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Human Exploration of the Moon and Cislunar Space (1)

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LUNAR AGRICULTURE: FARMING FOR THE FUTURE

Abstract

With revitalized international efforts toward human exploration of the Moon and Mars, evidenced by NASA's Artemis program, the International Space University conducted a project involving a multidisciplinary team of 27 experts from eight countries on the topic of sustainable food production on the Moon. They identified six key requirements for the establishment of lunar farming activities, to enable long-term human activity on the Moon. Recommendations include developing technological and economic roadmaps that can be applied on upcoming lunar exploration missions.

An interdisciplinary approach was taken in determining the viability of current and novel technologies, agricultural practices, food sources, and operational management models for addressing physiological limitations, the challenging lunar environment, resource constraints, and sustainability considerations. The following recommendations have been proposed:

1. Prioritize soil-based farming, hydroponics, insect growth, and cell cultures as agricultural methods.
2. Repeat the Biosphere 2 experiment as a proof of concept demonstrating viability of farming on the Moon. This should target variance in carbon levels and soil richness to mitigate biological issues previously encountered and optimize crop production.
3. Lower costs and the number of resupply missions and materials from Earth with in-situ resource utilization (ISRU) of lunar materials such as lunar basalt rock and regolith, through structures built underground, or semi-underground with a regolith barrier above to protect from micrometeorites, radiation, and thermal variation.
4. Include tomatoes, carrots, garden cress, sweet potatoes, soybeans, peanuts, rice, oyster mushroom, cloudberry cell cultures, and crickets in the range of initial lunar-farmed food sources for nutritional diversity and physiological and psychological benefit.
5. Establish a regulatory and economic approach that enables the free flow of scientific, technological, and educational exchange that will provide return on investment and give credence to the establishment of a lunar farm, while remaining compliant with the Outer Space Treaty and the Moon Agreement.
6. Establish an international authority management structure similar to that used for the European Council for Nuclear Research (CERN), incorporating applicable UN guidelines for the Long-term Sustainability of Outer Space Activities into the planning, design, development, and implementation of the initiative.

The establishment of a lunar farm is key in enabling humankind to explore the solar system, and further development of existing technologies and agricultural processes, in alignment with the six recommendations, provide a promising foundation.