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1] No risk of a debris impact---

Stuff blows up in space all the time, and almost none of it involves objects we care about---robust modeling found a .001% chance of collisions---that's Wein

Probability – 0.1% chance of a collision.

Salter 15 – Assistant Professor of Economics & Comparative Economics Research Fellow at Texas Tech University

Alexander W. Salter, Space Debris: A Law and Economics Analysis of the Orbital Commons, Mercatus Working Paper, Mercatus Center at George Mason University, 19 STAN. TECH. L. REV. 221 (2016), https://law.stanford.edu/wp-content/uploads/2017/11/19-2-2-salter-final_0.pdf

*numbers replaced with English words

The probability of a collision is currently low. Bradley and Wein estimate that the maximum probability in LEO of a collision over the lifetime of a spacecraft remains below one in one thousand, conditional on continued compliance with NASA's deorbiting guidelines.³ However, the possibility of a future "snowballing" effect, whereby debris collides with other objects, further congesting orbit space, remains a significant concern.⁴ Levin and Carroll estimate the average immediate destruction of wealth created by a collision to be approximately \$30 million, with an additional \$200 million in damages to all currently existing space assets from the debris created by the initial collision.⁵ The expected value of destroyed wealth because of collisions, currently small because of the low probability of a collision, can quickly become significant if future collisions result in runaway debris growth.

2] Space is huge---nothing will collide

Albrecht 16 – Chairman of the board of USSpace LLC & fmr. head of the National Space Council

Mark Albrecht, chairman of the board of USSpace LLC, head of the White House National Space Council from 1989 to 1992, and Paul Graziani, CEO and founder of Analytical Graphics, a company that develops software and provides mission assurance through the Commercial Space Operations Center (ComSpOC), Congested space is a serious problem solved by hard work, not hysteria, 2016, <https://spacenews.com/op-ed-congested-space-is-a-serious-problem-solved-by-hard-work-not-hysteria/>

There are over a half million pieces of human-made material in orbit around our planet. Some are the size of school buses, some the size of BB gun pellets. They all had a function at some point, but now most are simply space debris littered from 100 to 22,000 miles above the Earth. Yet, all behave perfectly according to the laws of physics. Many in the space community have called the collision hazard caused by space debris a crisis. Popular culture has embraced the risks of collisions in space in films like Gravity.

Some participants have dramatized the issue by producing graphics of Earth and its satellites, which make our planet look like a fuzzy marble, almost obscured by a dense cloud of white pellets meant to conceptualize space congestion. Unfortunately, for the sake of a good visual, satellites are depicted as if they were hundreds of miles wide, like the state of Pennsylvania (for the record, there are no space objects the size of Pennsylvania in orbit). Unfortunately, this is the rule, not the exception, and almost all of these articles, movies, graphics, and simulations are exaggerated and misleading. Space debris and collision risk is real, but it certainly is not a crisis. So what are the facts? On the positive side, space is empty and it is vast. At the altitude of the International Space Station, one half a degree of Earth longitude is almost 40 miles long. That same one half a degree at geostationary orbit, some 22,000 miles up is over 230 miles long. Generally, we don't intentionally put satellites closer together than one-half degree.

3] Tracking debris exists now and solves collisions.

Mosher '19 [Dave; September 3rd; Journalist with more than a decade of experience reporting and writing stories about space, science, and technology; Business Insider, "Satellite collisions may trigger a space-junk disaster that could end human access to orbit. Here's How,"
https://www.usafa.edu/app/uploads/Space_and_Defense_2_3.pdf; GR]

The **Kessler syndrome** plays center-stage in the movie "Gravity," in which **an accidental space collision** endangers a crew aboard a large space station. But Gossner said **that type of a runaway space-junk catastrophe is unlikely**. "Right now I **don't think we're close to that**," he said. "I'm not saying we couldn't get there, and I'm not saying we don't need to be smart and manage the problem. But **I don't see it ever becoming, anytime soon, an unmanageable problem**." There is no current system to remove old satellites or sweep up bits of debris in order to prevent a Kessler event. Instead, **space debris is monitored from Earth**, and new rules require satellites in low-Earth orbit be deorbited after 25 years so they don't wind up adding more space junk. "**Our current plan is to manage the problem and not let it get that far**," Gossner said. "**I don't think that we're even close to needing to actively remove stuff**. There's lots of research being done on that, and maybe some day that will happen, but I think that — **at this point**, and in my humble opinion — **an unnecessary expense**." A major part of the effort to prevent a Kessler event is **the Space Surveillance Network (SSN)**. The project, **led by the US military, uses 30 different systems around the world to identify, track, and share information about objects in space**. Many **objects are tracked day and night via a network of radar observatories around the globe**. Optical telescopes on the ground also keep an eye out, but they aren't always run by the government. "The commercial sector is actually putting up lots and lots of telescopes," Gossner said. The government pays for their debris-tracking services. Gossner said **one major debris-tracking company is called Exoanalytic**. It **uses about 150 small telescopes set up around the globe to detect, track, and report space debris to the SSN**. Telescopes in space track debris, too. **Far less is known about them because they're likely top-secret military satellites**. **Objects detected by the government and companies get added to a catalog of space debris and checked against the orbits of other known bits of space junk**. **New orbits are calculated with supercomputers to see if there's a chance of any collisions**. Diana McKissock, a flight lead with the US Air Force's 18th Space Control Squadron, helps track space debris for the SSN. She said the surveillance network issues warnings to NASA, satellite companies, and other groups with spacecraft, based on two levels of emergency: basic and advanced. **The SSN issues a basic emergency report to the public three days ahead of a 1-in-10,000 chance of a collision**. **It then provides multiple updates per day until the risk of a collision passes**. To qualify for such reporting, a rogue object must come within a certain distance of another object. In low-Earth orbit, that distance must be less than 1 kilometer (0.62 mile); farther out in deep space, where the precision of orbits is less reliable, the distance is less than 5 kilometers (3.1 miles). **Advanced emergency reports help satellite providers see possible collisions much more than three days ahead**. **In 2017, we provided data for 308,984 events, of which only 655 were emergency-reportable**," McKissock told Business Insider in an email. Of those, 579 events were in low-Earth orbit (where it's relatively crowded with satellites).

1NC 1 OFF: Mining

Private companies are set to mine in space – new tech and profit motives make space lucrative

Gilbert 21, (Alex Gilbert is a complex systems researcher and PhD student in Space Resources at the Colorado School of Mines. “Mining in Space is Coming”). 4-26-21. Milken Institute Review. <https://www.milkenreview.org/articles/mining-in-space-is-coming//MNHS.NL>

Space exploration is back. after decades of disappointment, a combination of better technology, falling costs and a rush of competitive energy from the private sector has put space travel front and center. indeed, many analysts (even some with their feet on the ground) **believe that commercial developments in the space industry may be on the cusp of starting the largest resource rush in history: mining on the Moon, Mars and asteroids.** While this may sound fantastical, some

baby steps toward the goal have already been taken. **Last year, NASA awarded contracts to four companies to extract small amounts of lunar regolith by 2024, effectively beginning the era of commercial space mining. Whether this proves to be the dawn of a gigantic adjunct to mining on earth — and more immediately, a key to unlocking cost-effective space travel — will turn on the answers to a host of questions ranging from what resources can be efficiently.** As every fan of science fiction knows, the resources of the solar system appear virtually unlimited compared to those on Earth. There are whole other planets, dozens of moons, thousands of massive asteroids and millions of small ones that doubtless contain humungous quantities of materials that are scarce and very valuable (back on Earth). **Visionaries including Jeff Bezos imagine heavy industry moving to space and Earth becoming a residential area. However, as entrepreneurs look to harness the riches beyond the atmosphere,** access to space resources remains tangled in the realities of economics and governance. Start with the fact that space belongs to no country, complicating traditional methods of resource allocation, property rights and trade. With limited demand for materials in space itself and the need for huge amounts of energy to return materials to Earth, creating a viable industry will turn on major advances in technology, finance and business models. That said, there’s no grass growing under potential pioneers’ feet. **Potential economic, scientific and even security benefits underlie an emerging geopolitical competition to pursue space mining.** The United States is rapidly emerging as a front-runner, in part due to its ambitious Artemis Program to lead a

multinational consortium back to the Moon. But it is also a leader in creating a legal infrastructure for mineral exploitation. **The United States has adopted the world’s first space resources law, recognizing the property rights of private companies and individuals to materials gathered in space.** However, the United States is hardly alone. Luxembourg and the United Arab Emirates (you read those right) are racing to codify space-resources laws of their own, hoping to attract investment to their entrepot nations with business-friendly legal frameworks. China reportedly views space-resource development as a national priority, part of a strategy to challenge U.S. economic and security primacy in space. Meanwhile, Russia, Japan, India and the European Space Agency all harbor space-mining ambitions of their own. Governing these emerging interests is an outdated treaty framework from the Cold War. Sooner rather than later, we’ll need new agreements to facilitate private investment and ensure international cooperation.

