Carrying Capacity Improvement

CCARDESA
Centre for Coordination of Agricultural Research and Development for Southern Africa

Technical Brief 43

Carrying capacity defines the number of Animal Units (AU; head of cattle or number of sheep, goats or other animals) that can graze in a rangeland unit without exhausting the vegetation and soil quality – essentially optimally utilising resources. Optimum carrying capacity is where a given unit of rangeland can support healthy populations of animal species, while allowing an ecosystem to regenerate, thus creating a sustainable balance. The stocking rate - defined as the number of animal species grazing a unit of rangeland for a limited period - must be kept fixed on an average year, meeting the carrying capacity to allow regeneration, the fallen seeds to rejuvenate and the soil to recover. However, stocking rates can fluctuate depending on the nature of the vegetation, rainfall variability, herd composition and management system. If the conditions are not favourable for vegetation growth during drought season, the number of livestock or the grazing period must be adjusted to avoid overgrazing. Moreover, the purpose of livestock keeping, i.e. for milk, meat, or wool production, will determine the carrying capacity of a rangeland unit. Factors such as climatic zone, rainfall dependency, class of livestock (steer, dry cow, calves, lactating cow and bull, etc), health of grassland and animal species affect the stocking rate. While relevant in all climatic zones, it is more applicable in arid and semi-arid zones where rainfall is most scarce. This climate smart practice increases production (meat/dairy), increases pasture resilience to extreme climate hazards (drought) and enhances soil fertility.

MOST SUITABLE AGRO-ECOLOGICAL CONDITIONS

Value chain

- Maize
- Sorghum
- Rice
- Livestock
- Other

Soil texture

- Light
- Medium
- Heavy

Climatic zone

- Arid
- Semi-arid
- Sub-humid
- Humid

Water source

- Rainfed
- Partly irrigated
- Irrigated

Annual average rainfall (mm)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1500
- > 1500

Topography

- Flat to gentle slope (0 – 5 %)
- Moderate to rolling slope (6 – 15 %)
- Hilly slope (16 – 30 %)
- Steep slope (> 30 %)

MOST APPROPRIATE CONDITIONS AND REQUIRED INPUTS

Farming system

Does it require collective action

- Yes
- No

Characteristics

- Subsistence
- Commercial Small
- Commercial Medium
- Commercial Large

Farm size (ha)

- < 2
- 2 to 5
- 5 to 10
- > 10

Mechanisation

- Manual
- Animal
- Mechanised

Human resources

Labour intensity – level of effort

- Low (household)
- Medium (seasonal)
- High (outside labour)

Gender/youth smart (low investment/low labour requirements)

- Yes
- No

Financial resources

Initial investment

- Low
- Medium
- High

Maintenance Costs

- Low
- Medium
- High

Access to finance capital or credit required

- Yes
- No

Enabling Environment

Extension support

- Yes
- No

Access to inputs

- Yes
- No

Market access

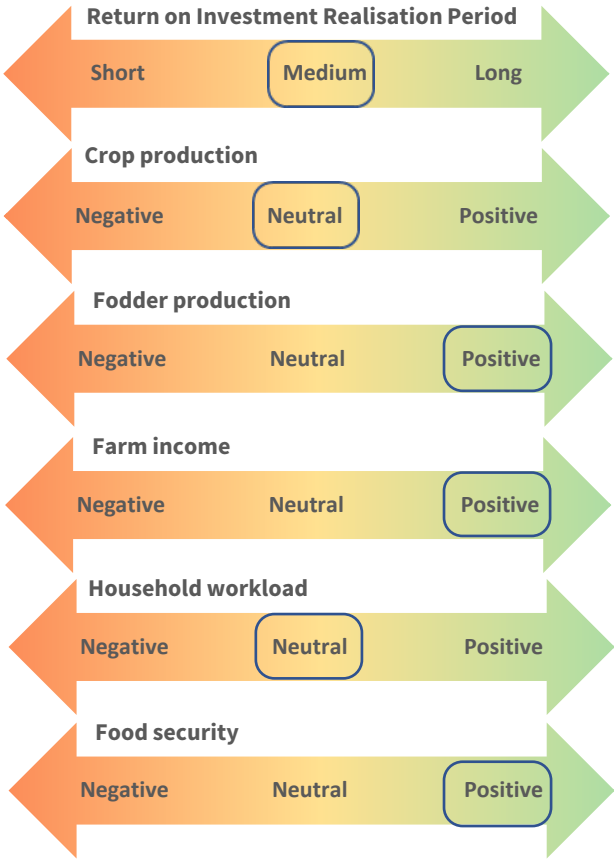
- Yes
- No

The purpose of this technical brief is to guide where this **practice, technology or strategy** could be applied. It may be applicable in other circumstances, but this brief focuses on where it is possibly **most suitable**. Content is general, and should be contextualised depending upon locality. The brief provides an overview, details of appropriate agroecological characteristics, appropriate conditions and inputs, possible outcomes and impacts, how the **practice, technology or strategy** should be applied, potential benefits and drawbacks, and provides suggestions for further reading in terms of CCARDESA materials and other sources, including those used to develop this technical brief.

