Service employees and Bureau of Land Management employees involved in federal public rangeland management in Montana. The survey used a Likert-type attitudinal instrument. Chi square test compared the groups' attitudes to determine uniformity or discrepancies of perceptions on selected parameters. Borich's method and open-ended questions were applied to capture educational needs. Data revealed that all groups agreed on potential uses of livestock grazing as a natural resource management tool, the importance of public ranching to the community, most factors that affect public land managers' decision-making motives, major sources of conflict over public rangeland uses, and actions needed to improve the management of public rangeland. Between groups statistically significant different perceptions were observed relative to rangeland condition, management behavior of ranchers on public rangeland, impacts of ranching on the cattle industry, and relationships between permittees and public land managers. All groups perceived needs to improve the natural resource inventory process by utilizing significant input from ranchers and to implement flexible grazing management methods. There was a perceived need to implement and/or strengthen coordinated/cooperative/participatory methods in management of natural resources. In conclusion, the study revealed a need to separate out the effects of livestock grazing and other uses on public rangeland. There was a perceived need for the use of scientifically and legally valid recording systems for the management of the natural resource and for educating environmental groups and the general public on the foundations of natural resource conservation and management. The College of Agriculture in cooperation with public land management agencies should deliver education to concerned groups about public land conservation and management.

INTRODUCTION

Managing and preserving the environment is a leitmotif worldwide, since the Stockholm Conference on the Human Environment in 1972 (MacNeil, 1989). More than ever the human community faces a number of problems: threats to human survival due to diseases, food, and social insecurity (Brown, 1994), threatened loss of biodiversity, pollution, global climatic changes, and soil degradation (Clark, 1989; MacNeil, 1989). All of those problems have increased awareness of the necessity of better conservation and management of all types of natural resources. The greatest concern that drives politicians, scientists, economists, environmentalists, ecologists, demographers, agronomists, developmental agencies, and the list goes on, is the dilemma between an exponential world population growth and high depletion rate of the non-elastic global natural resources (Johnston, 1988; MacNeil, 1989). Several media have brought the world to this point: (1) an increasing body of knowledge and more understanding of biological processes in different ecosystems, (2) an increasing efficacy, in terms of speed and volume, of information exchanges, and (3) consequently to the previous factors an increasing concern, at any level of our community, for preserving the environment (MacNeil, 1989).

All of these facts have led to different "environmentally sensitive policies," regulations, and management plans, supported by numerous publications based on scientific finding and facts (Johnston, 1988).

In spite of this dramatic increase in the knowledge base, biological processes and their complex interactions with human parameters are not understood well enough to solve the dilemma of natural resource preservation and population growth (Wilson & Macleod, 1991). It is now common to hear about scientists and experts working as much as possible with the new trend of "interdisciplinary team," "holistic approach," and "integrated approach" (Bentley, 1994; Donart, 1994). Still, debates persist among: (1) scientists from different but related fields and disciplines in ecology and all natural resource management, (2) policy makers within different regulatory agencies, and (3) different interest groups such as environmentalists and primary producers (Holloway & Guy, 1994). One would wonder if some parts of the population, having fulfilled their basic needs according to Maslow's hierarchy, blame the primary producers for all natural resource degradation without considering the importance of agricultural production, even though claims have arisen that the cost of natural resources conservation had negative impacts on overall production and economic development (Bartlett, 1994).

This situation focuses the attention on primary producers, especially "ranchers." Most of the time, livestock production practices in general are pointed out to be causes of one or another type of natural resource degradation

like soil erosion, non-point source water pollution, and loss of biological richness. This is true in developing as well as in developed countries like the United States of America. It is also true, on the other hand, that ranchers tend to reject environmentalists of any kind. Complaints are raised from individuals that regulations based upon sound scientific findings do not take into account the objectives of ranch production nor consider ranching as one productive component of the economy.

This controversial situation has produced a new wave of approaches like "ecosystem management," "landscape ecology," "integrated development," and "sustainable development" to integrate the "human parameter," whether as actors in the change processes or as partners in the processes of needs assessment, evaluation, and decision making. Another new approach, "integrated research-development," focuses mainly on associating the primary producers in field research with experimental activities. More wildly, advocates of "participatory approaches" and "indigenous" or local-based "knowledge systems" argue that the primary producers have to be the cornerstone to any decision making, actions, and issues that would affect their own environment.