Back up for a moment. For the record, **space is already being heavily exploited** because space resources include non-material assets such as orbital locations and abundant sunlight that enable satellites to provide services to Earth. Indeed, satellite-based telecommunications and global positioning systems have become indispensable infrastructure underpinning the modern economy. Mining space for materials, of course, is another matter. In the past several decades, planetary science has confirmed what has long been suspected:

celestial bodies are potential sources for dozens of natural materials that, in the right time and place, are incredibly valuable. Of these, water may be the most attractive in the near-term, because — with assistance from solar energy or nuclear fission — H₂O can be split into hydrogen and oxygen to make rocket propellant, facilitating in-space refueling. **So-called “rare earth” metals are also potential targets of asteroid miners intending to service Earth markets.** Consisting of 17 elements, including lanthanum, neodymium, and yttrium, these critical materials (most of which are today mined in China at great environmental cost) are required for electronics. And they loom as bottlenecks in making the transition from fossil fuels to renewables backed up by battery storage. **The Moon is a prime space mining target.**

Boosted by NASA’s mining solicitation, it is likely the first location for commercial mining. The Moon has several advantages. It is relatively close, requiring a journey of only several days by rocket and creating communication lags of only a couple seconds — a delay small enough to allow remote operation of robots from Earth. Its low gravity implies that relatively little energy expenditure will be needed to deliver mined resources to Earth orbit. The Moon may look parched — and by comparison to Earth, it is. But **recent probes have confirmed substantial amounts of water ice lurking in permanently shadowed craters at the lunar poles.** Further, it seems that solar winds have implanted significant deposits of helium-3 (a light stable isotope of helium) across

the equatorial regions of the Moon. Helium-3 is a potential fuel source for second and third-generation fusion reactors that one hopes will be in service later in the century. The isotope is packed with energy (admittedly hard to unleash in a controlled manner) that might augment sunlight as a source of clean, safe energy on Earth or to power fast spaceships in this century. **Between its water and helium-3 deposits, the Moon could be the resource stepping-stone for further solar system exploration. Asteroids are another near-term mining target.** There are all sorts of space rocks hurtling through the solar system, with varying amounts of water, rare earth metals and other materials on board. The asteroid belt between the orbits of Mars and Jupiter contains most of them, many of which are greater than a kilometer in diameter. Although the potential water and mineral wealth of the asteroid belt is vast, the long distance from Earth and requisite travel times and energy consumption rule them out as targets in the near term. **The prospects for space mining are being driven by technological advances across the space industry. The rise of reusable rocket components and the now-widespread use of off-the-shelf parts are lowering both launch and operations costs. Once limited to government contract missions and the delivery of telecom satellites to orbit, private firms are now emerging as leaders in developing “NewSpace” activities** — a catch-all term for endeavors including orbital tourism, orbital manufacturing and mini-satellites providing **specialized services. The space sector, with a market capitalization of \$400 billion, could grow to as much as \$1 trillion by 2040 as private investment soars.**

The private sector is essential for asteroid mining – competition is key and government development is not effective, efficient, or cheap enough. Thiessen 21:

Marc Thiessen, 6-1, 21, Washington Post, Opinion: SpaceX's success is one small step for man, one giant leap for capitalism,
<https://www.washingtonpost.com/opinions/2020/06/01/spacexs-success-is-one-small-step-man-one-giant-leap-capitalism/>

It was one small step for man, one giant leap for capitalism. Only three countries have ever launched human beings into orbit. This past weekend, SpaceX became the first private company ever to do so, when it sent its Crew Dragon capsule into space aboard its Falcon 9 rocket and docked with the International Space Station. This was accomplished by a company Elon Musk started in 2002 in a California strip mall warehouse with just a dozen employees and a mariachi band. At a time when our nation is debating the merits of socialism, SpaceX has given us an incredible testament to the power of American free enterprise. While the left is advocating unprecedented government intervention in almost every sector of the U.S. economy, from health care to energy, today Americans are celebrating the successful privatization of space travel. If you want to see the difference between what government and private enterprise can do, consider: It took a private company to give us the first space vehicle with touch-screen controls instead of antiquated knobs and buttons. It took a private company to give us a capsule that can fly entirely autonomously from launch to landing — including docking — without any participation by its human crew. It also took a private company to invent a reusable rocket that can not only take off but land as well. When the Apollo 11 crew reached the moon on July 20, 1969, Neil Armstrong declared “the Eagle has landed.” On Saturday, SpaceX was able to declare that the Falcon had landed when its rocket settled down on a barge in the Atlantic Ocean — ready to be used again. That last development will save the taxpayers incredible amounts of money. The cost to NASA for launching a man into space on the space shuttle orbiter was \$170 million per seat, compared with just \$60 million to \$67 million on the Dragon capsule. The cost for the space shuttle to send a kilogram of cargo into to space was \$54,500; with the Falcon rocket, the cost is just \$2,720 — a decrease of 95 percent. And while the space shuttle cost \$27.4 billion to develop, the Crew Dragon was designed and built for just \$1.7 billion — making it the lowest-cost spacecraft developed in six decades. SpaceX did it in six years — far faster than the time it took to develop the space shuttle. The private sector does it better, cheaper, faster and more efficiently than government. Why? Competition. Today, SpaceX has to compete with a constellation of private companies — including legacy aerospace firms such as Orbital ATK and United Launch Alliance and innovative start-ups such as Blue Origin (which is designing a Mars lander and whose owner, Jeff Bezos, also owns The Post) and Virgin Orbit (which is developing rockets than can launch satellites into space from the underside of a 747, avoiding the kinds of weather that delayed the Dragon launch). In the race to put the first privately launched man into orbit, upstart SpaceX had to beat aerospace behemoth Boeing and its Starliner capsule to the punch. It did so — for more than \$1 billion less than its competitor. That spirit of competition and innovation will revolutionize space travel in the years ahead. Indeed, Musk has his sights set far beyond Earth orbit. Already, SpaceX is working on a much larger version of the Falcon 9 reusable rocket called Super Heavy that will carry a deep-space capsule named Starship capable of carrying up to 100 people to the moon and eventually to Mars. Musk's goal — the reason he founded SpaceX — is to colonize Mars and make humanity a multiplanetary species. He has set a goal of founding a million-person city on Mars by 2050 complete with iron foundries and pizza joints. Can it be done? Who knows. But this much is certain: Private-sector innovation is opening the door to a new era of space exploration. Wouldn't it be ironic if, just as capitalism is allowing us to explore the farthest reaches of our solar system, Americans decided to embrace socialism back here on Earth?

Non-appropriation scares investors away and spills over to other space activities.

Freeland 05

Steven Freeland (BCom, LLB, LLM, University of New South Wales; Senior Lecturer in International Law, University of Western Sydney, Australia; and a member of the Paris-based International Institute of Space Law). "Up, Up and ... Back: The Emergence of Space Tourism and Its Impact on the International Law of Outer Space." Chicago Journal of International Law: Vol. 6: No. 1, Article 4. 2005. JDN.
<https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1269&context=cjil>

V. THE NEED FOR CELESTIAL PROPERTY RIGHTS? ¶ The fundamental principle of "non-appropriation" upon which the international law of outer space is based stems from the desire of the international community to ensure that outer space remains an area beyond the jurisdiction of any state(s). Similar ideals emerge from UNCLOS (in relation to the High Seas) as well as the Antarctic Treaty, 42 although in the case of the latter treaty, it was finalised after a number of claims of sovereignty had already been made by various States and therefore was structured to "postpone" rather than prejudice or renounce those previously asserted claims.⁴³ In the case of outer space, its exploitation and use is expressed in Article I of the Outer Space Treaty to be "the province of all mankind," a term whose meaning is not entirely clear but has been interpreted by most commentators as evincing the desire to ensure that any State is free to engage in space activities without reference to any sovereign claims of other States. This freedom is reinforced by other parts of the same Article and is repeated in the Moon Agreement (which also applies to "other celestial bodies within the solar system, other than the earth"). Even though both the scope for space activities and the number of private participants have expanded significantly since these treaties were finalised, it has still been suggested that the nonappropriation principle constitutes "an absolute barrier in the realization of every kind of space activity." 4 ' The amount of capital expenditure required to research, scope, trial, and implement a new space activity is significant. To bring this activity to the point where it can represent a viable "stand alone" commercial venture takes many years and almost limitless funding. From the perspective of a private enterprise contemplating such an activity, it would quite obviously be an important element in its decision to devote resources to this activity that it is able to secure the highest degree of legal rights in order to protect its investment. Security of patent and other intellectual property rights, for example, are vital prerequisites for private enterprise research activity on the ISS, and these rights are specifically addressed by the ISS Agreement between the partners to the project and were applicable to the experiments undertaken by Mark Shuttleworth when he was onboard the ISS.⁴⁶

