

## Results: Delphi 4, Gaps

The following list is a compilation of the comments from Delphi 4. Participants were asked to look at the list made at the Salt Lake City meeting and to identify important missing issues. Below you will find the list of topics and important issues identified in SLC in the same font as these directions. In the typewriter font, you will find comments by participants identifying gaps in the SLC list.

### Topic: Social Good - Communities

1. Measure distribution of rangeland resource outputs and resulting costs/benefits to various stakeholders.
2. Measure community viability, stability, and culture
3. Measure social attitudes beliefs, and options toward rangelands and their use and management over time among various groups. [For example, urban dwellers may support protecting burros and wild horses in the desert, even at the cost of some endangered species and ungulates]
4. Measure social and economic flows between urban and rural communities.
  - What about U.S. population, or population by state or county? Crime rate and/or educational achievement rates for each of these?
  - If we're going to measure "community viability, stability, and culture" can we account for the within-community diversity (given that we measure at a scale larger than the community)?
  - Under social goods, as long as we are talking about pie-in-the-sky data collection, we should monitor how many people depend on the range for their livelihood.

### Topic: Change on the Range

1. Conversion
  - \*From something to rangeland [CRP, aquifer changes, green space]
  - \*From rangeland to something [parking lots]
  - \*From rangeland to rangeland (type change; mgmt. change, fire, etc.) [Ted Turner type of change (use), disturbances of drought or fire]
2. Protection (level/status)
  - \*Land trusts – conservation easement
  - \*Wilderness, parks, etc.
  - \*School trusts, state lands
  - \*Ranching for wildlife
  - \*Legal/political [non source pollution would impact protection level or status]
3. Patch/parcel
  - \*changes in ownership? [possibly subdivided into to smaller pieces or aggregated into larger units]
  - \*Size class distributions (State, federal, private, tribal, etc.)
  - \*Habitat partnerships [groups coming together for specific mgt. decisions. Larger than any one land owner]

Overlaps were noted between Change on the Range and Social Good in areas such as land tenure and changes in ownership. Change on the Range also overlaps with Capacity on protection levels status with what products are being produced.

## Change in Vegetation Patterns

- changes in the size and pattern of landscape patches (the text under “Change on the Range #3 seems to refer mainly to ownership changes, not to changes in the size of vegetation mosaics)
- How about measuring desertification (or is this already under change on the range)?
- **Indicator 15: Area affected by processes beyond the range of historic variation.** This information would be applicable to the Change on the Range, Capacity, Rangeland Health, and Invasives.

## Monitoring change

- "Ranching for Wildlife" is a subtopic, but many are "Ranching for the way of life". We need to monitor why ranches are being purchased, or "Ranching for the Way-of-life".

### Topic: Capacity

1. What products are being produced? [forage, recreation, AUMs, etc.]
2. What products could be produced? [forage, recreation, AUMs, wilderness, etc.]
3. Issues of fragility and resiliency [under both 1 and 2]

Notes from SLC discussion: 1. It is important to assess the cost and benefits to society for producing these products. 2. It is difficult to measure capacity. There are suites of capacity. Would fire or other natural processes be accounted for as a product, for example?

- Capacity is not “what” products, but rather “what and how much can be produced in a sustainable fashion” . Capacity is a relative term, that is, amounts that can be produced, etc.
- Under **Capacity**, natural processes such as fire should not be considered a product. These natural processes should be considered under **Rangeland Health**. Capacity should address the topics of 1 and 2 under capacity-products being produced or could be produced--and the costs and benefits to society for producing these products should be an explicit aspect of this topic.
- Not sure what ‘issues of fragility and resiliency’ mean under capacity. Clearly, some rangeland ecosystems are subject to episodic events, such as insect epidemics or extreme weather events. This aspect of capacity might be addressed through estimates of variability in the

production of rangeland outputs such as AUMS, forage, recreation, etc.

- The "Capacity" group discussed at length the topic of "What products could be produced?" I have a great deal of concern about that route. I don't think it can be defined except for very specific areas. Wilderness area is one that could be [defined] by setting some criteria for wilderness designation and monitoring through time how many acres meet the defined criteria.