This challenging idea of putting the primary producers as center of interest in any change processes merits more attention on the part of all entities, indeed scientists, change agents, and educators at all level, in formal as well as non-formal settings. This option does not have to dilute the focus that there is a need to balance the interests of food production and natural resource conservation.

Thus, all parts of our community have to be responsible in working out better solutions to resolve this critical dilemma of agricultural production and natural resource conservation. The focus of this study is to find a workable methodology that will include systematically the primary producers of interest, here the livestock producers, in the process of decision making that deals with rangeland natural resource conservation and livestock production.

Statement of the Problem

The purposes of this study were (1) to explore and describe factors that affect, positively or negatively, the behavior of Montana cattle ranchers toward natural resource conservation practices and, taking into account those factors, (2) to develop a decision-making process model that integrates systematically the interests of the primary producers with the concern of natural resource conservation.

Need for the Study

The increasing conflicts between primary producers and environmentalists, in general, and livestock producers and conservationists, in particular, are signs of social action process failure. Those conflicts indicate that there is a need for a change.

First, there is a need to (a) determine factors that bring conflict between farmers and conservationists and (b) define an approach that would resolve the

conflicts. Second, there is an educational need to change the view of environmentalists and conservationists that agricultural production is a "competitor for natural resources," and simultaneously there is a need to increase the awareness of the urban population of the importance of agriculture. Third, agricultural education needs to follow changes and dynamics of the environmentally concerned community. Consequently, there is a need to adjust agricultural education in its roles, methodology, and target groups to be responsive of our community's natural resource management and conservation needs. Fourth, there is a need to reinforce the social action process, that it will take systematically into account both agricultural production interests and objectives and natural resource conservation concerns.

Objectives

The objectives of this study were to:

(1) determine convergence and/or divergence of concerns about range management taking into account the ranchers and agency responsible for natural resources conservation objectives; and

(2) determine potential roles of agricultural educators in conflict resolution between land use practices management and conservation.

Assumptions

Three assumptions were made in this study:

(1) There are conflicting interests between livestock producers and natural resource conservationists.

(2) There are identifiable factors that are determinant to the relationships between the behavior of ranchers and federal public land managers.

(3) Agricultural education, whether in formal or non-formal settings, has a major role to convey accurate information to both ranchers and regulatory agencies and to bring the involved parties into the social action process to solve the dilemma of primary production and natural resource conservation and management.

Limitations

This study was limited to (1) cattle producers (whether or not they operated other types of production) that leased federal public lands for grazing in Montana during the summer 1995 and (2) employees of the United States Forest Service (USFS) and the United States Department of Interior--Bureau of Land Management (BLM) who dealt with public land grazing and related fields inside the state of Montana during 1995.

Definition of Terms

Natural resources: All non-manufactured resources that support life development.

Sustainability: A concept that any type of exploitation of natural resources or its management at least maintain the original rate of resource renewal and slow down the consumption of non-renewable resources by the use of alternative goods.

Environmentalist: An individual or group whose concerns and efforts are directed at preserving the environment at any cost.

Primary producers: Individuals or groups that produce raw goods. In economic concept, they are the first chain in the process of production.

Agricultural educators: Individuals, organizations, or institutions that are involved directly or indirectly in educating people in fields related to agriculture. The education process can be formal or informal.

Change agents: Individuals or political entities that bring about changes in defined areas of the community.

Social action process: A process that is installed in a democratic community to create debate between divergent entities or interests groups about issues that are crucial at that precise moment in time.

REVIEW OF RELATED LITERATURE

After the World Summit on Humans and Environment, in 1972, the world community realized that the world population has increased dramatically, more than three times its original level since the beginning of the century. Parallel to it, the consumption of world goods has increased more than 20 times. MacNeil (1989), Secretary General of the World Commission on Environment and Development, asked if "there is any way to meet the needs and aspirations of the five billion people now living on the earth without compromising tomorrow's eight to ten billion to meet theirs" and if the "growth on the scale projected over the next one to five decades can be managed on a basis that is sustainable both economically and ecologically" (p. 155). Those two "provocative questions and critical challenges" (Thrupp & Haynes, 1994, p. 3) underline a complex and multiple-factorial problem that the global community has to face and solve. The problem includes human population, its growth and values, natural resource conservation, management, economic policy, and socio-economic development of the human community, not only at the global or governmental level but also at the local level. Although there are profound concerns about the multiple-factorial characteristic of sustainability of natural resource uses and management, conflicts between different entities of agricultural production and conservationists are common at all levels of our community. Those facts require a focus and

understanding of "why do planet wide environmental problems arise and why do they persist?" (Johnston, 1988, p. 1).