Space mining is the only way to solve climate change

Duran 21, (Paloma Duran is a journalist and industry analyst at Mexico Business News. "Is Space Mining the Best Option to Face Climate Change?"), 11-03-21, Mexico Business News, [//MNHS NL](https://mexicobusiness.news/mining/news/space-mining-best-option-face-climate-change)

Going to net zero means that more mining is needed. Experts have said that the current supply cannot support the necessary metals demand for the green transition. As a result, new mining alternatives have gained greater relevance, among them is space mining. Several countries, including Mexico, have shown their interest in this alternative, creating a new space race. "The solar system can support a billion times greater industry than we have on Earth. When you go to vastly larger scales of civilization, beyond the scale that a planet can support, then the types of things that civilization can do are incomprehensible to us ... We would be able to promote healthy societies all over the world at the same time that we would be reducing the environmental burden on the Earth," said Dr. Phil Metzger, Planetary Scientist at the University of Central Florida. Currently, there are several attempts to address global warming and transition to a net zero carbon economy. There has been an increasing interest in renewable energy and infrastructure, which has increased demand

for various minerals, especially lithium, cobalt, nickel, copper and rare earth elements. However, according to experts, the world is close to entering a metals supercycle, where demand will exceed available supply, causing prices to skyrocket. Consequently, the mining industry has sought alternatives to achieve the required supply. Options include recycling and improved mine waste management, sea mining and space mining. The latter is considered one of the alternatives with the greatest potential. However, a regulatory framework is still lacking and there is almost no experience in this regard. Despite the lack of knowledge regarding space mining, it has become a very attractive option since the planet is running out of resources. While some people believe that land-based mining is cheaper than space mining, experts believe this may change in the long term. Furthermore, within the solar system there are countless bodies rich in minerals, ores and elements that will accelerate the fight against climate change. "There will come a point when there is nothing left to mine on the surface, prompting mines to reach even further below. But even those resources are destined to run out and so we will aim toward ocean mining, which already has specific technologies that are being developed. Nevertheless, even those mines are limited as well. The mine of the future, which today may seem unlikely, will no longer be on our planet. There will be a time when space mining will be as common as an open leach mine," Eder Lugo, Minerals Head at Siemens, told MBN. More than 150 million asteroids measuring approximately 100m are believed to be in the inner solar system alone. In addition, astronomers have also identified abundant minerals near the Earth's space and the Main Asteroid Belt. There are three main groups into which asteroids are divided: C- type, S- type, and M- type. The last two groups are the most abundant in minerals such as gold, platinum, cobalt, zinc, tin, lead, indium, silver, copper and rare earth metals. "Energy is limited here. Within just a few hundred years, you will have to cover all of the landmass of Earth in solar cells. So, what are you going to do? Well, what I think you are going to do is you are going to move out in space ... all of our heavy industry will be moved off-planet and Earth will be zoned residential and light-industrial," said Jeff Bezos, Founder of Amazon and the Space Launch Provider Blue Origin.

Climate change causes extinction.

Specktor 19

[Brandon writes about the science of everyday life for Live Science, and previously for Reader's Digest magazine, where he served as an editor for five years] 6-4-2019, "Human Civilization Will Crumble by 2050 If We Don't Stop Climate Change Now, New Paper Claims," livescience, <https://www.livescience.com/65633-climate-change-dooms-humans-by-2050.html> Justin

The current climate crisis, they say, is larger and more complex than any humans have ever dealt with before. General climate models — like the one that the United Nations' Panel on Climate Change (IPCC) used in 2018 to predict that a global temperature increase of 3.6 degrees Fahrenheit (2 degrees Celsius) could put hundreds of millions of people at risk — fail to account for the sheer complexity of Earth's many interlinked geological processes, as such, they fail to adequately predict the scale of the potential consequences. The truth, the authors wrote, is probably far worse than any models can fathom. How the world ends What might an accurate worst-case picture of the planet's climate-addled future actually look like, then? The authors provide one particularly grim scenario that begins with world governments "politely ignoring" the advice of scientists and the will of the public to decarbonize the economy (finding alternative energy sources), resulting in a global temperature increase 5.4 F (3 C) by the year 2050. At this point, the world's ice sheets vanish; brutal

droughts kill many of the trees in the **Amazon rainforest** (removing one of the world's largest carbon offsets); **and the planet plunges into a feedback loop of ever-hotter, ever-deadlier conditions.** " **Thirty-five percent of the global land area, and 55 percent of the global population, are subject to more than 20 days a year of lethal heat conditions, beyond the threshold of human survivability,**" the authors hypothesized. Meanwhile, **droughts, floods and wildfires** regularly **ravage the land.** Nearly **one-third of the world's land surface turns to desert.** Entire **ecosystems collapse,** beginning with the **planet's coral reefs, the rainforest and the Arctic ice sheets.** The world's tropics are hit hardest by these new climate extremes, **destroying** the region's **agriculture** and **turning** more than **1 billion** people **into refugees.** This mass movement of refugees — coupled with **shrinking coastlines and severe drops in food and water** availability — begin to **stress the fabric of the world's largest nations** including the United States. **Armed conflicts over resources, perhaps culminating in nuclear war, are likely.** The result, according to the new paper, is "outright chaos" and perhaps **"the end of human global civilization as we know it."**

1NC 2 OFF: Food Insecurity

Constellations key to Precision Ag – key to food sustainability and increasing food supply to account for exponential population growth.

Greensight 21 3-15-2021 "Can Starlink Save the World by Connecting Farms?"

<https://www.greensightag.com/logbook/can-starlink-save-the-world-by-connecting-farms/>
(Data Management Consulting Firm)//Elmer

GreenSight innovates in a number of different areas, but one of the areas we are most passionate about is in agriculture. We've deployed our drone intelligence systems all over the world at all sorts of different facilities. **One of the most challenging has been deployments at farms, and one of the biggest challenges has been connectivity.** **Connected farms are a requirement to feed the world, and Starlink will make that happen.** Most urban and suburban households in the United States have had easy and reasonably inexpensive access to high speed internet access for 20 years. **It is easy to forget that the situation is not the same for rural areas of the country. Many areas have no access to high speed, "broadband", internet access, with some having only dialup internet access in their homes.** According to the 2015 FCC broadband report, **only 53% of rural households have access to high speed internet, even using low standards for "high" speed.** On average farms have even less access, and that doesn't even include high speed connectivity out in their fields. **Cellular service is spotty especially on large farms in primarily agricultural areas, and legacy satellite systems provide slow upload speeds at expensive prices.** Utilizing modern internet connected technologies and cloud based systems that require constant, high speed access can be a challenge at best and potentially impossible. **A 2016 research study by Goldman and Sachs projected that by 2050, the world's food production efficiency needs to increase by 50% to support our growing population.** This paper backs up this conclusion with a lot of research, but the **fundamental conclusion is that farming land area is unlikely to increase nor will the number of farmers.** **Increased global food**