#### Topic: Invasives

1. Ranking of invasives
  - \*Incorporating ecological impacts
  - \*Community/economic impacts
  - \*Feasibility of control or reversal [weed infestations have different degrees of severity, these should be ranked]
2. Monitoring and early detection
  - a. New populations
  - b. Data management [very difficult to employ, but critical]
3. Area impacted
  - a. Remote sensed, large populations
  - b. Rate of spread
  - c. Percent of dominance (different levels, areas or acres) [could be done % of upland, or % of riparian areas, for example]

### **Conservation of biological diversity, plants, animals**

1. While invasives are often the mechanism by which rangeland biodiversity is reduced and attention needs to be paid to the spread of invasive, the tabulation of the loss of biodiversity is also critical to establish. Other factors, such as loss of habitat through land use shifts or the acceptance of society to handle wild horses in arid ecosystems, influence the biodiversity of rangelands. [This category should include:]
  1. Loss of native plant species
  2. Loss of native animal species
  3. Loss of ecosystem types, such as the tall-grass prairie
  4. Loss of successional stages within ecosystem types, such as young to old sagebrush communities
  5. Reduction of total area in rangeland
  6. Issues of how to conserve biological diversity on fragmented rangeland
2. I may have missed it but I did not see anything on Biodiversity.

3. **Indicator 12: Biomass of native and exotic rangeland species.** This information would be applicable to both the Invasive and Rangeland Health Topics.
4. Rangeland Health should include ratios or relationships between such variables as native vs non-natives. It should also include disease (perhaps plant and animal)
5. The list inadequately covers the criterion of species diversity; i.e., status of rangeland-dependent species, including TES. This criterion may be covered in part in the vegetation and animal components of the topic, Rangeland Health. If so, the Rangeland Health topic is worded much too generally.
6. **Indicator 17: Area with diminished biological components.** This indicator information would assist in addressing Change on the Range, Rangeland Health, and Invasives topics.

Topic: Rangeland Health

1. Components
  - a. Vegetation
  - b. Animals
  - c. Water
  - d. Soils
2. Structure
  - a. Horizontal – spatial relationships
  - b. Vertical – life forms
3. Processes/functions
  - a. Nutrient cycling
  - b. Energy flow
  - c. Water cycling

Overlaps: Rangeland Health overlaps with Capacity in terms of goods rangelands provide, with ownership and rangeland types issues found with Change on the Range, and with Soil.

- The current topics under rangeland health are pretty broad and most issues I would want to include fit under these. Two that I think deserve focus are:
  - Threatened and Endangered Species/Species at Risk
  - Carbon sequestration

## **Disturbance Regimes**

1. Both fire frequency and grazing levels as driving processes in rangeland health, e.g. conversion of nitrogen bound up in old plant tissues to free nitrogen for use by seedlings and/or redistribution of nutrients across landscapes.

2. Under Rangeland health, there should be an explicit accounting for changes in natural and human-induced disturbances such as fire, insects, disease, air pollution, toxic chemicals, etc. The natural disturbances (fire, insects, disease, extreme climatic events) have been altered by human disturbance. For example, human-caused fires are a problem in rangeland ecosystem types that did not evolve under a periodic fire regime, such as the drier parts of the interior west and where climatic events are such that regeneration is highly episodic.
3. One item I believe is specifically missing is a direct addressing of disturbance factors that sustain grasslands including climatic patterns, fire, and herbivory. Perhaps one way to address this concern is to just add climate and fire to the list under "1. Components". I believe that just having animals, vegetation, water, and soils misses some of the other important abiotic interactions in grasslands and I would recommend adding climate and fire under this section.

#### Topic: Soil

1. Soil amount or loss
    - \*Depth, redistribution, stability and/or erosion
  2. Soil Constituents
    - \*Organic matter, salinity
    - \*Aggregate stability
  3. Soil Physical Properties
    - \*Texture, crumb, compaction, bulk density, physical crusts, infiltrability, porosity
  4. Soil food web structure
    - \*Bacteria, fungi, micro and macro-invertebrates
- **Indicator 18: Area and percent of rangeland with significant soil erosion.** Again, this indicator would be applicable to Rangeland Health, and the Soil Topics.

#### Water Resources

1. water pollution (chemical, biological)
2. water distribution/use/storage
3. water conservation
4. aquifer depletion. In "Sustainable Development in the United States", aquifer depletion is covered by the indicator "Ratio of Renewable Water Supply to Withdrawals". I realize we're not supposed to be identifying indicator gaps in this Delphi 4, so I raise the sub-issue of aquifer depletion only to justify the need for inclusion of a water

topic. Aquifer depletion beneath rangelands is an issue that will only become more critical as time goes by.