Human Population Growth and Its Effect on Natural Resources

Brown (1994), in his article entitled "Facing the Food Insecurity," reported that world grain and fisheries production had increased respectively 2.6 and 4.6 folds from the middle of this century to the end of the '80s. However, the trend has reversed. From 1984 to 1993 the world grain production declined 11% per capita. This situation was brought about by an increasing population growth rate and depletion of natural resources due to over exploitation (pp. 177-195). Adding to that, Johnston (1988) emphasized that human population growth is not the only "source of global pressure on the natural resources" (p. 1). There is also the problem of increasing consumption per capita. Consequent to the human population growth and its effects on natural resources, Brown (1994) stated with a note of hopelessness that "the bottom line is that the world's farmers can no longer be counted on to feed the projected additions" to the world population and that "achieving a humane balance between food and people now depends more on family planners than on farmers" (p. 178). These statements show that the population and its growth do affect the natural resources.

Effects of Population Growth and Economic Development on Agriculture

Another consequence of human population growth is economic development and vice versa economic development favors human population growth. The dynamic pattern of this tandem results in expanding urbanization. The urbanization phenomenon, relative to agriculture and agricultural lands, has two effects. The first effect is the decline of agricultural lands due to urban development. The second effect is a relative shift in population distribution. Barrows (1988) observed that the rural population in industrialized countries is indeed becoming a minority.

In the case of the United States of America (USA) and particularly the state of Montana, statistics are revealing. Nationwide in the USA, Kellogg et al. (1994) reported the following ten year (1982-92) changes: cropland and rangeland decreased respectively by a net of 39 million (-9% of the total) and 10 million acres (-2.4%). Inversely, "developed land increased by 14 million acres" (+18% since 1982). In Montana, in 30 years (1963-93) all land in farms decreased by 7.3 million acres (-10.9%), and for the same period the number of farms lost was 5,000 (-17%). The number of farms in Montana has declined steadily since 1920 resulting in a 57.75% loss from 1920 to 1994 (Montana Agricultural Statistics Service). Relative to the population distribution effect, representatives of rural population and agricultural producers have become such a minority in the political arena that they need a strong coalition to be heard (Shelhamer, 1994, personal communication).

Population Distribution, Agricultural Production, and Natural Resources

As explained by Barrows (1988), the fixed characteristic of land necessitates that it be shared among all parts of the population. Without agreement about the way to share or manage the land, a fixed good, conflict arises. The actual patterns and dynamics of the natural resource concerns show more conflicts than agreements. Typically urban populations require more space not only for urban development but also for recreational uses. Another pressure that arises from the urban population is concern about natural resources conservation. Meyer (1993) remarked that agriculture is seen as a "competitor to natural resources" but not a part of it or a life supporting element (p. 881).

Rangeland Natural Resources Conservation and Management

The concern for rangeland, related to livestock production for human food, is well depicted by Schuster (1993):

> The contribution of rangelands to the earth life support system and economic welfare of its people is tremendous. As the demand on rangeland resources escalates with increasing population pressure, the need for sustainable, multiple use management will become stronger. Socio-economic and political pressure will continue to bring about changes in range resource uses. (p. 63)

In general livestock grazing is seen to be the worst pressure on rangeland. Non-agriculturists charge that livestock grazing causes natural resource degradation, loss of biological richness, soil erosion, riparian degradation, and non-point source water pollution, even though these facts are not always supported by scientific

findings (Wilson & Macleod, 1991, p. 175). Still, rangeland users and livestock producers have to face "several socio-economic-political issues impacting rangelands and rangeland resource management" (Schuster, 1991, p. 61).

Problems Relative to Rangeland and Rangeland Management

The problem relative to rangeland exploitation and management impacts on natural resources is the inability to show "concrete evidence . . . of the effects of overgrazing . . . as opposed to the resource base" (Wilson & Macleod, 1991, p. 61). Rangeland managers need to "recognize and integrate ecological relationships in order to achieve short and long term goals" and do so without affecting "the ability of the rangelands to produce the goods and services necessary to basic needs (Rowan & White, 1994, p. 338). However, Thomas remarked that if "grazing can be modified or eliminated if considered a pressure to the health of the ecosystem, who is to determine whether or not it is detrimental." He also claimed that the "USDI-Bureau of Land Management and USDA-Forest Service proposed rule changes for public land grazing" that were "disturbing to ranchers who depend on public land" (1994, p. 149).