production increases must come from productivity boosts. Researchers feel that productivity improvements from chemistry and genomics are unlikely to yield significant increases as they have in the past. They predict that the most likely area for these improvements are **with precision farming techniques**, notably precision planting and precision application of chemicals and water. The term “Precision Agriculture” was coined in the late 1960s and 1970s in seminal research that projected that in the future farming **would be driven by data** with inputs and practices varied and optimized based on weather, measurements from the field, and accurate year over year yield measurements. Since then, many tools and technologies have been developed that have made true precision agriculture more and more practical. Precision RTK GPS can guide equipment with precision better than an inch. Drones and satellite mapping of fields using remote sensing can map out health and detect problems with the crops. In field **IoT sensors** will stream live data (such as our partners Soil Scout). **Soil genomics and analysis** can analyze macro and micro nutrient content of the soil and track the genetics of the soil microbiome (like our friends at Trace Genomics). **Robotic and automated farming equipment** (like our partners at Monarch Tractor and Husqvarna are building) can vary applications and planting according to precomputed variable rate application maps. Despite all these breakthroughs, **precision farming techniques still have a low penetration.** There are many reasons for this (more than could be discussed in this article!) **but one of them is inadequate connectivity.** Most of these modern technologies **rely on access to the internet** and in many cases it just isn’t possible. For decades subsidies and programs have been rolled out to improve rural connectivity but the reality is that connecting up far flung areas is expensive, often labor intensive, and consequently from a pure business standpoint does not make sense for the connectivity providers. **Even as infrastructure expands to more remote areas, there will always remain large swaths of rural america where conventional connectivity infrastructure is highly impractical.** Most of GreenSight’s data processing is done in the cloud. Several gigabytes of imagery data are uploaded from our aircraft after every flight to be processed and delivered to our customers. Our custom artificial intelligence analyses the data and informs farmers to problem areas. From many remote farm fields, uploading can be a slow process. We’ve invested heavily in the portability of our systems and our upcoming next generation aircraft will be capable of onboard processing, but despite this connectivity will still be needed to make data available for farmers and other automated agriculture systems. **Advanced sensing systems like ours have to be able to integrate with connected robotic sprayers, harvesters and tractors, unlocking the productivity potential of precision agriculture.** Humanity needs precision agriculture, and connected data-driven systems will be a big part of that revolution. Beyond the global necessity, the economics for farmers work too! A 2018 USDA studies indicate that connecting US farmland will unlock \$50B in industry revenue. We are extremely excited about **Starlink** and its **potential to bring cost effective internet connectivity to farms and rural areas.** Starlink **levels the playing field for rural areas**, enabling high speed connectivity everywhere. No longer will farmers have to wait for high speed wired connectivity to come to their area or install a complex mesh network on their property. **IoT data can be streamed** from fields as **easily** as it now streams from urban homes. Starlink will be a catalyzing force for change, advancing access to precision agriculture globally and contributing to solving global food challenges.

Food Insecurity goes nuclear – escalates multiple hotspots.

Cribb 19 Julian Cribb 8-23-2019 “Food or War”

<https://www.cambridge.org/core/books/abs/food-or-war/hotspots-for-food-conflict-in-the-twenty-first-century/1CD674412E09B8E6F325C9C0A0A6778A> (principal of Julian Cribb & Associates

who provide specialist consultancy in the communication of science, agriculture, food, mining, energy and the environment. , His published work includes over 8000 articles, 3000 media releases and eight books. He has received 32 awards for journalism.))//Elmer

Future Food Wars The mounting threat to world peace posed by a food, climate and ecosystem increasingly compromised and unstable was emphasised by the US Director of National Intelligence, Dan Coats, in a briefing to the US Senate in early 2019. 'Global environmental and ecological degradation, as well as climate change, are likely to fuel competition for resources, economic distress, and social discontent through 2019 and beyond', he said. 'Climate hazards such as extreme weather, higher temperatures, droughts, floods, wildfires, storms, sea level rise, soil degradation, and acidifying oceans are intensifying, threatening infrastructure, health, and water and food security. Irreversible damage to ecosystems and habitats will undermine the economic benefits they provide, worsened by air, soil, water, and marine pollution.' Boldly, Coats delivered his warning at a time when the US President, Trump,

was attempting to expunge all reference to climate from government documents. 23 **Based upon these recent cases of food conflicts, and** upon the

lessons gleaned from the longer history of the interaction between food and war, several regions of the planet face a greatly heightened risk of conflict towards

the mid twentyfirst century. **Food wars often start out small,** as mere quarrels over grazing rights, access to wells or as one faction trying to control food supplies and markets. However, if not resolved quickly these **disputes can quickly escalate into violence, then into civil conflagrations which, if not quelled, can in turn explode into crises that reverberate around the planet** in the form of soaring prices, floods of refugees and the involvement of major powers — **which** in turn **carries the risk of transnational war**.

The danger is magnified by swollen populations, the effects of climate change, depletion of key resources such as water, topsoil and nutrients, the collapse of ecosystem services that support agriculture and fisheries, universal pollution, a widening gap between rich and poor, and the rise of vast megacities unable to feed themselves (Figure 5.3). Each of the world's food 'powderkeg regions' is described below, in ascending order of risk. United States In one sense, food wars have already broken out in the United States, the most overfed country on Earth. Here the issue is chiefly the growing depletion of the nation's mighty ground- water resources, especially in states using it for food production, and the contest over what remains between competing users — farmers, ranchers and Native Americans on the one hand and the oil, gas and mining industry on the other. Concern about the future of US water supplies was aggravated by a series of savage droughts in the early twentyfirst century in the west, south and midwest linked to global climate change and declining snow- pack in the Rocky Mountains, both of which affect not only agriculture but also the rate at which the nation's groundwater reserves recharge. 'Groundwater depletion has been a concern in the Southwest and High Plains for many years, but increased demands on our groundwater resources have overstressed aquifers in many areas of the Nation, not just in arid regions', notes the US Geological Survey.24 Nine US states depend on groundwater for between 50 per cent and 80 per cent of their total freshwater supplies, and five states account for nearly half of the nation's groundwater use. Major US water resources, such as the High Plains aquifers and the Pacific Northwest aquifers have sunk by 30–50 metres (100–150 feet) since exploitation began, imperilling the agricultural industries that rely on them. In the arid south- west, aquifer declines of 100–150 metres have been recorded (Figure 5.4). To take but one case, the famed Ogallala Aquifer in the High Plains region supports cropping industries worth more than US \$20 billion a year and was in such a depleted state it would take more than 6000 years to replace by natural infiltration the water drawn from it by farmers in the past 150 years. As it dwindles, some farmers have tried to kick their dependence on ground- water other users, including the growing cities and towns of the region, proceeded to mine it as if there was no tomorrow.25 A study by Kansas State University concluded that so far, 30 per cent of the local groundwater had been extracted and another 39 per cent would be depleted by the mid century on existing trends in withdrawal and recharge.26 Over half the US population relies on groundwater for drinking; both rural and urban America are at risk. Cities such as New Orleans, Houston and Miami face not only rising sea levels — but also sinking land, due to the extraction of underlying ground- water. In Memphis, Tennessee, the aquifer that supplies the city's drinking water has dropped by 20 metres. Growing awareness of the risk of a nation, even one as large and technologically adept as the USA, having insufficient water to grow its food, generate its exports and supply its urban homes has fuelled tensions leading to the eruption of nationwide protests over 'fracking' for oil and gas — a process that can deplete or poison groundwater — and the building -of oil pipe- lines, which have a habit of rupturing and also polluting water resources. The boom in fracking and piping is part of a deliberate US policy to become more self-reliant in fossil fuels.27 Thus, in its anxiety to be independent of overseas energy suppliers, the USA in effect decided to barter away its future food security for current oil security — and the price of this has been a lot of angry farmers, Native Americans and concerned citizens. The depletion of US groundwater coincides with accelerating climate risk, which may raise US temperatures by as much as 4–5 oc by 2100, leading to major losses in soil

moisture throughout the US grain belt, and the spread of deserts in the south and west. **Food production will also be affected by fiercer storms, bigger floods, more heatwaves, an increase in drought frequency and greater impacts from crop and livestock diseases**. In such a context, it is no time to be wasting stored water. The case of the USA is included in the list of world 'hot spots' for future food conflict, not because there is danger of a

serious shooting war erupting over water in America in the foreseeable future, but to illustrate that **even in technologically advanced countries unforeseen social tensions and crises are on the rise over basic resources like food, land and water and their depletion**. This doesn't just happen in Africa or the Middle East. **It's a global phenomenon**. Furthermore, **the USA is the world's largest food exporter and any retreat on its part will have a disproportionate effect on world food** price and **supply**. **There is still plenty of time to replan America's food systems and** water usage —

but, as in the case of fossil fuels and climate, rear-guard action mounted by corporate vested interests and their hired politicians may well paralyse the national will to do it. That is when **the US food system could find itself at serious risk**, losing access to water in a time of growing climatic disruption, caused by exactly the same forces as those depleting the groundwater:

the fossil fuels sector and its political stooges. The probable effect of this will, in the first instance, be a decline in US meat and dairy production accompanied by rising prices and a **fall in its feedgrain exports, with domino effects on** livestock **industries worldwide**. The flip-side to this issue is that America's old rival, Russia, is likely to gain in both farmland and water availability as the planet warms through the twentyfirst century — and likewise Canada. Both these countries stand to prosper from a US withdrawal from world food markets, and together they may negate the effects of any US food export shortfalls. Central and South America South America is one of the world's most bountiful continents in terms of food production — but, after decades of improvement, malnutrition is once more on the rise, reaching a new peak of 42.5 million people affected in 2016. 28 'Latin America and the Caribbean used to be a worldwide example in the fight against hunger. We are now following the worrisome global trend', said regional FAO representative Julio Berdegue. 29 Paradoxically, obesity is increasing among Latin American adults, while malnutrition is rising among children. 'Although Latin America and the Caribbean produce enough food to meet the needs of their population, this does not ensure healthy and nutritious diets', the FAO explains. Worsening income inequality, poor access to food and persistent poverty are contributing to the rise in hunger and bad diets, it adds.30 'The impact of climate change in Latin America and the Caribbean will be considerable because of its economic dependence on agriculture, the low adaptive capacity of its population and the geographical location of some of its countries', an FAO report warned.31 Emerging food insecurity in Central and Latin America is being driven by a toxic mixture of falling water supplies, drying farmlands, poverty, maladministration, incompetence and corruption. These issues are exacerbated by climate change, which is making the water supply issue worse for farmers and city people alike in several countries and delivering more weather disasters to agriculture. Mexico has for centuries faced periodic food scarcity, with a tenth of its people today suffering under-nutrition. In 2008 this rose to 18 per cent, leading to outbreaks of political violence. 2 In 2013, 52 million Mexicans were suffering poverty and seven million more faced extreme hunger, despite the attempts of successive governments to remedy the situation. By 2100 northern Mexico is expected to warm by 4–5 oc and southern Mexico by 1.5–2.5 oc. Large parts of the country, including Mexico City, face critical water scarcity. Mexico's cropped area could fall by 40–70 per cent by the 2030s and disappear completely by the end of the century, making it one of the world's countries most at risk from catastrophic climate change and a major potential source of climate refugees.33 The vanishing lakes and glaciers of the high Andes confront montane nations — Bolivia, Peru and Chile especially — with the spectre of growing water scarcity and declining food security. The volume of many glaciers, which provide meltwater to the region's rivers, which in turn irrigate farmland, has halved since 1975.34 Bolivia's second largest water body, the 2000 square kilometres Lake Poopo, dried out completely.35 The loss of water is attributed partly to El Niño droughts, partly to global warming and partly to over-extraction by the mining industries of the region. Chile, with 24,000 glaciers (80 per cent of all those in Latin America) is feeling the effects of their retreat and shrinkage especially, both in large cities such as the capital Santiago, and in irrigation agriculture and energy supply. Chile is rated by the World Resources Institute among the countries most likely to experience extreme water stress by 2040.36 Climate change is producing growing water and food insecurity in the 'dry corridor' of Central America, in countries such as El Salvador, Guatemala and Honduras. Here a combination of drought, major floods and soil erosion is undermining efforts to raise food production and stabilise nutrition. Food production in Venezuela began falling in the 1990s, and by the late 2010s two thirds of the population were malnourished; there was a growing flood of refugees into Colombia and other neighbouring countries. The food crisis has been variously blamed on the Venezuelan government's 'Great Leap Forward' (modelled on that of China — which also caused widespread starvation), a halving in Venezuela's oil export earnings, economic sanctions by the USA, and corruption. However, local scientists such as Nobel Laureate Professor Juan Carlos Sanchez warn that climate impacts are already striking the densely populated coastal regions with increased torrential rains, flooding and mudslides, droughts and hurricanes, while inland areas are drying out and desertifying, leading to crop failures, water scarcity and a tide of climate refugees.37 These factors will tend to deepen food insecurity towards the mid century. Venezuela's climate refugees are already making life more difficult

for neighbouring countries such as Colombia. Deforestation in the Brazilian Amazon has, in recent decades, removed around 20 per cent of its total tree cover, replacing it with dry savannah and farmland. At 40 per cent clearance and with continued global warming, scientists anticipate profound changes in the local climate, towards a drying trend, which will hammer the agriculture that has replaced the forest.³⁸ Brazil has already wiped out the once-vast Mata Atlantica forest along its eastern coastline, and this region is now drying, with resultant water stress for both farming and major cities like São Paulo. Brazil's outlook for 2100 is for further drying — tied to forest loss as well as global climate change — increased frequency of drought and heatwaves, major fires and acute water scarcity in some regions. Moreover, as the Amazon basin dries out, it will release vast quantities of CO2 from its peat swamps and rainforest soils. These are thought to contain in excess of three billion tonnes of carbon and could cause a significant acceleration in global warming, affecting everyone on Earth. 39 Latin America is the world capital of private armies, with as many as 50 major guerrilla groups, paramilitaries, terrorist, indigenous and criminal insurgencies over the past half century exemplified in familiar names like the Sandanistas (Nicaragua), FARC (Colombia) and Shining Path (Peru). 40 Many of these drew their initial inspiration from the international communist movement of the mid twentieth century, while others are right-wing groups set up in opposition to them or else represent land rights movements of disadvantaged groups. However, all these movements rely for oxygen on simmering public discontent with ineffectual or corrupt governments and lack of fair access to food, land and water generally. In other words,

the tendency of South and Central America towards internal armed conflict is supercharged significantly by failings in the food system which generate public anger, leading to sympathy and support for anyone seen to be challenging the incumbent regimes. This is not to suggest that feeding every person well would end all insurgencies — but it would certainly take the wind of popular support out of a lot of their sails. In that sense the revolutionary

tendency of South America echoes the preconditions for revolution in France and Russia in the eighteenth and twentieth centuries. Central Asia **The risk of wars breaking out over water, energy and food insecurity in Central Asia is high.**⁴¹ Here, the five main players —

Kazakhstan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan — face swelling populations, crumbling Soviet-era infrastructure,

flagging resource cooperation, a **degrading land- scape, deteriorating food availability and a changing climate.** At the heart of the issue and the region's increasingly volatile politics is water: 'Without water in the region's two great rivers — the Syr Darya and the Amu Darya — vital crops in the down- stream agricultural powerhouses would die. Without power, life in the upstream countries would be unbearable in the freezing winters', wrote Rustam Qobil. Central Asia's water crisis first exploded onto the global consciousness with the drying of the Aral Sea — the world's fourth largest lake — from the mid 1960s⁴³, following the damming and draining of major rivers such as the Amu Darya, Syr Darya and Naryn. It was hastened by a major drought in 2008⁴⁴ exacerbated by climate change, which is melting the 'water tower' of glacial ice stored in the Tien Shan, Pamir and Hindu Kush mountain ranges that feed the region's rivers. The Tien Shan alone holds 10,000 glaciers, all of them in retreat, losing an estimated 223 million cubic metres a year. At such a rate of loss the region's rivers will run dry within a generation.⁴⁵ Lack of water has already delivered a body blow to Central Asia's efforts to modernise its agriculture, adding further tension to regional disputes over food, land and water. 'Water has always been a major cause of wars and border conflicts in the Central Asian region', policy analyst Fuad Shahbazov warned. This potential for conflict over water has been exacerbated by disputes over the Fergana valley, the region's greatest foodbowl, which underwent a 32 per cent surge in population in barely ten years — while more and more of it turned to desert.⁴⁶ The Central Asian region is ranked by the World Resources Institute as one of the world's most perilously water-stressed regions to 2040 (Figure 5.6). With their economies hitting rock bottom, corrupt and autocratic governments that prefer to blame others for their problems and growing quarrels over food, land, energy and water, the 'Stans' face 'a perfect storm', Nate Shenkan wrote in the journal Foreign Policy.⁴⁷ Increased meddling by Russia and China is augmenting the explosive mix: China regards Central Asia as a key component of its 'Belt and Road' initiative intended to expand its global influence, whereas Russia hopes to lure the region back into its own economic sphere. Their rival investments may help limit some of the problems faced by Central Asia — or they may unlock a fresh cycle of political feuding, turmoil and regime change.⁴⁸ A 2017 FAO report found 14.3 million people — one in every five — in Central Asia did not have

