

## Measuring vegetation characteristics in rangelands more accurately through the VegMeasure<sup>®</sup> tool

### KEY MESSAGES

- Vegetation cover is an important parameter in understanding ecosystem health and productivity, yet to continually measure vegetation cover at scale can be challenging, expensive and time-consuming. This type of data, however, is needed to make good decisions about land management and usage.
- VegMeasure<sup>®</sup> meets that challenge by providing a simple and rapid way to analyse changes to vegetation cover in the form of free-downloadable software that processes digital images of an ecosystem to identify the vegetation types and coverage therein.
- The tool is popular amongst researchers, development agencies and field technicians, particularly in rangeland areas where land managers need to make difficult decisions about how much grazing to allow in the context of livelihood needs, a fragile ecosystem and a changing climate.

### SUMMARY

VegMeasure<sup>®</sup> is a computerised vegetation-management program. It uses image-processing software to process digital images which are collected in a standardized manner, to classify vegetation and measure changes over time.

The tool was created by the Department of Animal and Rangeland Sciences at Oregon State University (OSU, USA) in collaboration with the International Centre for Agricultural Research in the Dry Areas (ICARDA). The tool provides a scientifically sound method to monitor vegetation on natural and agronomic landscapes, which can be applied in a range of ecosystems and operated with only basic training.

Monitoring vegetation cover is important because it helps land managers, land users and decision makers to understand the health of the ecosystems in which they operate - as well as the effects of human and natural impacts on those ecosystems over time.

Historically, it has been difficult, expensive and time-consuming to acquire reliable data about vegetation cover and changes at a landscape level. With the readily accessible information that VegMeasure<sup>®</sup> provides, managerial systems can be more easily, accurately, and safely evaluated for ecosystem health and long-term sustainability.

## THE CHALLENGE

Climate change, land-use change, grazing strategies and other human and natural interventions all impact the types and amount of vegetation that is present across a particular landscape. Vegetation plays an important role in ecosystem stability through reducing soil loss in the form of erosion.

As such, vegetation cover is a fundamental parameter in many studies of plant ecology, and a key element of monitoring and assessment for ecosystems such as rangelands. It is used to measure the surface of the ground exposed to the direct impact of raindrops and sunlight; to evaluate the nature of plant communities; to assess productivity; and to explore trends and changes in vegetation structure over time.

Therefore, access to accurate, comprehensive information about vegetation cover, and its changes over time, helps land managers and decision makers to make better choices for the environments in which they work. Historically, vegetation cover has been assessed using field-based methods such as visual estimates, line transects and quadrant sampling. These methods may be effective at collecting the data required, but they are also costly, laborious, heavily dependent on personal judgement and can be destructive, particularly in delicate ecosystems. This often results in reduced coverage and low accuracy of collected data. Frequently, highly detailed records are produced for just a few locations.

## HOW DOES THE TOOL ADDRESS THE CHALLENGE?

The above limitations inspired ICARDA and OSU scientists to explore new methods to monitor ecosystem health and trends that are rapid, precise, cost-effective and non-subjective. The result is VegMeasure®, a software-based tool that is used to interpret, classify and interpolate digital images into meaningful classes. This enables users to quickly find out the percentage and type of vegetation cover in a particular ecosystem and chart changes over time.

Digital imaging is widely recognised as one of the most reliable and accurate techniques for monitoring vegetation under different conditions, because of its low price and simple, straightforward setup and application process. However, image processing software is often expensive and requires users to have a solid remote sensing background. VegMeasure® software, by contrast, is offered free of charge, and is easy to use and interpret while providing high frequency and resolution data.

## WHO IS THE TOOL FOR?

VegMeasure® can be applied in a wide span of research areas and ecosystems, including rangelands, grasslands, forests, agronomy (cropland), coastal vegetation and mining reclamation.

The tool is designed to be used by national agricultural research systems, advanced research institutes, development agencies, the Consultative Group on International Agricultural Research (CGIAR), international organisations, private sector consultants and non-governmental organisations.

Ultimately, the tool is intended to help land managers meet environmental and livelihood preservation goals for ecosystems and their communities. Focus is on environments such as rangelands where issues such as overgrazing and climate change impacts can have grave consequences for an ecosystem's ability to regenerate over time. For example, if better-informed decisions can be made about when to graze and when to 'rest' particular rangeland areas, pastoralists will ideally have a better chance of feeding their herds sustainably for the years to come.