In the case of Montana, the situation is controversial. Even though ranchers estimated losses from wildlife using private forage and grazing at $12 million for the overall livestock industry, ranchers nonetheless showed positive attitudes toward big game (Lacey, 1992). Ranchers did show little consideration toward environmentalists and conservation strategies. From range extension

specialists' point of view, some policies, like those relative to overgrazing or riparian conservation did not have foundation. Water quality policies were the exception (Surber, 1994, personal communication).

Rangeland Resource Management and Natural Resource Conservation Dilemma

These controversial facts call for alternatives dispute resolution in subject matters relative to natural resources preservation and management (Torell, 1993). Among ten recommendations given by Donart, president of the Society for Range Management, the following are significant:

> Development of consensus building to obtain agreement and avoid conflict; expansion of educational systems for managers, resources users, landowners, public officials . . . focus on pro-active programs to integrate more scientific data and information into policy process; revising the federal cost-benefit guidelines to reflect contemporary resources economics. (1994, p. 111)

METHODOLOGY

As this study was exploratory and descriptive, it used an attitudinal survey instrument. The survey included three groups that dealt concurrently with rangeland natural resource conservation and management and livestock production: livestock producers, Forest Service (FS) employees, and Bureau of Land Management (BLM) employees.

Population

Subjects were classified into two categories: livestock producers and federal public land managers from the Forest Service and Bureau of Land Management. The first category comprised ranchers that operated cattle enterprises on the federal public grazing allotment in Montana during the summer of 1995. The latest updated sampling frames, respectively from Montana FS and BLM, were used to select livestock producers. It was understood that cattle producers can use grazing allotment managed by both FS and BLM. Also, a rancher can operate under several permits inside one agency, and some permits are utilized by several ranchers. Since there was no means to merge the two sampling frames and eliminate subjects that run several permits (either inside one agency or both agencies) and the two clusters were of unequal sizes, the sampling procedure was based on one-stage cluster sampling of unequal size clusters with probability

proportional to the size of clusters based on the statistic of permit numbers given to the researcher by the agencies (Lee et al., 1989). Since the sampling frames did not distinguish the type of livestock operation run under the permit nor the region where the subjects operate, no further clustering nor stratification was done. However, the researcher estimated the total size of the population on the statistic given by the agencies with the assumption that all listed permittees were operating cattle enterprises. The elimination of selected permits that did not fit this population is explained in the survey instrument design. The final sampling design adopted in this study is then a one-stage cluster sampling of unequal clusters with probability proportional to the estimated size of the clusters (Lee et al., 1979).

Based on this adopted sampling procedure the population size required an estimated sample size of 360 sample units (permit number) to be statistically sound at α =.05 (Krejcie & Morgan, 1970). However, given that the information relative to the subjects of interest was limited, the sensitivity of study, and the knowledge that spring is not the best time of the year to survey cattle producers, the researcher over-sampled by 40%. The over-sampling was based on results from the Montana Ranch and Farm Survey (L. Irby, November, 1995, personal communication) conducted at Montana State University. The subject selection was produced through simple random sampling within the clusters using random numbers generated by MSUSTAT (Lund, 1994).

The second category of the population was the federal public land manager employees from BLM and FS who had worked with the grazing allotments for at least one year in Montana. The small size and ready availability of the population list led the researcher to conduct a census for this category.

Survey Instrument Design

Since no survey instrument was available to survey either livestock producers or federal land management agency employees about the impacts of livestock production from public grazing allotment on rangeland management systems and conservation, the researcher developed a new survey instrument. The logic of the instrument development was based on different claims made by ranchers, environmentalists, and range conservationists as identified by a review of literature, conversations with livestock producers and extension agents during the researcher internship, discussions with professionals in range management science and related fields and individuals that worked on ranches using public grazing allotment.

The collected information was compiled and classified into the four generic domains: (1) natural resource base, (2) livestock grazing and public ranching, (3) federal land manager management approach and public relations, and (4) multiple use and its philosophical foundation. The survey instrument was designed to capture uniformity or differences of perception among livestock producers and federal land managers about these generic domains. It was

assumed that significant discrepancies in perception were a source for disagreements and conflicts over the use of public land resources. The survey was organized to assess agricultural education needs and at the same time reduce researcher bias.