enough to eat and a million faced actual starvation, children especially. It noted that after years of steady improvement, the situation was deteriorating. This combination of **intractable and deteriorating factors makes Central Asia a serious internal war risk** towards the mid twentyfirst century, **with involvement by superpowers raising the danger of international conflict** and mass refugee flight. The Middle East **The Middle East is** the most water-stressed region on Earth (see Figure 5.5 above). It **is 'particularly vulnerable** to climate change. It is one of the world's most water-scarce and dry regions, with a high dependency on climate-sensitive agriculture and a large share of its population and economic activity in flood-prone urban coastal zones', according to the World Bank. 49 The Middle East — consisting of the 22 countries of the Arab League, Turkey and Iran — has very low levels of natural rainfall to begin with. Most of it has 600 millimetres or less per year and is classed as arid. 'The Middle East and North Africa [MENA] is a global hotspot of unsustainable water use, especially of ground- water. In some countries, more than half of current water withdrawals exceed what is naturally available', the Bank said in a separate report on water scarcity.⁵⁰ 'The climate is predicted to become even hotter and drier in most of the MENA region. Higher temperatures and reduced precipitation will increase the occurrence of droughts. It is further estimated that an additional 80–100 million people will be exposed by 2025 to water stress', the Bank added. The region's population of 300 million in the late 2010s is forecast to double to 600 million by 2050. Average temperatures are expected to rise by 3–5 oc and rainfall will decrease by around 20 per cent. The result will be vastly increased water stress, accelerated desertification, growing food insecurity and a rise in sea levels displacing tens of millions from densely popu- lated, low-lying areas like the Nile delta.⁵¹ The region is deemed highly vulnerable to climate impacts, warns a report by the UN Development Programme. 'Current climate change projections show that by the year 2025, the water supply in the Arab region will be only 15 per cent of levels in 1960. With population growth around 3 per cent annually and deforestation spiking to 4 per cent annually... the region now includes 14 of the world's 20 most water-stressed countries.'⁵² The Middle East/North Africa (MENA) region has 6 per cent of the world's population with only 1.5 per cent of the world's fresh water reserves to share among them. This means that the average citizen already has about a third less water than the minimum necessary for a reasonable existence — many have less than half, and populations are growing rapidly. Coupled with political chaos and ill governance in many countries, growing religious and ethnic tensions between different groups — often based on centuries-old disputes — a widening gap between rich and poor and foreign meddling by the USA, Russia and China, shortages of food, land and water make the Middle East an evident cauldron for conflict in the twentyfirst century. Growing awareness of their food risk has impelled some oil-rich Arab states into an international farm buying spree, purchasing farming, fishing and food processing companies in countries as

assorted as South Sudan, Ethiopia, the Philippines, Ukraine, the USA, Poland, Argentina, Australia, Brazil and Morocco. In some food-stressed countries these acquisitions have already led to riots and killings.⁵³ **The risk is high that, by exporting its own food—land—water problems worldwide, especially to regions already facing scarcity, the Middle East could propagate conflicts and government collapses around the globe.** This is despite the fact that high-tech solar desalination, green energy, hydroponics, aquaponics and other intensive urban food production technologies make it possible for the region to produce far more of its own food locally, if not to be entirely self-sufficient. Dimensions of the growing crisis in the Middle East include the following. Wars have already broken out in Syria and Yemen in which scarcity of food, land and water were prominent among the tensions that led to conflict between competing groups. Food, land and water issues feed into and exacerbate already volatile sentiment over religion, politics, corruption, mismanagement and foreign interference by the USA, China and Russia. The introduction of cheap solar-powered and diesel pumps has accelerated the unsustainable extraction of groundwater throughout the region, notably in countries like Libya, Egypt, Saudi Arabia and Morocco. 54 Turkish building of new dams to monopolise waters flowing across its borders is igniting scarcity and potential for conflict with downstream nations, including Iraq, Iran and Syria. 55 Egypt's lifeline, the Nile, is threatened by Ethiopian plans to dam the Blue Nile, with tensions that some observers consider could lead to a shooting war. 56 There are very low levels of water recycling throughout the region, while water use productivity is about half that of the world as a whole. There is a lack of a sense of citizen responsibility for water and food scarcity throughout the region. Land grabs around the world by oil-rich states are threatening to destabilise food, land and water in other countries and regions, causing conflict. A decline in oil prices and the displacement of oil by the global renewables revolution may leave the region with fewer economic options for solving its problems. There is a risk that acquisition of a nuclear weapon by Iran may set off a nuclear arms race in the region with countries such as Saudi Arabia, Syria and possibly Turkey following suit and Israel rearming to stay in the lead. This would translate potential food, land and water conflicts into the atomic realm. Together these issues, and failure to address their root causes, make the Middle East a fizzing powder keg in the twentyfirst century. The question is when and where, not whether, it explodes — and whether the resulting conflict will involve the use of weapons of mass destruction, including nuclear, thus affecting the entire world.

China China is the world's biggest producer, importer and consumer of food. Much of the landmass of the People's Republic of China (PRC) is too mountainous or too arid for farming, but the rich soils of its eastern and southern regions are highly productive provided sufficient water is available and climate impacts are mild. Those, however, are very big 'ifs'. In 1995, American environmentalist Lester R. Brown both Eked and aroused the PRC Communist Party bosses with a small, hard-hitting book entitled Who Will Feed China? Wake-Up Call for a Small Planet.⁵⁷ In it he posited that Chinese population growth was so far out of control that the then-agricultural system could not keep up, and China would be forced to import vast amounts of grain, to the detriment of food prices and availability worldwide. His fears, so far, have not been realised — not because they were unsoundly based, but because China managed — just — to stay abreast of rising food demand by stabilising and subsidising grain prices, restoring degraded lands, boosting agricultural science and technology, piping water from south to north, developing high-intensity urban farms, buying up foreign farmland worldwide and encouraging young Chinese to leave the country.

What Brown didn't anticipate was the economic miracle that made China rich enough to afford all this. However, his essential thesis remains valid. **China's food supply will remain on a knife-**edge for the entire twentyfirst century, vulnerable especially to water scarcity and climate impacts. **If the nation outruns its domestic resources yet still has to eat, it may well be at the expense of others globally.** Some western commentators were puzzled when China scrapped

its 35-year 'One Child Policy' in 2015, but in fact the policy had done its job, shaving around 300 million people off the projected peak of Chinese population. It was also causing serious imbalances, such as China's huge unmarried male sur- plus. Furthermore, rising urbanisation and household incomes meant Chinese parents no longer wanted large families, as in the past. Policy or no policy, China's birthrate has continued to fall and by 2018 was 1.6 babies per woman — well below replacement, lower than the USA and nearly as low as Germany. Its population was 1.4 billion, but this was growing at barely 0.4 per cent a year, with the growth due at least in part to lengthening life expectancy. 58 For China, female fertility is no longer the key issue. The critical issue is water. And the critical region is the north, where 41 per cent of the population reside. Here surface and ground- waters — which support not only the vast grain and vegetable farming industries of the North China Plain but also burgeoning megacities like Beijing, Tianjin and Shenyang — have been vanishing at an alarming rate. 'In the past 25 years, 28,000 rivers have disappeared. Groundwater has fallen by up to 1–3 metres a year. One consequence: parts of Beijing are subsidising by 11 cm a year. The flow of the Yellow River, water supply to millions, is a tenth of what it was in the 1940s; it often fails to reach the sea. Pollution further curtails supply: in 2017 8.8 per cent of water was unfit even for agricultural or industrial use', the Financial Times reported.⁵⁹ On the North China Plain, annual consumption of water for all uses, including food production, is about 27 billion cubic metres a year — compared with an annual water availability of 22 billion cubic metres, a deficit that is made up by the short-term expedient of mining the region's

