MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Journal of Ecology and Natural Resources
ISSN: 2578-4994

Technologies for Humanity Adaptation to a Changed Climate

Krasnyansky M*

Professor, Doctor of Chemistry, Donetsk National Technical University, Ukraine

Corresponding author: Mikhail Krasnyansky, Dr. of Chemistry, and professor, Donetsk National Technical University, Ukraine, Email: mykhayloo2@gmail.com

Mini Review
Volume 7 Issue 3
Received Date: August 23, 2023
Published Date: September 19, 2023
DOI: 10.23880/jenr-16000347

Abstract

This article is an attempt to prove that the urgent adaptation of mankind to an already significantly changed climate, at least, is no less important than "the fight with global warming." In conditions of an already globally changed climate, in order to survive, it's not enough to replace fossil fuels with clean energy. Humankind also urgent needs the implementation of modern technologies for protection against hurricanes, floods, and wildfires, modern technologies to replace of the traditional low-efficiency agriculture and cattle breeding, minimization huge food wastage, and more. Unfortunately, humanity is absolutely not ready for this "new climate reality" and does not have carefully thought-out scientific and technical adaption plans. The main idea of this article is well expressed in the Charles Darwin's quote written 165 years ago: "*It is not the strongest and smartest who survive but the one who adjusts best to the changing environment*."

Keywords: Climate Change; Climate Resilience; Natural Disasters; Urgent Adaptation; Mankind Survival

Introduction

It's already obvious that an increase in the concentration of CO_2 in the atmosphere as well as an increase of its average temperature, correlates well with an increase in the number of natural disasters and, accordingly, an increase in budget costs for the removal of their consequences. On the other hand, the impossibility of completely stopping global climate change, let alone return to its 1970 parameters is also obvious, for example: removing billions of tons of CO_2 from the Earth's atmosphere; restoring millions of tons of ice at the poles of the Earth and its mountain peaks; reducing the acidity and temperature of the World Ocean. Hence, the conclusion is made about the inexpediency of spending all hundreds of billions of "climatic dollars" on the fighting with global warming and the expediency of spending at least half of these billions on the urgent adaptation of mankind to an already changed climate.

Discussion

The way to solve all the previous problems of mankind was the jump to a higher technological level: from a raw food diet to making a fire, from the Stone Age to the Iron Age, and from a horse to a "Ford". The challenges of the changed climate must be solved in the same modus. Here are the main problems where "climatic billions" should be invested in for urgent adaptation of mankind:

Vertical farms against crop failures, drought, and world hunger

Cultivation of many agricultural crops should be transferred into vertical farms (Figure 1) where it produces by hydroponics methods are indoors in a specially designed multi-storey building. A vertical farm is approximately 10 times more efficient than a greenhouse and 100 times more efficient than in an open field. In accordance with [1], vertical farms have the following benefits: full automation of growing and harvesting; crop stability, which does not depend on natural conditions; application of water collection and purification systems that reduce water consumption by 90% compared to traditional agricultural production; its conditions exclude the occurrence of pests as well as make unnecessary the use of pesticides, herbicides and insecticides; possibility of location within city limits, which reduces transportation costs by dozens of times. Also, vertical farms are a faster and more efficient response to severe droughts.

Figure 1: Vertical farm with hydroponics (10-shelf rack on each floor of the farm).

Cultivated (cell-based) meat against anti-ecological, low efficiency, and disaster-unsustainable cattle breeding

It is necessary to abandon cattle and pig breeding and switch to cultivated (artificial) meat grown from cow or pig stem cells taken from their muscles [2,3]. According to well known "Lindeman ten percent rule", the efficiency of energy transfer from one trophic level of the living ecosystem to the next is about 10%, i.e., each level in an ecosystem only gives 10% of its energy to the level above it (Figure 2). 90% energy is lost at each trophic level. I.e., in living ecosystems, the first law of thermodynamics

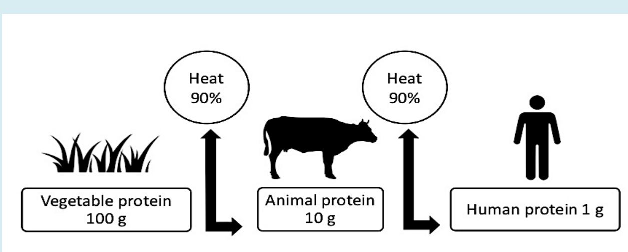

Figure 2: Progressive loss of efficiency in food chain ("Lindeman ten percent rule").

Manifests as "the 10 percent rule". For example, if a cow eats 1 kg of vegetable feed, then only 10% of the vegetable protein will turn into meat protein, that is, the energy efficiency of this process is only 10% (this is the efficiency of a 1900 steam locomotive, how can such a process be used in the 21st century?) If we consider food as energy for a person, then the beef is not only environmentally polluting, but also an extra-energy-wasteful fuel. In addition, the world herd of cows (more than one billion) emits into the atmosphere about 100 million tons of greenhouse gas methane per year which is equivalent to 3 billion tons of CO_2. So the contribution of animal husbandry to climate change is very significant. In addition, our planet no longer has enough resources to feed a billion cows. In the same time, growing artificial meat ("in vitro") requires five times less energy and 10 times less water than conventional production of the same amount of beef and reduces greenhouse gas emissions by 20 times compared to raising livestock for slaughter. Under such sterile conditions as artificial meat technologies, you can obtain an environmentally friendly product without any parasitic worms, salmonella, toxic metals that are often present in raw meat. Also, an artificial "meat plant" requires only 1% of the land compared to a conventional farms of the same meat productivity. For example, the "Good Meat" company plans to start building the complex of the world's largest bioreactors for the production of artificial meat; the company plans to grow artificial beef and chicken [4].