## HOW THE TOOL WORKS

THERE ARE FIVE MAIN STEPS TO USING THE TOOL:

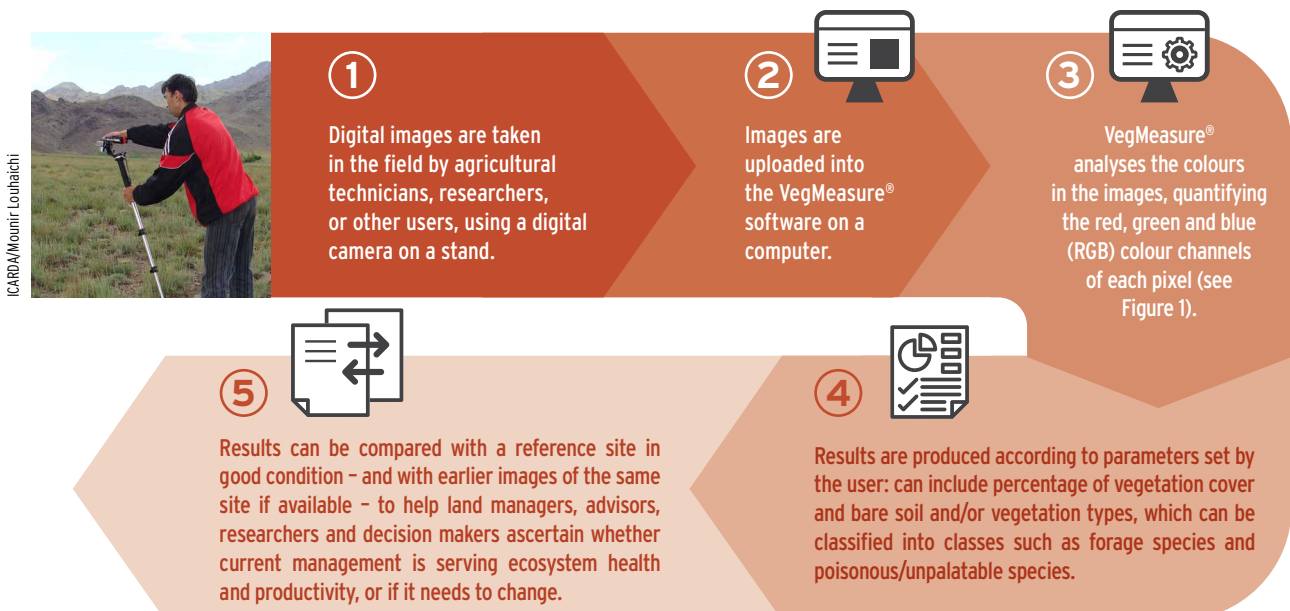
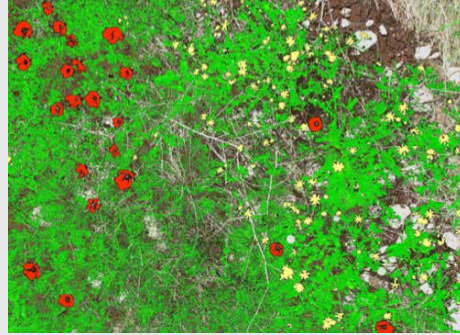


Figure 1 Digital image processing by VegMeasure®

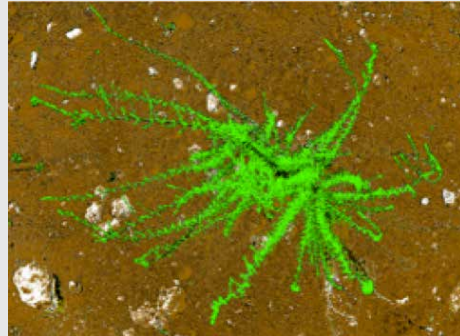
Digital image (Original) before processing