Survey Instrument

The survey instrument was printed as a nine-page booklet (Appendix B). The front cover presented the title and year of the study, the institution name, and a thank you for all categories. The front cover of the instrument sent to livestock producers had additional information. A series of statements was presented to eliminate selected subjects that did not fit the population characteristics, using the procedure adopted by the Montana Ranch and Farm Survey (L. Irby, November, 1995, personal communication).

The back of the front cover explained (1) the purposes of the study, (2) the participants in the study, (3) directions for completing the instrument, and (4) contact number for additional information or comments. The core of the instrument had six sections. The first five sections used mostly attitudinal scales based on the principles of "methods of scale construction" (Shaw & Wright, 1967, p. 3). These first five sections were submitted to both livestock producers and federal agency employees without modification. The method was adopted to measure the perceptions of both groups on the same items so that measurement errors and bias would be limited.

The first section was designed to measure which natural resource base constructs were of perceived importance for both livestock producers and federal employees. At the same time, it measured how both groups assessed the perceived current health and condition of the rangeland natural resource base of interest such as vegetation status, soil components, water quality and supply, and riparian areas. These two distinctive constructs divided this first section into two parts.

The first part evaluated the groups' perception of importance of each natural resource of interest on a scale of seven units ranging from 1 to 7. One constituted the lowest negative answer "not important at all" and seven the highest positive response "very important." The neutral point was four which stated "uncertain."

The second part of the section evaluated the perceived current health and condition of the range, again with a continuum scale of 1 to 7. One constituted the lowest negative unit "extremely decreased" and seven the highest positive unit "greatly increased." The neutral point four ("stable") meant no decrease nor increase. An eighth column "na" meaning "not available" was added to the second part so as not to force the respondents to address items that may not exist in their allotment. Another row was also added at the end of the section to give the respondents an opportunity to address information on specific natural resources of importance but not addressed in the section.

The second section measured the perception of both livestock producers and federal land managers about livestock and ranchers using public grazing allotments. This section also had two parts with a seven unit scale. The scale was built to capture opposite opinions with one being the negative lowest rating of "strongly disagree" and seven being the positive and highest rating of "strongly agree." The continuum scale had a neutral point of four for "uncertain." Even though the researcher was aware of the possibilities of statistical difficulties of this neutral point, the choice was dictated for two reasons: (1) a logical flow of statements in the scale and (2) discussions with ranchers and a panel of experts revealed that some items may be out of the scope of experience of certain participants. This logic and background was also applied to the scale construction of sections two, three, and four. Given the underlying philosophy of the scale, the first part of this second section was designed to assess the perceived impacts of livestock grazing given the conditional statement "under proper management." The emphases were the impact of livestock on the natural resources base, on recreational value of the public land, and the potential of livestock grazing as a natural resource management tool.

The second part assessed the perception of each group about ranchers using federal public allotment for their livelihood with consideration to (1) livestock producers' contribution in developing the rangeland for different uses, (2) their influences and importance for the community, and (3) their

influence on the management of natural resource conservation policies and management.

The third section evaluated the underlying foundation of natural resource management. It was divided into four parts. The first two parts assessed motives that drive public land managers in their natural resource management decision making. The third part evaluated the perceived types of relationship between public land managers and permittees. These three parts used the same attitudinal scale as section two. The fourth and last part in this section was an open-ended question. It inquired the written reflection of the participants about the best approach to improve range management.

The fourth section of the instrument dealt with potential sources of conflicts relative to rangeland and actions that may be taken to resolve those conflicts. It had five parts. The first part addressed claimed sources of conflict relative to the uses of public rangeland. The second part evaluated the perceived best action toward the management of public rangeland. The third part addressed what should be the primary focus on public rangeland management based on the concept of multiple uses. These three parts used the adopted attitudinal scale. The fourth part was an open-ended question. It evaluated the participants' definition of the concept of multiple uses. The last part assessed the perceived importance of selected items pertaining to multiple uses by asking participants to rank items. The selected items were classified as commodity and amenity production oriented.