groundwater.⁶⁰ To stave off disaster, the PRC has built a prodigious network of canals and pipelines from the Yangtse River in the water-rich south, to Beijing in the water-starved north. Hailed as a 'lifeline', the South—North Water Transfer Project had two drawbacks: first, the fossil energy required to pump millions of tonnes of water over a thousand kilometres and, second, the fact that while the volume was sufficient to satisfy the burgeoning cities for a time, it could not supply and distribute enough clean water to meet the needs of irrigated farming over so vast a region in the long run, nor meet those of its planned industrial growth.⁶¹ Oft-mouthed 'solutions' like desalination or the piping of water from Tibet or Russia face similar drawbacks: demand is too great for the potential supply and the costs, both financial and environmental, prohibitive. China is already among the world's most water-stressed nations. The typical Chinese citizen has a 'water footprint' of 1071 cubic metres a year — three quarters of the world average (1385 cubic metres), and scarcely a third that of the average American (2842 cubic metres).⁶² Of this water, 62 per cent is used to grow food to feed the Chinese population — and 90 per cent is so polluted it is unfit to drink or use in food processing. Despite massive investment in water infrastructure and new technology, many experts doubt that China can keep pace with the growth in its demand for food, at least within its own borders, chiefly because of water scarcity.⁶³ Adding to the pressure is that China's national five-year plans for industrialisation demand massive amounts more water — demands that may confront China with a stark choice between food and economic growth. 'The Chinese government is moving too slowly towards the Camel Economy. It has plans, incentives for officials; it invests in recycling, irrigation, pollution, drought resistant crops; it leads the world in high voltage transmission (to get hydro, wind and solar energy from the west of China). None of this is sufficient or likely to be in time', the Financial Times opined. As the world's leading carbon emitter, China is more responsible for climate change than any other country. It is also, potentially, more at risk. The main reason, quite simply, is the impact of a warming world on China's water supply — in the form of disappearing rivers, lakes, groundwater and mountain glaciers along with rising sea levels. To this is coupled the threat to agriculture from increasing weather disasters and the loss of ecosystem services from a damaged landscape. ⁶⁵ China is thus impaled on the horns of a classic dilemma. Without more water it cannot grow its economy sufficiently to pay for the water-conserving and food-producing technologies and infrastructure it needs to feed its people. Having inadvertently unleashed a population explosion with its highly successful conversion to modern farming systems, the challenge for China now is to somehow sustain its food supply through the population peak of the mid twentyfirst century, followed by a managed decline to maybe half of today's numbers by the early twentysecond century. It is far from clear whether the present approach — improving market efficiency, continuing to modernise agricultural production systems, pumping water, trying to control soil and water losses and importing more food from overseas will work. ⁶⁶ China has pinned its main hopes on technology to boost farm yields and improve water distribution and management. Unfortunately, it has selected the unsustainable American industrial farming model to do this — which involves the massive use of water, toxic chemicals, fertilisers, fossil fuels and machines. This in turn is having dreadful consequences for China's soils, waters, landscapes, food supply, air, climate and consumer health. Serious questions are now being asked whether such an approach is not digging the hole China is in, even deeper. Furthermore, some western analysts are sceptical whether the heavy hand of state control is up to the task of generating the levels of innovation required to feed China sustainably.⁶⁷ Plan B, which is to purchase food from other countries, or import it from Chinese-owned farming and food ventures around the world, faces similar difficulties. Many of the countries where China is investing in food production themselves face a slow-burning crisis of land degradation, water scarcity, surging populations and swelling local food demand. By exporting its own problems, China is adding to their difficulties. While there may be some truth to the claim that China is helping to modernise food systems in Africa, for example, it is equally clear that the export of food at a time of local shortages could have dire consequences for Africans, leading to wars in Africa and elsewhere. How countries will react to Chinese pressure to export food in the face of their own domestic shortages is, as yet, unclear. If they permit exports, it could prove catastrophic for their own people and governments — but if they cut them off, it could be equally catastrophic for China. Such a situation cannot be regarded as anything other than a menace to world peace. Around 1640, a series of intense droughts caused widespread crop failures in China, leading to unrest and uprisings which, in 1644, brought down the Ming Dynasty. A serious domestic Chinese food and water crisis today — driven by drought, degradation of land and water and climate change in northern China coupled with failure in food imports — could cause a re-run of history: 'The forthcoming water crisis may impact China's social, economic, and political stability to a great extent', a US Intelligence Assessment found. The adverse impacts of climate change will add extra pressure to existing social and resource stresses'.⁶⁸ Such events have the potential to precipitate tens, even hundreds, of millions of emigrants and refugees into countries all over

the world, with domino consequences for those countries that receive them.

Strategic analysts have speculated that tens of millions of desperate Chinese flooding into eastern Russia, or even India, could lead to war, including the risk of international nuclear exchange

⁶⁹ Against such a scenario are the plain facts that China is a technologically advanced society, with the foresight, wealth and capacity to plan and implement nationwide changes and the will, if necessary, to enforce them. Its leaders are clearly alert to the food and water challenge — and its resolution may well depend on the extent of water recycling they are able to achieve. As to whether the PRC can afford the cost of transitioning from an unsustainable to a sustainable food system, all countries have a choice between unproductive military spending and feeding their populace. A choice between food or war. It remains to be seen which investment China favours. However, it is vital to understand that the problem of whether China can feed itself through the twentyfirst century is not purely a Chinese problem. It's a

problem, both economic and physical, for the entire planet — and it is thus in everyone's best interest to help solve it. For this reason, China is rated number 3 on this list of potential food war hotspots. **Africa** Food wars — that is, wars in which food, land and water play a significant contributing role — have been a constant in the story of Africa since the mid twentieth century, indeed, far longer. In a sense, the continent is already a microcosm of the world of the twentyfirst century as climate change and resource scarcity combine with rapid population growth to ratchet up the tensions that lead competing groups to fight, whether the superficial distinction between them are ethnic, religious, social or political. We have examined the particular cases of Rwanda, South Sudan and the Horn of Africa — but there are numerous other African conflicts, insurgencies and ongoing disturbances in which food, land and water are primary or secondary triggers and where famine is often the outcome: Nigeria, Congo, Egypt, Tunisia, Libya, Mali, Chad, the Central African Republic, the Maghreb region of the Sahara, Mozambique, Cote d'Ivoire and Zimbabwe have all experienced conflicts in which issues of access to food, land and water were important drivers and consequences. The trajectory of Africa's population in the first two decades of the twentyfirst century implies that the number of its people could quadruple from 1.2 billion in 2017 to 4.5 billion by 2100 (Figure 5.6). If fulfilled, this would make Africans 41 per cent of the world population by the end of the century. The UN Population Division's nearer projections are for Africans to outnumber Chinese or Indians at 1.7 billion by 2030, and reach 2.5 billion in 2050, which represents a doubling in the continent's inhabitants in barely 30 years. ⁷⁰ While African fertility rates (babies per woman) remain high by world standards — 4.5 compared with a global average of 2.4 — they have also fallen steeply, from a peak of 8.5 babies in the 1970s. Furthermore, the picture is uneven with birthrates in most Sub-Saharan countries remaining high (around five to six babies/woman), while those of eight, mainly southern, countries have dropped to replacement or below (i.e. under 2.1). As has been the case around the world, birth rates tend to drop rapidly with the spread of urbanisation, education and economic growth — whereas countries which slide back into poverty tend to experience rising birth-rates. Food access is a vital ingredient in this dynamic: it has been widely observed that better-fed countries tend to have much lower rates of birth and population growth, possibly because people who are food secure lose fewer infants and children in early life and thus are more open to family planning. So, in a real sense, food sufficiency holds one of the keys to limiting the human population to a level sustainable both for Africa and the planet in general. Forecasting the future of Africa is not easy,

given the complexity of the interwoven climatic, social, technological and political issues — and many do not attempt it. **However, the relentless optimism of the UN and its food agency, the FAO, is probably not justified by the facts as they are known to science — and may have more to do with not wishing to give offence to African governments or discourage donors than with attempting to accurately analyse what may occur.** Even the FAO acknowledges however that

food insecurity is rising across Sub-Saharan Africa as well as other parts In 2017, conflict and insecurity were the major drivers of acute food insecurity in 18 countries and territories where almost 74 million food-insecure people were in need of urgent assistance.

Eleven of these countries were in Africa and accounted for 37 million acutely food insecure people; the largest numbers were in northern Nigeria, Democratic Republic of Congo, Somalia and South Sudan the agency said in its Global Report on Food Crises 2018.⁷¹ The FAO also noted that almost one in four Africans was undernourished in 2016 — a total of nearly a quarter of a billion people. The rise in undernourishment and food insecurity was linked to the effects of climate change, natural disasters

and conflict according to Bukar Tijani, the FAO's assistant director general for Africa. ⁷² **Even the comparatively prosperous nation of South Africa sits on a conflict knife-edge, according to a scientific study: 'Results indicate that the country exceeds its environmental boundaries for biodiversity loss, marine harvesting, freshwater use, and climate change, and that social deprivation was most severe in the areas of safety, income, and employment, which are significant factors in conflict risk'**, Megan Cole and colleagues found. ⁷³ In the Congo, home to the world's second largest tropical forest, 20 years of civil war had not only slain five million civilians but also decimated the forests and their ecological services on which the nation depended. Researchers found evidence that reducing conflict can also

help to reduce environmental destruction: 'Peace-building can potentially be a win for nature as well, and... conservation organizations and governments should be ready to seize conservation opportunities'. ⁷⁴ **As the**

African population doubles toward the mid century, as its water, soils, forests and economic wealth per capita dwindle, as foreign corporations plunder its riches, as a turbulent climate hammers its herders and farmers — both industrial and traditional — the prospect of Africa resolving existing conflicts and avoiding new ones is receding The mistake most of the world is making is to imagine this only affects the Africans. **The consequences will impact everyone on**

the planet

A World Bank study has warned that 140 million people will have to leave just three regions of the world as climate refugees before 2050 — and the vast majority of these, some 86 million, would be displaced from their homes in Sub-Saharan Africa. 75 The second decade of the

usly available.

Case

AT: Contention 1

Significant Mining investments are mutually exclusive - even if mining happens now, our Freeland 05 Card proves that a regime without appropriation is unable to realize the immense gains of private space appropriation.

They said that its a problem - theres no response

AT: Contention 2

2nr] Capitalist Entrepreneurs for themselves - you can't cite capitalism

Public Space Agencies, especially NASA are notorious for drawing out deadlines and increasing costs; SQ companies prove that public space is morbidly inefficient.