Processed image

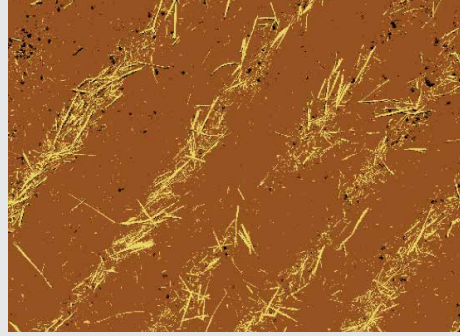
RANGELAND



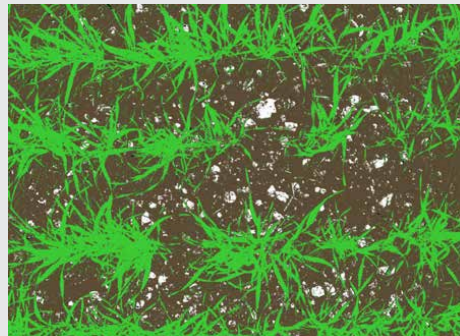
SHRUBLAND (*Salsola vermiculata*)



CONSERVATION AGRICULTURE (CROP RESIDUE)



AGRONOMIC (WHEAT) FIELD



## BENEFITS, CHALLENGES, AND OPPORTUNITIES

VegMeasure® is a reliable, objective and non-destructive method for estimating vegetation cover. It is quick, easy and cost-effective to collect the images with a digital camera and process them using the software. The entire process usually takes less than one week.

The tool has the potential to significantly reduce monitoring costs, while enabling the collection of detailed data sets that are extremely valuable in documenting site changes and trends. Monitored sites can easily be revisited each season or year to assess the spatial and temporal effect of natural and human interventions. Furthermore, ground cover estimates between sites can be standardized in a way that cannot be accomplished

through visual estimates.

In terms of remaining challenges for the tool's rollout, a small amount of training is required to use the software effectively, and two training manuals have been developed to address this. The developers also note that the tool is relatively ineffective when shrubs are very tall, or when vegetation cover reaches 100%.

Looking to the future, the scientists would like to develop a VegMeasure® app, whereby the software and image-capturing would be integrated on a smartphone and users could get an instant estimate of vegetation cover while in the field. This could considerably streamline decision making processes.

### CASE STUDY: Analysing vegetation cover in a semi-arid grassland site in Kazakhstan

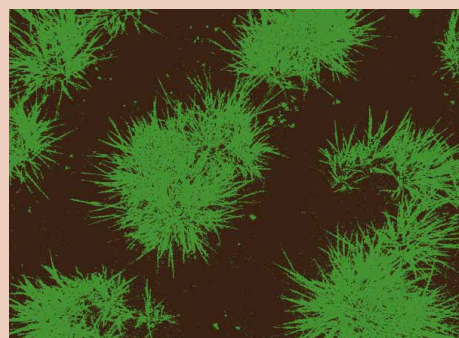
Grasslands cover vast areas of the globe and play a critically important role in the livelihoods of rural communities in arid and semi-arid ecosystems. Having a good estimate of grassland productivity is crucial to local communities and to decision makers working to help maintain sustainable livestock production systems.

In a 2018 study, ICARDA ecologists Mounir Louhaichi and Sawzan Hassan, alongside OSU ecologist Douglas E. Johnson, used VegMeasure® software to assess rangeland health in Kazakhstan by estimating the percentage of vegetation cover in a semi-arid grassland site. Vegetation cover has been recognized as an important surrogate variable to predict the biomass of grassland as well as an indicator of land degradation and desertification. The higher the vegetation cover, the more stable and healthier the site is.

The scientists used a GPS-enabled digital camera with a 16 mega-pixel resolution and a high-quality lens, which was mounted on a pole that held the camera at a height of 1.5 metres above the ground. Green cover (vegetation) was estimated at 75%, while the bare ground (soil) was 25% (see figure 2). The classification accuracy was determined to be 98%.

This finding suggests the site is in good health, although the researchers emphasise that this is only one assessment at a particular time and space, and if the experiment were repeated over time, they would be able to detect trends and monitor the conditions of the site. If cover was declining, then management would need to be adjusted, such as reducing grazing time or the number of animals. In a worst-case scenario, land managers might be forced to protect an area from grazing for longer, until the vegetation recovered.

**Figure 2** Original (left) and processed (right) images using VegMeasure® software to estimate ground cover in a grassland site in Kazakhstan





ICARDA/Mounir Louhaichi



ICARDA/Mounir Louhaichi

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