The fifth section was a compact approach to determine the agricultural educational needs for the management of the rangeland natural resources. Based on the review of literature 20 selected items were submitted to the participants. The competencies of interest were related to three areas: (1) basic sciences relative to the natural resource base, (2) management oriented competencies relative to natural resource conservation and livestock production, and (3) socio-economic competencies as they pertained to public relations as advocated by new trends such as ecosystem management and rural participatory approach. The section had three built-in parts. The first two parts used an attitudinal scale. These parts were designed following the Borich (1980) educational needs assessment method. The first part evaluated the perceived level of competencies of the participants. It used a seven unit scale range on a continuum from the lowest point "do not have knowledge at all" to the highest point "very knowledgeable" without a neutral point. The second section evaluated the perceived need for each selected competency. The scale was again a continuum of seven units ranging from a lowest point "no need" to the highest level "strongly needed" without a neutral point. The researcher recognized that the statement "uncertain" in the middle of the scale might lead one to interpret it as a neutral point; however, it was assumed that if the participants selected the lower levels of the scale, "no need" to "little need," they indicated a more precise perception of their needs. If participants were uncertain, their need for that item was assumed to be greater in the sense that they most likely did not have enough background

of that particular competency to make a firm decision. The third part of the section evaluated the major knowledge sources of the participants. Five sources: books, workshops, life experiences, course work, and Extension Service, were identified. The selection of the sources was based on discussions with livestock producers, extension professionals, and the researcher's graduate committee.

The sixth and last section, unlike the five first sections, had different contents for the two categories of population. It was designed to fit each type of participant activities due to the specific structure of the study (public land management nested within livestock production). The sixth section submitted to the ranchers was designed to collect information relative to the overall operation and demographics of the respondents. On the other hand, the sixth section administered to the public land managers collected information about overall allotments under the management of the respondent and his/her demographic profile and educational background. One common question submitted to both categories for this section was the perceived adequate and fair grazing price.

The six sections described above constituted the main core of the survey instrument. However, due to the extent of issues on livestock production from public land, a blank page was included for participants to address comments either on the study or the survey instrument and any issues relevant to the study.

Test for Validity of the Survey Instrument

A draft of the survey instrument was submitted to a selected panel of experts at Montana State University--Bozeman (MSU--Bozeman). Due to the time constraint of the researcher no pilot test was conducted. However, the survey instrument was submitted to senior students having the experiences of public ranching to ensure the content and vocabulary used reflected the day-to-day language of the livestock producers.

Test for Reliability of the Instrument

A reliability test was computed using a two-way Anova (Schuessler, 1971) for section one, parts one and two, and sections two, three and four including all items as a pool for each category of population. Separate reliability tests for each section were determined to show the internal consistency of each component of the survey for future uses. The separate reliability test computations for the two categories of population, on the other hand, were dictated by concerns for external validity of the survey instrument since the study in essence surveyed two distinct populations. The computation procedure itself was applied after cleaning the data (i.e., after eliminating incomplete responses) using a two-way analysis of variance without replication.

Data in Table 1 show that reliability test results ranged from 0.685 to 0.909 and 0.528 to 0.884 for the livestock producers and public land managers. Overall, the reliability yielded higher levels on the part of livestock producers than public land

Table 1. Reliability results from each section and part of the instrument.

Respondent category	Section/Part				
	One/One	One/Two	Two/All	Three/All	Four/All
Livestock producers	0.909	0.772	0.685	0.801	0.694
Public land managers	0.884	0.650	0.528	0.690	0.578

managers. This fact could be explained by two reasons. The survey instrument was designed from the livestock producer perspective due to the nested structure of the population. As a result, the researcher thought that the instrument reflected more accurately the environment of livestock production and public ranching than public land managers. Consequently, the reliability attained the acceptable to high recommended reliability levels (0.70) (Peterson, 1994). Reliability results for public land managers ranged from 0.884 to 0.528. Results were at acceptable levels for section one, parts one and two, and section three. These results indicated that public land managers have consistent perceptions toward the assessment of natural resource importance and conditions. They also seemed to have a consistent view of their decision-making motives. However, public land managers had split opinions toward livestock production using public land and public ranching and causes of conflicts on public rangeland and actions to take for the management of public rangeland. The analysis of frequency distribution for public land managers showed bimodal frequency distributions for several items in these sections. Thus, the reliability test results from these sections were lower.