5. Surface water quality

### **Riparian areas**

1. wetlands (role in rangeland landscape)
2. Water is mentioned in gaps, but it is a primary driver for riparian areas (also an indicator of health) and rangeland condition (i.e., good health) results in “proper hydrology” (i.e., normal runoff, maintenance of water table, perennial flows, etc.), and thus should be a measure of “health” as a capacity term, or separate.
3. riparian area condition (may be there under Rangeland Health / water, but not obviously so)
4. condition of riparian areas
5. Would like to see wetlands and riparian ecosystems elevated to some higher level than an example.
6. “water” is insufficient to describe the need for indicators on the status of riparian zones.
7. Rangeland Health and Capacity - Functional status of rangeland riparian/wetland communities and outputs from these communities.
8. Water is an essential issue, but I have assumed it will be covered under capacity/rangeland health and/or rangeland health
9. Water quantity, water quality, watersheds as functioning systems, and riparian and aquatic ecosystems are important on rangeland landscapes and are not mentioned in these topics. This could be a topic area alone, or combined. Water as a component and water cycling under Processes are included under Rangeland Health. It is not clear what is meant by water as a component—quality, quantity? Water cycling is definitely a process of rangeland ecosystems but does this encompass the role of watersheds in cycling water through the landscape? Riparian ecosystems and watersheds have been significantly manipulated through human influences. These alterations affect the sustainability of rangelands through site processes such as soil erosion and larger processes such as changes in stream flow.

### **Economic evaluation of economic and biological costs**

1. Costs of introducing invasive plants, cost of using too much water or polluting water, costs of changing land use etc.
2. Expenditure on Research and Development

3. I am most concerned about topics under "CAPACITY" e.g. products that are or could be produced. The examples listed are quite general and could be considered to cover most items of economic importance. Some caveats: The words "value" or "prices" do not appear in the examples and I would expect to be important indicators. The forest examples are much more specific, using terms such as value, volume, supply, consumption, and contribution to GDP.

Some items are more easily obtained for forest products because lumber, even though an intermediate rather than a final good, passes through a visible market where prices are discovered and reported. Grass, as forage, is only infrequently priced by the market.

4. Indicators are needed to monitor production and consumption of rangeland products, value of investments on rangelands

### **Legal, economic, and institutional framework**

1. Legal, institutional, and economic indicators relating to private property rights, public participation in planning and other public policy and decision making activities, maintenance of resource management skills, support for monitoring and assessments at multiple scales, promotion of research for new technologies as well as basic research on understanding rangeland ecosystem structure and function.
2. Capacity or Social Good – Have previous or traditional uses of rangelands led to the development of governmental or legal structures that precludes shifts to new “products”? For example, the need to foster management on public rangelands led to the creation the Federal grazing permit system. While permits, in and of themselves, have limited value, county assessors, real estate agents, etc. inflate the value of base properties because of the opportunity to support more livestock. Thus, even though the larger US population may no longer value livestock grazing as it once was, elimination or significant downsizing of grazing permits to accommodate new “products” may be resisted by local government and real estate markets because of long standing policies and pricing mechanisms. Allowing the “market” to amend existing policies has resulted in the issues listed under the Change on the Range Topic.
3. International influences on production and consumption of rangeland products. International trade influences on products from rangelands–US capability to produce.

4. Infrastructure to plan for the management of rangeland—environmental regulations, public involvement in public land management issues. The **Social Good** topic has issues related to distribution, community viability and attitudes, but does not seem to encompass an assessment of the current institutional capacity to conserve/protect/ manage/regulate land management and use of rangelands.

### **Social/political Uses**

1. Indicators are needed to monitor the degree of use and value for recreation and other non-consumptive rangeland values, tourism, levels of rangeland research, use of rangeland for cultural, spiritual and social needs and values, etc.
2. Level of rangeland use by use type (e.g., livestock grazing, recreation, etc.)
3. Cultural and spiritual values of rangelands? Native American values of rangelands?
4. How can we make sure we don't miss some non-traditional "outputs" such as pre-settlement cultural resources, spiritual renewal, non-consumptive wildlife recreation days, motorized recreation opportunities, etc.?
5. If we're worrying about recreation "capacity" how can we develop indicators that don't tend to disperse use more evenly across the landscape or region, thereby extensifying human use impacts?

### **Toxics**

1. I'm not credible on this topic but I wonder if toxics and their concentrations should have a seat at the rangeland sustainability table. I bring it up here only for discussion at our Reno meeting.
2. What is the role of rangelands in handling society's toxic waste?