Follett 21 Andrew Follett, "Private Firms are Key to Space Exploration," The National Review, 21 August 2021

<https://www.nationalreview.com/2021/08/private-firms-are-the-key-to-space-exploration/>

America's **public-sector space** program recently had a rough couple of weeks that perfectly exemplify why it **desperately needs a free-market overhaul**.

On July 29, the International Space Station (ISS) suffered a serious loss of control after a Russian spacecraft docked with it, accidentally causing the station to make a full 540-degree rotation and a half before coming to a stop upside down, when the astronauts got it under control. Like most NASA programs, the ISS is massively over budget. Costs were initially projected at \$12.2 billion, but the bill ultimately reached a stunning \$150 billion. American taxpayers paid around 84 percent of that. What happened to the American dream of human space exploration? Put

simply, the government happened. **NASA** devolved into a jobs program to bring home the space bacon. Then, on August 10, NASA's inspector

general released a report **deeming plans to send astronauts back to the moon in 2024 unfeasible**

because of significant delays in developing the mission's spacesuits. Right now **the suits**

are being built by 27 different companies that successfully lobbied the government for a piece of the action. SpaceX's

Elon Musk has rightly noted that **NASA has “too many cooks in the kitchen.”** The difference **between NASA’s cumbersome designed-by-committee suits and SpaceX’s suits — created by a single contractor — is remarkable,** even to the naked eye. **The report unconvincingly blames NASA’s failure to develop a new spacesuit over the last 14 years solely on shifting technical requirements.** It recommends “ensuring technical requirements for the next-generation suits are solidified before selecting the acquisition strategy to procure suits for the ISS and Artemis programs.” **Instead of dealing with the problem, the Biden administration is trying to distract attention from the space agency’s mismanagement by announcing plans to land the first person of color on the moon . . . even though NASA has been incapable of sending astronauts of any color into space** under its own power since July 2011. NASA has been reduced to begging the Russians for a ride. The agency’s troubled Constellation program, meant to replace the Space Shuttle fleet, was canceled after tens of billions of dollars had already been spent. But NASA’s troubles are, depressingly, likely to get even worse. In November **the James Webb Space Telescope (JWST) will finally launch, after taxpayers have forked over \$9.7 billion.** It was originally supposed to launch in 2007 on a budget of \$500 million. That means **the project is over a decade behind schedule and costing almost 20 times its initial budget. Perhaps the telescope, meant to locate potentially habitable planets around other stars and perhaps even extraterrestrial life, could instead search for a calendar . . . or fiscal sanity . . . in the stars?** JWST isn’t the first NASA space telescope to suffer cost overruns and setbacks. **The Hubble Space Telescope (HST) was originally intended to launch in 1983,** but technical **issues delayed the launch until 1990** because the main mirror was incorrectly manufactured. JWST is very likely to fail because it is supposed to unfold itself “origami style” in space in an extremely technically complicated process. If difficulties arise, JWST lacks **HST’s generous margin for error** because of its location far beyond earth’s orbit at the Sun-Earth L2 LaGrange point. NASA currently lacks the capability to send a team of astronauts out that far to fix any problems. Even if NASA could get out to JWST, the telescope doesn’t have a grappling ring for an astronaut to grab onto and thus could potentially kill astronauts attempting to fix it. **It is hard to imagine a better example of the private sector’s amazing ability to outcompete government bureaucracy and mismanagement than NASA’s planned Shuttle replacement, the Space Launch System.** It is estimated to **cost more than \$2 billion per flight.** That’s **on top of the \$20 billion and nine years the agency has already spent developing the vehicle.** **Contrast that with the comparatively inexpensive \$300 million spent by SpaceX to develop the Falcon 9 in a little over four years, and the fact that each Falcon 9 costs around \$62 million.** **One SLS launch could pay for over 32 SpaceX launches.** **Private ventures** such as SpaceX **are more efficient because they have a lot more incentive to avoid excessive costs and focus on solutions:** Their own money is at stake, and people spend their own money more carefully than they spend taxpayer dollars collected from others. **Multiple private American space firms are** currently pursuing accomplishments beyond those of NASA, and they are **more advanced and ambitious than the entire government space**

programs of China and the European Union combined. So one possible solution to NASA's woes would be to greatly increase its reliance on commercial launch providers. And one way to do that would be to return to the system that made civil aviation great: prizes to reward private-sector innovation. Charles Lindbergh flew across the Atlantic Ocean in pursuit of the privately funded Orteig prize, valued at almost \$395,000 in today's money. Another famous example was the X Prize, which rewarded Burt Rutan's company Scaled Composites with over \$14 million in today's money for becoming the first nongovernmental organization to launch a reusable and manned space vehicle. SpaceShipOne. The X Prize succeeded in creating over \$100 million in investment by private corporations and individuals. Aerospace experts expect that establishing a \$10 billion prize for successfully landing a crew on Mars and returning it safely to earth could very well lead to a successful landing. That's a bargain compared with the \$500 billion cost estimates NASA puts out for the same objective. And of course in the worst-case failure scenario for a prize program, taxpayers would pay nothing until the mission was complete. A system based on private enterprise incentivized by a fixed prize would end government cost overruns and waste.

AT: Ozone

No Ozone Impact.

Ridley 14 (Matthew White Ridley, BA and PhD in Zoology from Oxford. "THE OZONE HOLE WAS EXAGGERATED AS A PROBLEM," *Rational Optimist*, 9/25/14, <http://www.rationaloptimist.com/blog/the-ozone-hole-was-exaggerated-as-a-problem.aspx>)
dwc 19

Serial hyperbole does the environmental movement no favours My recent Times column argued that the alleged healing of the ozone layer is exaggerated, but so was the impact of the ozone hole over Antarctica: The ozone layer is healing. Or so said the news last week. Thanks to a treaty signed in Montreal in 1989 to get rid of refrigerant chemicals called chlorofluorocarbons (CFCs), the planet's stratospheric sunscreen has at last begun thickening again. Planetary disaster has been averted by politics. For reasons I will explain, this news deserves to be taken with a large pinch of salt. You do not have to dig far to find evidence that the ozone hole was never nearly as dangerous as some people said, that it is not necessarily healing yet and that it might not have been caused mainly by CFCs anyway. The timing of the announcement was plainly political: it came on the 25th anniversary of the treaty, and just before a big United Nations climate conference in New York, the aim of which is to push for a climate treaty modelled on the ozone one. Here's what was actually announced last week, in the words of a Nasa scientist, Paul Newman: "From 2000 to 2013, ozone levels climbed 4 per cent in the key mid-northern latitudes." That's a pretty small change and it is in the wrong place. The ozone thinning that worried everybody in the 1980s was over Antarctica. Over northern latitudes, ozone concentration has been falling by about 4 per cent each March before recovering. Over Antarctica, since 1980, the ozone concentration has fallen by 40 or 50 per cent each September before the sun rebuilds it. So what's happening to the Antarctic ozone hole? Thanks to a diligent blogger named Anthony Watts, I came across a press release also from Nasa about nine

months ago, which **said**: “Two **new studies show** that signs of recovery are not yet present, and that **temperature and winds are** still **driving** any annual **changes in ozone hole size**.” As recently as 2006, Nasa announced, quoting Paul Newman again, that the Antarctic ozone hole that year was “the largest ever recorded”. The following year a paper in Nature magazine from Markus Rex, a German scientist, presented new evidence that suggested CFCs may be responsible for less than 40 per cent of ozone destruction anyway. Besides, nobody knows for sure how big the ozone hole was each spring before CFCs were invented.

All we know is that it varies from year to year. **How much damage did the ozone hole ever threaten to do anyway?** It is fascinating to go back and read what the usual hyperventilating eco-exaggerators said about ozone thinning in the 1980s. As a result of the extra ultraviolet light coming through the Antarctic ozone hole, southernmost parts of Patagonia and New Zealand see about 12 per cent more UV light than expected. **This means that the weak September sunshine**, though it feels much the same, **has the power to cause sunburn** more like that of latitudes a few hundred miles north. **Hardly Armageddon**. The New York Times reported “an increase in Twilight Zone-type reports of sheep and rabbits with cataracts” in southern Chile. Not to be outdone, Al Gore wrote that “hunters now report finding blind rabbits; fisherman catch blind salmon”. Zoologists briefly blamed the **near extinction** of many amphibian species on thin ozone. **Melanoma** in people was also said to be on the **rise** as a result. **This was nonsense**. Frogs were dying out because of a fungal disease spread from Africa — nothing to do with ozone. Rabbits and fish blinded by a little extra sunlight proved to be as mythical as unicorns. An eye disease in Chilean sheep was happening outside the ozone-depleted zone and was caused by an infection called pinkeye — nothing to do with UV light. And **melanoma** incidence in people actually **levelled out** during the period **when** the **ozone got thinner**.