Survey Calendar

The survey instrument was reviewed and accepted by the researcher's graduate committee at the end of December 1995. The first survey mailing was sent out on January 15, 1996, accompanied by a letter explaining the objectives and purposes of the survey. Two weeks later (recommended waiting time), the researcher sent the first postcard follow-up to the non-respondents. The postcard emphasized the importance of the participation of the potential respondents. After another two weeks of waiting time, the researcher sent the third follow-up containing another copy of the survey instrument and a letter stating the turn-in deadline as March 1, 1996. At that point, selected livestock producers with incorrect addresses (counted by the number of returned postcards) and forwarded addresses known to be unavailable were dropped from the sample without replacement. No further follow-up was done due to the relatively small gain (less than 5%) in additional responses from the livestock producers and recognition that they were in the middle of the calving period. The return rates from the public land managers (67.5 and 85.7%, respectively, for FS and BLM) was judged satisfactory.

Data Analysis

Data collected were classified into two categories: qualitative from open-ended questions and quantitative from the attitudinal survey. Qualitative data were processed on word processors distinguishing the group characteristics of the

respondents and the corresponding section in the survey. All quantitative data were coded and entered in spreadsheets, using Microsoft Excel 5.0 (1994). The codifications were made to keep track of the type of respondents such as livestock producers, FS, BLM, and sections of the survey instrument. To begin the analysis, the researcher computed a summary statistic (mean and standard deviation) and frequency and percent frequency distributions for each section and each item to determine the behavior of the collected data for each group. Then, depending on the nature and structure of the data, different statistical tests were applied.

Chi squares ($\chi 2$) were computed for each item for sections one, two, three and four using a two-way contingency table from MSUSTAT (Lund, 1994). The choice of this univariate analysis was determined by the non-parametric nature of the data, and comparative purpose of the study. The computations of χ^2; however, proceeded with two constraints. First, for χ^2 to be accurate, it required that at least 80% of E_{ij} (expected frequencies) be greater than five (>5) (Strohmeyer, E., EDCI 402, personal communication). Due to the relatively small size of the BLM population and the dimension of scale used, two to three scales were collapsed into one to permit the statistical computation. Second, due to the relatively high proportion of "undecided" responses among livestock producers, which brought statistical "noise" into the χ^2 computation, the researcher chose to drop the fourth scale in the χ^2 computation of sections two, three, and four, so that the comparison between groups was only about the

strength of agreement or disagreement. This approach may lead one to consider a loss of information; however, the researcher did not think so for two reasons: (1) χ^2 is a very flexible statistical test. Due to its non-parametric characteristic, "statistical significant results from χ^2 would also be significant for a more powerful test like Student-t test" (Popham & Sirotnik, 1992, p. 251), and (2) the interpretation of the result included all information from the summary statistic, frequency distribution, and χ^2.

Spearman-rank correlations were computed for the multiple use comparison (section four, part five) for all the groups. Data from respondents who ranked or chose only five uses were computed for the frequency distributions. Then, each count with precise rank was multiplied by an inverse score so that the highest rank "1" was given a highest score "5." Then a total score was computed for each item for each group. These total scores were ranked based on the score they yielded. For each group, the first rank was given to the item with the maximum score. Tied ranks were given the same rank as before the computation. The results of this ranking were then used to compute the Spearman-rank correlations.

A weighted discrepancy score from Borich's (1980) model was computed for section five, parts one and two. First, the mean for each item was calculated using the overall observations. Then, each observation from section five, part one was matched with and subtracted from its counterpart in section five, part two to get the discrepancy scores for each item and each respondent. Observations without a matched pair were dropped from the computation procedure. Next,

each discrepancy score was multiplied by the knowledge needs mean of that item to get the weighted discrepancy score. All the weighted discrepancy scores from each item and each respondent were used to compute the weighted discrepancy mean for that item for each group. Finally, the weighted discrepancy means were ranked, first being the means with the maximum value for each group.

RESULTS AND INTERPRETATION

To facilitate the presentation and interpretation of the results of the study, the researcher chose to describe the response rate for characteristics and demographics of the respondents and interpret the overall results for each section and then each item inside the section. The convergence and/or divergence between the three groups of interest will be described.

Response Rates

Response Rate from Ranchers

A total of 591 livestock producers were randomly selected from a population of 4863. After deduction for incorrect addresses and unavailable selected subjects, 570 participants were mailed a survey instrument. The researcher received 207 surveys back resulting in return rate of 36.3%. Among the returned surveys 151 (73.0%) were useable. The data in Table 2 reveal the reasons that the survey instruments were not useable.

The information in Table 2 shows that non-useable surveys constituted 27.0% of the returned surveys. Due to sampling frame error, the researcher expected that a certain proportion of the sample would not meet the population criteria.