### **Carbon Budgets**

1. Contribution of Rangelands to Carbon budgets
2. Indicator 27: Contribution of rangeland ecosystems to the total global carbon budget. This indicator is applicable towards Rangeland Health and Soil Topics, and will become very important as global climate change discussions continue.
3. There is no reference at all to the contribution of rangelands to carbon cycling and sequestration. It needs to be included as a separate indicator.

4. Carbon on rangeland?? Loss of carbon in rangeland soils.

## **Climatic Change**

1. Given the dramatic period of change we are entering in terms of climate, it is concerning that there are few, if any, direct references in this document to the fact that no matter how well we manage or plan, some desired end-point may be impossible because of changes in overall climatic conditions. One does not need to even involve global warming to have this issue. We are still living with the impact of Europeans entering the West at the end of the little Ice Age when the conditions were unusually wet (for the recent past). This resulted in unsustainable patterns of land-use evolving during the 1800s. Conditions noted by early explorers of settlers or explorers such as “belly-high grass” may not be obtainable regardless of whether over grazing occurred or not. The climatic variability needs to be somehow factored into all our discussions.

## **Comments on monitoring:**

- A number of topics are too detailed (site level) for a national monitoring system; i.e. information on soil physical properties, soil constituents, and soil food web structures. These would be better described by incorporating them into Montreal Process indicators 21 and 22 – area of rangeland with diminished soil organic matter and significant soil compaction due to human activities.
- It will be impossible to measure many (most) of these factors. Accordingly, we should discuss what happens when: (a) the data aren't there and/or (b) it will be impossible to get the data
- Will there be a trained Human Resource available to monitor and implement change? And at what scales?

## **General concerns and comments**

- Human impacts are included in conversion of rangeland to another type of land and introduction of invasives. [response to comment made in SLC that human impacts should be included in this important issues list as different from natural disturbances]
- While in general the list looks good. I am a bit concerned that while it is functional, it may not be descriptive enough. For example, under “Process/ Functions” there are listed three items including Nutrient cycling, Energy flow, Water cycling. While these are undoubtedly crucial, at the

same time I suspect that 10 ecologists would have 10 different ways of dealing with these issues.

### **Comments on using the Forestry C&I:**

I am sure that there are lots of issues that are essential to our project that are not on the lists. It will take much effort to identify them all.

I went through the Forestry C&I to see what was there. I thought the 7 Criteria and 67 Indicators were quite comprehensive - and remarkably adaptable to our rangeland interests.

I edited the Forestry C&I into a set of passable Rangeland C&I. Obviously, quite a bit of fine-tuning is needed to eliminate needless and duplicative indicators, but the framework seems to be there. I am attaching a copy of my draft for consideration.

I know that there are folks in the group who do not want to use the Forestry C&I as a starting point, but it seems wasteful to ignore an agreed-upon product of years of international effort. I would rather start there and evolve as necessary than start from scratch.

The really hard part of our project is figuring out what to measure and how to integrate the measurements into a matrix that provides some answers. I know it is now fashionable to take a "We report - You decide" approach, but if we are ever going to arrive at an answer to whether something is sustainable, we are going to have to make some "value" decisions - especially in the social and economic arenas.

Thanks for the opportunity to comment.

### **DRAFT A**

**Seven criteria and 67 indicators used by the Sustainable Rangeland Roundtable  
for temperate and boreal rangelands**

**CRITERION 1: Conservation of biological diversity**

[Indicator 1](#): (MP-1.1.a) Extent of area by range type relative to total range area.

[Indicator 2](#): (MP-1.1.b) Extent of area by range type and successional stage.

[Indicator 3](#): (MP-1.1.c) Extent of area by range type in protected area categories as identified by IUCN or other classification systems.

[Indicator 4](#): (MP-1.1.d) Extent of areas by range type in protected areas defined by successional state.

[Indicator 5](#): (MP-1.1.e) Fragmentation of range types.

[Indicator 6](#): (MP-1.2.a) The number of range dependent species.

[Indicator 7](#): (MP-1.2.b) The status (threatened, rare, vulnerable, endangered, or extinct) of range dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment.

[Indicator 8](#): (MP-1.3.a) Number of range dependent species that occupy a small portion of their former range.

[Indicator 9](#): (MP-1.3.b) Population levels of representative species from diverse habitats monitored across their range.

