

Issues of Space Agriculture Concept

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Space agriculture is engineering for sustaining activities of crew on extraterrestrial bodies, such as Mars, by function of biological and ecological elements. Agriculture was invented about ten thousand years ago. It enabled to provide foods more than self consumption, and to start human civilization. Astronomer was the earliest scholar, and contributed to develop agriculture with innovation of calendar. Emergence of modern science and industrial revolution proceeded about three hundred years ago. Modern agriculture based on scientific achievements allows our future of exploring extraterrestrial bodies and space agriculture on them. Healthy curiosity towards space might be a key for maintaining our civilization sustainable.

For Earth orbiting station or Moon base, open system is the appropriate choice for life support. Foods are carried from ground, and recycling is limited to water, of which consumption rate is high. Recycling of foods and oxygen from metabolic waste and inedible biomass requires huge initial investment for its system. Space agriculture would be selected at the phase of larger and longer manned mission beyond Moon, where integrated amount of consumable becomes larger than investment and operational cost for recycling system. Beside of this economy for life support, survivability is the highest priority in life support engineering. Space agriculture relies on supreme functions of biological and ecological system. However, they turn to a black box with confidence or reliability less defined. Study for closed ecological life support has been oriented to improve degree of closure in materials recycling loop, and minimize quantity of drop out of materials from the loop. We consider survivability as the top priority, and recycled food and other resources is stored to fill the needs of the next crew. Space agriculture will import on site materials resources into the loop, and realize more than 100 % expanded recycle. Available on site resources are carbon dioxide in atmosphere, frozen water in subsurface, and biotic elements in regolith and rock. We should plan and conduct preceding exploration to confirm feasibility of utilization of those resources. We develop phased deployment of space agriculture based on its results. Forward quarantine must be strictly implemented in space agriculture in order to save the exploration target from terrestrial contamination.

Once survivability is secured in life support function, our target will be improvement of crew productivity and emergence of comfortable living environment in outpost on extraterrestrial bodies. Space agriculture is extended from materials recycle to the whole engineering to produce living environment and improve its amenity. In this context, space agriculture is scoped with its associated area, such as psychology of space mission, and space architecture for pleasant living. These aspects are important for long space mission under stressful factors.

Space agriculture will be chosen at the phase of manned space exploration to Mars at large and long scale. However, it would be an effective testbed for engineering solving global problems, such as shortage of farming ground against increasing human population, and severe deterioration of land. Among them, entomophagy by raising insect without competition of food crop production is an excellent contribution to life support engineering for space exploration from traditional culture of Japan and east Asia.

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