Table 2. Frequency distributions and reasons for non-useable surveys.

Reasons	n	%*
Returned without any further information	10	17.8
Indicated operating cattle production but did not participate	4	7.1
Owner only	22	39.4
Selected subjects operating different production	12	21.4
Retired or sold cattle operation	5	8.9
Completed the survey but non-useable	3	5.4
Total	56	27.0**

*Percentage relative to the non-useable surveys.
**Proportion of non-useable relative to all surveys returned.

Of the non-useable returns 69.7% were due to owner only (22), operating different livestock operations (12), and retired people (5) that did not fit the population criteria. Comments worth being reported came from four different respondents saying that cattle operation was no longer "economically feasible" and "the economic return from cattle production using public grazing allotment was not worth the trouble from using public land" (not shown in table).

Ten non-useable returns came from respondents who did not indicate the reason why they were in the sampling frame or why they did not fill out the survey, even though they were given the opportunity. An explanation for why these people did not want to participate in the study could be summarized by the comments of this non-useable respondent, "Surveys of this type seem to assume that permittee will have some influence regarding the grazing on his/her leased federal land." In fact they perceived that the "final authority on any disagreement

would be resource manager" rather than the local ranger who would "listen to their idea or suggestions." The respondent concluded, "Since we have no effective influence in the above (issues regarding the management of the public grazing allotment), our opinions are useless; therefore, there is no reason to complete a survey of this type." The feeling of this respondent might indeed indicate the malaise regarding the issues on public land management.

The return rates of useable as well as non-useable were satisfactory given the quality of the sampling frames available and the length of the study.

Response Rate from Public Land Managers

The researcher sent the survey instrument to 115 public land managers, 35 for BLM and 80 for the FS. Thirty of the 35 BLM sampling units returned useable instruments resulting in an 85.7% response rate. Fifty-four FS respondents returned the survey resulting in an 67.5% response rate. Fifty-one (94.4%) of the FS surveys were useable. Among the three non-useable, one subject did not volunteer to participate in the study for two reasons. The subject perceived that (1) "misinformation and biased research from land grant universities have done much to inflame the controversy over the use and management of public land" and (2) the subject questioned the research institution's "ability to objectively review the issue of grazing on public land." Once again, the comment underlines a complex issue relative to the grazing on public land. The second non-useable survey came from a person who just took a position in Montana. Since, the researcher had limited the participants to those

who had at least one summer experience in Montana, this response was dropped from the study. The last response dropped was incomplete.

Demographic Analysis

Demographic Data of Livestock Producers

Due to the incompleteness of the respondents' surveys, the number of responses varies in each table. Among those (145) who gave their gender, 93.1% (135) were male and 6.9% (10) were female. The age distribution is presented as interval data in Table 3.

Table 3. Frequency distributions of age of livestock producers (N=120).

Age (years)	n	%
<=40	13	10.8
]40 - 50]	40	33.3
]50 - 60]	33	27.5
> 60	34	28.3

The majority (60.8%) of respondents were between the age brackets 40 to 60 years. Younger generations were under represented as 10.8% (n=13) were under 40 years of age. On the other hand, the generation of 60 and over constituted 28.3% of the respondents. The mean age was 54, with the youngest respondent being 25 and the oldest being 80. The distribution seemed to follow the age groups of agricultural operators in Montana.

This distribution was also reflected in the years of experiences in the business as shown by the data in Table 4.

Table 4. Frequency distributions of years experience in cattle production (N=142).

Experience (years)	n	%
<=10	3	2.1
] 10 - 20]	16	11.3
] 20 - 30]	45	31.7
] 30 - 40]	40	28.2
] 40 - 50]	25	17.6
> 50	13	9.1

As shown in Table 4, the majority (31.7% + 28.2% = 59.9%) of the respondents had been in an agricultural business for 20 to 40 years. Those who had been in the business over 40 years constituted 26.6% (17.6% + 9.1%) of the respondents and, as expected, 13.4% (11.3% + 2.1%) of respondents indicated being in the business less than 20 years.

Cattle Production Operation Profile

The five operation characteristics of interest in this study were (1) the size of the operation, (2) the size of grazing allotment used, (3) the number of AUM/AM run under the permit, (4) the estimated proportion of income generated by livestock production, and (5) the estimated proportion of livestock production possible because of the grazing permit.