## **CRITERION 2: Maintenance of productive capacity of range ecosystems**

[Indicator 10](#): (MP-2.a) Area of rangeland and net area of rangeland available for commodity production.

Indicator 11: (MP-2.b) Total commodity production on rangeland available for commodity production.

Indicator 12: (MP-2.c) The area and growing stock of plantations (mono-cultures) of native and exotic species.

Indicator 13: (MP-2.d) Annual removal of range products compared to the volume determined to be sustainable.

Indicator 14: (MP-2.e) Annual removal of range products (e.g., fur bearers, berries, mushrooms, game), compared to the level determined to be sustainable.

### **CRITERION 3 Maintenance of range ecosystem health and vitality**

[http://www.sustainableforests.net/C&I\\_workshops/pdf/Criterion 3/Criterion 3 Summary](http://www.sustainableforests.net/C&I_workshops/pdf/Criterion%203/Criterion%203%20Summary%20NearFinal.pdf)

Indicator 15: (MP-3.a) Area and percent of range affected by processes or agents beyond the range of historic variation, e.g. by insects, disease, competition from exotic species, fire storm, land, clearance, permanent flooding, salinization, and domestic animals.

Indicator 16: (MP-3.b) Area and percent of rangeland subjected to levels of specific air pollutants (e.g. sulfates, nitrate ozone) or ultraviolet B that may cause negative impacts on the range ecosystem.

Indicator 17: (MP-3.c) Area and percent of rangeland with diminished biological components indicative of changes in fundamental ecological processes (e.g. soil, nutrient cycling, seed dispersion, pollination) and/or ecological continuity (monitoring of functionally important species such as fungi, arboreal epiphytes, nematodes, beetles, wasps, etc.)

### **CRITERION 4: Conservation and maintenance of soil and water resources**

[Indicator 18](#): (MP-4.a) Area and percent of rangeland with significant soil erosion.

[Indicator 19](#): (MP-4.b) Area and percent of rangeland managed primarily for protective functions (e.g. watersheds, flood protection, avalanche protection, riparian zones.)

[Indicator 20](#): (MP-4.c) Percent of stream kilometers in rangeland catchments in which stream flow and timing has significantly deviated from the historic range of variation.

[Indicator 21](#): (MP-4.d) Area and percent of rangeland with significantly diminished soil organic matter and/or changes in other soil chemical properties.

[Indicator 22](#): (MP-4.e) Area and percent of rangeland with significant compaction or change in soil physical properties resulting from human activities.

[Indicator 23](#): (MP-4.f) Percent of water bodies in range areas (e.g. stream kilometers, lake hectares) with significant variance of biological diversity from the historic range of variability.

[Indicator 24](#): (MP-4.g) Percent of water bodies in range areas (e.g. stream kilometers, lake hectares) with significant variation from the historic range of variability in pH, dissolved oxygen, levels of chemicals (electrical conductivity), sedimentation or temperature change.

[Indicator 25](#): (MP-4.h) Area and percent of rangeland experiencing an accumulation of persistent toxic substances.

## **CRITERION 5: Maintenance of range contribution to global carbon cycles**

[Indicator 26](#): (MP-5.a) Total range ecosystem biomass and carbon pool, and if appropriate, by range type, and successional stages.

[Indicator 27](#): (MP-5.b) Contribution of range ecosystems to be the total carbon budget, including absorption and release of carbon (standing biomass, coarse wood debris, peat and soil carbon.)

[Indicator 28](#): (MP-5.c) Contribution of range products to the global carbon budget.

## **CRITERION 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies**

### **Production and consumption**

[Indicator 29](#): (MP-6.1.a) Value and volume of rangeland products production, including value added through downstream processing.

[Indicator 30](#): (MP-6.1.b) Value and quantities of production of range products.

[Indicator 31](#): (MP-6.1.c) Supply and consumption of rangeland products, including consumption per capita.

[Indicator 32](#): (MP-6.1.d) Value of rangeland products production as percentage of GDP.

[Indicator 33](#): (MP-6.1.e) Degree of recycling of range products.

[Indicator 34](#): (MP-6.1.f) Supply and consumption/use of rangeland products.

### **Recreation and Tourism**

[Indicator 35](#): (MP-6.2.a) Area and percent of rangeland managed for general recreation and tourism, in relation to the total area of rangeland.

[Indicator 36](#): (MP-6.2.b) Number and type of facilities available for general recreation and tourism, in relation to population and range area.

