food from space

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NASA did studies on space colonies back in the 1970s and 80s. Gerard O'Neill wrote on them in The High Frontier.

http://space.mike−combs.com/SCTHF.html

The costs do not take into account the ability of developing the technology more gradually in a way that sees it more of an investment that earns profits, which are then re−invested in technology development.

One interesting finding was that farms in space support 40,500 people per square kilometer at US per capita levels of consumption. This amounts to 730 kg per person per year. To fee 6.6 billion people at this level requires 162,963 square kilometers of pressure vessel area.

103,745 spheres each 1 km in diameter each housing a spinning cylinder 707 meters in diameter and 707 meters deep, support 1.57 square kilometers of growing area − each supporting 63,585 persons.

Each satellite has a rail gun and fires 2 meals per second − to people all over the Earth aided by low cost GPS guidance systems and ceramic aerogel thermal protection systems with aerodynamic features. MEMs based rockets forming a propulsive skin to execute a soft landing at the desired location for each meal. Terminal velocity of the aerogel encased meal is about 200 m/sec following re−entry − which requires a propellant fraction of 4.3% or 30.4 grams of propellant for a 700 gram meal. The rail gun fires it to the targeting envelope and the kinetic energy and tail fins of the falling meal are adjusted to bring it to a precise GPS cooerdinate. A solid state doppler radar determines precise altitude to ignite the engines, and bring the meal to a halt at zero altitude at the desired location.

The mass of 2 meals per second is 1.47 kg per second. With an ejection speed from the rail gun of 500 m/sec to deorbit each meal, this exerts a 75 kgf thrust on the station. This is made up for by burning of hydrogen and oxygen made from water at a rate of 0.17 kg per second.

Orders are taken via satellite cell phone or satellite internet, and delivered within 30 minutes or less anywhere on Earth. . .

10 billion tons per year of asteroidal materials, principally water and carbon−dioxide − are imported from the asteroid belt by nuclear pulse deflection of asteroidal material selected for quality and variety of materials.

The satellites are made from asteroidal material as well brought from the asteroid belt earlier..

7,255,410 equilateral triangles composed of aluminum framing encased in PET film are manufactured as a flexible 'string' 3,627 km long. An assembly head welds the aluminum frame, and seals the PET film in a spiral pattern to form a 1 km diameter stationary sphere. A 707 meter diameter cylinder 707 meters wide, rotates freely inside this sphere supported by magnetic bearings at the edges of the cylinder. The cylinder rotates once every 37.7 seconds. The interior of the cylinder has an oblate thin film reflective surface that reproduces over the course of 24 hours the same day/night conditions one finds on Earth which rotates along with the cylinder, but in such a way that it completes one rotation every 24 hours − giving a day night cycle to the plants and animals on the cylinder surface.
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40 farmers and 200 farm helpers are present tele−robotically to grow the foods at the station. Additionally, there are 360 cooks cleaners and handlers at each station to prepare meals and package them. Thus, 600 people are needed to support 40,500 in their food needs. All stations together require a total of 62,247,000 telerobotic workers. Each station has a set of 10 people present in person, thus 1,037,450 people are living on orbit in the 103,745 stations.

The world presently spends $9 trillion per year on food. The network here captures the bulk of this, and at $50,000 per person on average $3.15 trillion is salaries, and the balance is capital cost and profits. A total of $46 trillion may be supported in this way − This allows $440 million per satellite as the target price in this quantity. This is $282 per square meter − allowable cost.

This is the fourth step in a seven step process of lowering cost of space borne pressure vessels

1) mining − highest cost
2) smelting
3) forming/assembly
4) farming − mid−range
5) forestry
6) residential <−− high frontier level
7) private home − lowest cost

Moving entire asteroids from the asteroid belt into MEO seems to me more 'doable' than lifting things piecemeal from the lunar surface. Since substantial ice is present in the asteroid belt, that is also a plus.

10 billion tons per year requires the expulsion 17 billion tons of 'propellant' vaporized from the surface of the asteroids moved in this way. Expelling the materials at 7 km/sec requires an average expenditure of only 20 terawatts − averaged over the entire year. . 856 tons per second are harvested and 317 tons per second are made availale. Of this, half is turned into food and deposited on the Earth.

Four asteroid fragments, each roughly spherical each 100 meters in diameter, arrive at Earth orbit from around the asteroid belt every hour to resupply the ring of farm satellites. They have taken 3 years to get to Earth and enter a MEO to be processed at centers that build the satellites in the first place. Each fragment has sufficient raw material to feed a farm satellite for 3 years. Each moves to an appropriate position next to a satellite, and is fed into it − and raw materials are processed on board into air, water, fertilizer and nutrients− to replace the constant stream of materials falling to Earth.

The satellites form a Saturn like ring in polar orbit above the Earth − and each satellite flies over the entire Earth several times per day.

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