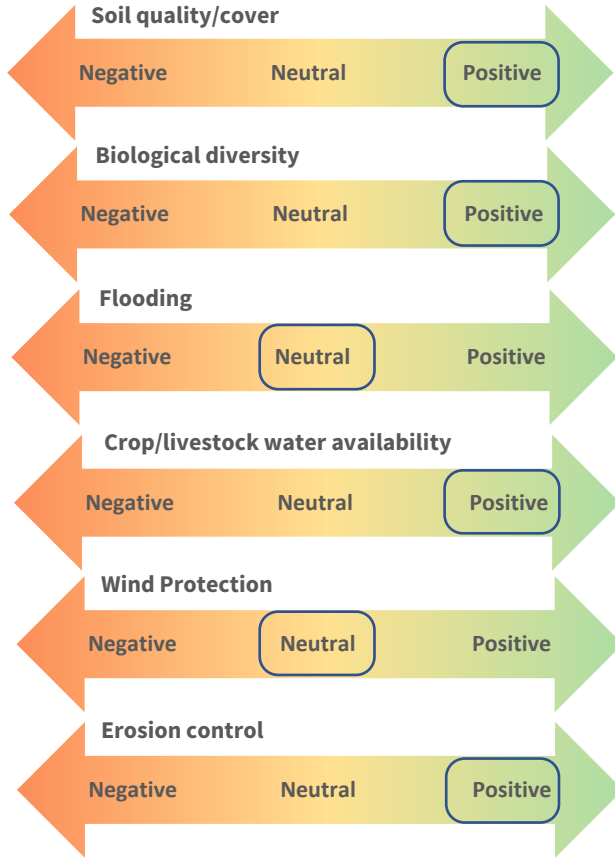
*CCARDESA is a subsidiary of SADC, coordinating and harmonising agricultural research and development in Southern Africa. This **Technical Brief** is part of a series of materials designed to support **Knowledge Products on climate smart agriculture** available here: www.ccardesa.org/saaiks-knowledge-hub*

POSSIBLE IMPACT/OUTCOMES

Socio-Economic Impacts Positive or Negative



Ecological Impacts Positive or Negative



These descriptors indicate whether the practice, technology or strategy has a positive, neutral , or negative impact or outcome
Those with no box are deemed not-applicable

TECHNICAL APPLICATION

To effectively implement Carrying capacity improvement:

- **Step 1:** There is no standard equation to determine the carrying capacity of an area, as many variables apply and factors relevant within each context including size of land unit, amount, frequency and timing of rainfall seasons, type of vegetation, species of animal, etc.
- **Step 2:** Extension officers should aim to support farmers to continuously monitor rangeland status and realise the impacts of over-grazing and the benefits of finding an equilibrium.
- **Step 3:** Constant monitoring of the pasture and animals must be carried out throughout the year to check if stocking rate aligns with the carrying capacity of the land unit. If land degradation is identified, adjustments to stocking rates should be considered, in the context of season and landscape regeneration.

- For communal grazing land, it is ideal to use Animal Units (AU) to calculate the relative grazing impact of different kinds and classes of domestic livestock and/or even common grazing wildlife species for one month (AUM = Animal Unit Months). This information should support collective decision-making regarding rangeland resources.

  Using a conversion table of, the AUE (Animal Unit Equivalent) and the formula:

  1) multiply the number of animals to be grazed on the pasture by AUE to determine total AU, then

  2) multiply the total AU by the number of months planned to graze (see formula below or

  Worksheet A of the Range Calculator).

  Formula: _____ x _____ = _____ x _____ = _____

  # Animals AUE(table) Animal Units (AU) Months (M) AUM

- **Step 4:** One option for effectively responding to carrying capacity challenges is shift or changing grazing species if high consumption species are placing pressure on a particular unit of land.

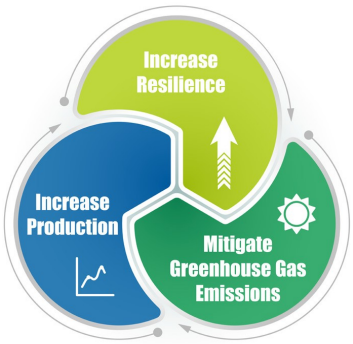
CLIMATE SMART AGRICULTURE OUTCOME(S)

Reflecting how this **practice, technology or strategy** contributes to Climate Smart Agriculture outcomes

Higher meat and/ or dairy production per unit area.

Improved pasture (through proper management) allow higher numbers without retrogression, thus more resilient even to drought conditions, erosion, flooding, etc.

Increases soil organic matter and plants-thus locks more carbon (c-sequestration).



SUMMARY/KEY ISSUES

Benefits

- Identifying, achieving and maintaining optimal carrying capacity helps to avoid rangeland degradation including vegetation depletion and soil erosion, bush encroachment, and optimises resource use.
- Effectively monitoring carrying capacity can allow communities to respond to climate change impacts, resulting from shifting rainfall patterns and temperature regimes.

Drawbacks

- Rainfall dependency, class of livestock and quality of grassland affect stocking rate.
- The stocking rate must be monitored to avoid animal overcrowding, which might cause diseases to spread quickly.
- It is important to monitor the plant species in your pasture and or rangelands to be able to determine its health and trend.
- Reseeding should be considered in areas when land is degrading.

REFERENCE MATERIAL

CCARDESA Related Content

- CCARDESA, 2019. Technical Brief 15, Climate Smart Pasture/Rangeland Management Options for Livestock in the SADC region.

Additional Information

- The Food and Agriculture Organisation (FAO), 1997. Livestock and the environment: Finding a balance. Rome, Italy.
- The Food and Agriculture Organisation (FAO), 2013. Carrying capacity tools for use in the implementation of an ecosystems approach to aquaculture. Rome, Italy.

Citation: CCARDESA and GIZ 2019. Technical Brief 43: Carrying Capacity Improvement. Secretariat, Gaborone, Botswana.