[Indicator 37](#): (MP-6.2.c) Number of visitor days attributed to recreation and tourism, in relation to population and range area.

### **Investment in the range sector**

[Indicator 38](#): (MP-6.3.a) Value of investment, including investment in range growing, range health and management, planted ranges, commodity processing, recreation and tourism.

[Indicator 39](#): (MP-6.3.b) Level of expenditure on research and development, and education.

[Indicator 40](#): (MP-6.3.c) Extension and use of new and improved technologies.

[Indicator 41](#): (MP-6.3.d) Rates of return on investment.

### **Cultural, social and spiritual needs and values**

[Indicator 42](#): (MP-6.4.a) Area and percent of range land managed in relation to the total area of range land to protect the range of cultural, social and spiritual needs and values.

[Indicator 43](#): (MP-6.4.b) Non-consumptive-use range values.

### **Employment and community needs**

[Indicator 44](#): (MP-6.5.a) Direct and indirect employment in the range sector and the range sector employment as a proportion of total employment.

**Indicator 45:** (MP-6.5.b) Average wage rates and injury rates in major employment categories within the range sector.

**Indicator 46:** (MP-6.5.c) Viability and adaptability to changing economic conditions, of range dependent communities, including indigenous communities.

**Indicator 47:** (MP-6.5.d) Area and percent of rangeland used for subsistence purposes.

### **CRITERION 7: Legal, institutional and economic framework for range conservation and sustainable management**

*Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of ranges, including the extent to which it:*

**Indicator 48:** (MP-7.1.a) Clarifies property rights, provides for appropriate land tenure arrangements, recognizes customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process.

**Indicator 49:** (MP-7.1.b) Provides for periodic range-related planning, assessment, and policy review that recognizes the range of range values, including coordination with relevant sectors.

**Indicator 50:** (MP-7.1.c) Provides opportunities for public participation in public policy and decision making related to ranges and public access to information.

**Indicator 51:** (MP-7.1.d) Encourages best practice codes for range management.

**Indicator 52:** (MP-7.1.e) Provides for the management of ranges to conserve special environmental, cultural, social and/or scientific values.

*Extent to which the institutional framework supports the conservation and sustainable management of rangelands, including the capacity to:*

**Indicator 53:** (MP-7.2.a) Provide for public involvement activities and public education, awareness and extension programs, and make

available range related information.

**Indicator 54:** (MP-7.2.b) Undertake and implement periodic range-related planning, assessment, and policy review including cross-sectoral planning and coordination.

**Indicator 55:** (MP-7.2.c) Develop and maintain human resource skills across relevant disciplines.

**Indicator 56:** (MP-7.2.d) Develop and maintain efficient physical infrastructure to facilitate the supply of range products and services and support range management.

**Indicator 57:** (MP-7.2.e) Enforce laws, regulations and guidelines.

*Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of ranges through:*

**Indicator 58:** (MP-7.3.a) Investment and taxation policies and a regulatory environment which recognize the long-term nature of investments and permit the flow of capital in and out of the range sector in response to market signals, non-market economic valuations, and public decisions in order to meet long-term demands for range products and services.

**Indicator 59:** (MP-7.3.b) Non-discriminatory trade policies for range products.

*Capacity to measure and monitor changes in the conservation and sustainable management of ranges, including:*

**Indicator 60:** (MP-7.4.a) Availability and extent of up-to-date data, statistics and other information important to measuring or describing indicators associated with criteria 1-7.

**Indicator 61:** (MP-7.4.b) Scope, frequency and statistical reliability of range inventories, assessments, monitoring and other relevant information.

**Indicator 62:** (MP-7.4.c) Compatibility with other countries in measuring, monitoring and reporting on indicators.

*Capacity to conduct and apply research and development aimed at improving range management and delivery of range goods and services, including:*

**Indicator 63**: (MP-7.5.a) Development of scientific understanding of range ecosystem characteristics and functions.

**Indicator 64**: (MP-7.5.b) Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect range related resource depletion or replenishment in national accounting systems.

**Indicator 65**: (MP-7.5.c) New technologies and the capacity to assess the socioeconomic consequences associated with the introduction of new technologies.

**Indicator 66**: (MP-7.5.d) Enhancement of ability to predict impacts of human intervention on rangelands.

**Indicator 67**: (MP-7.5.e) Ability to predict impacts on rangelands of possible climate change.