Note: It is world agriculture and cattle breeding consume 70% of the world's fresh water consumption. Mankind, in the context of global warming, can no longer afford such a monstrous waste of fresh water.

Minimizing food wastage as a fight against world hunger and huge waste of energy and fresh water

At all stages from harvesting and storing crops up to grocery store shelves and home dining tables [5,6]. According to the World Health Organization, in 2020, out of 7.5 billion people living on the planet, approximately 800 million people were partially or completely hungry. But the world annually produces approximately 4 billion tons of food, and this could be enough for all the inhabitants of the planet if food was rationally used and distributed. Unfortunately, around 1.3 billion tons food (30%) goes to loss and waste each year. Food disappears at all stages of production - during collection, processing, storage, transportation to retail chains and food outlets. Globally, according to the United Nations World Food Program (UN WFP), approximately 14% of food produced is lost between harvest and retail (e.g., in transit, storage, or processing), plus about 17% - in households (2-3 percent of them can be grocery stores and cafes). Total, we have: 14 + 17 = 31% of the global food lost and wasted. World

Bank estimates the value of the global food system at roughly \$8 trillion (i.e., 10% of the \$80 trillion GDP global economy.) That is, financial damage 31% of global food losses can be roughly estimated at USD 2.5 trillion. In addition, unused (lost and wasted) food not only makes millions of people hungry, but useless "consumes" approximately 20% of all global freshwater consumed as well as 20% of all world produced oil per year (i.e., 20 million barrels per day). With these "food waste" it would be quite possible not only to feed those same 800 million hungry people on Earth, but also to prevent, first, the useless waste of 20% of the world's fresh water (this is the loss of 1000 km^3 of fresh water per year!), second, the useless burning of 20 million barrels oil per day (and pollution by toxic and greenhouse gases of the environment).

Net-Zero Houses as one of the branches of clean energy and an example of a disaster-resilient resource-supply of housing.

The construction of so-called "Net-Zero Houses" gains popularity in the most technologically advanced countries of the world [7]: "Dancing Dragons", (Seoul, South Korea), Hikari Lyon (France), New-Blauhaus (Mönchengladbach, Germany), Manitoba Hydro Place (Winnipeg, Canada), Clean Technology Tower (Chicago, USA), the 300-meter 70-story "Pearl River Tower" (Guangzhou, China), and others. All surfaces of such buildings are completely covered by solar panels and mini-wind turbines (including "photovoltaic windows"), widely use heat pumps, regenerate all used water, reinforced thermal insulation of external walls reducing heating and cooling demand, the whole building is illuminated by ultra-economical light-emitting diodes (LED), etc. Therefore, these "Net-Zero Houses" consume almost all energy and water from its own sources throughout the year.

Heat pumps as an example of recycling "secondary solar energy".

We need much more use of heat pumps which work on the reverse thermodynamic cycle of Carnot and can pump out absorbed solar heat (or "secondary solar energy") from the environment (the upper layer of the seas, rivers, and ground and the lower layer of the atmosphere) for heating of the residential and office premises [8] - Figure 3. Since the efficiency of a heat engine (direct of Carnot cycle) is always less than 1, for a heat pump (reverse of Carnot cycle), this value will be greater than 1. That is, the heat pumps use a little electric energy to move a large amount of heat energy from the outside environment to heat the air inside a home. About 190 million heat pump units were in operation in buildings worldwide in 2021 but it is only about

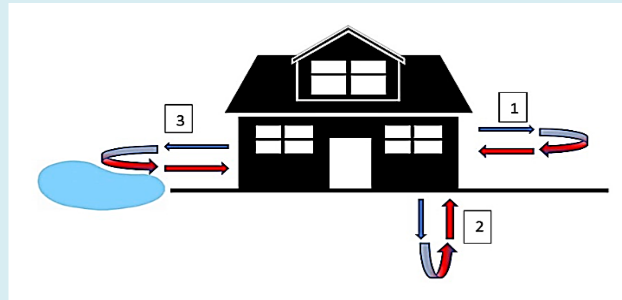

Figure 3: Environmental heat resources ("secondary solar energy") for heat pump operation:
1 – air heat source; 2 – ground heat source; 3 – water heat source.

10% of space heating needs globally. I would also like to emphasize: first, "secondary" solar heat of the environment is an inexhaustible source of energy which is available in any place where a person lives; second, because the heat carrier of the heat pump is liquid ammonia (-40°C), the heat pump can take away heat from the ground even in winter (-5°C), that is, to heat the premises at almost all latitudes, in summer and winter, daytime and nighttime. One of the best "energy formulas" for the house: a heat pump - in the basement, solar panels - on the roof.

Huge dams and drainage systems for flood protection.

Floods are one of the most dangerous and unavoidable natural disasters. Only in 2020-2021, stronger floods with destruction and casualties occurred in Brazil (Belo Horizonte), China (Henan), Germany (North Rhine), India (Maharashtra). Dams in flood-prone regions can initially be very expensive, but in a strategic perspective, they can provide great cost savings by preventing huge damage and loss of life, as climate change has raised oceans levels and the number of storms around the world and increased the risk of flooding of coastal communities as a result of storm and flood surges. Japan, which has about 30,000 km of coastline, has over 2,500 protective dams. One of the largest is the Tokuyama Dam: height 161 m, length 421 m, embankment volume 13.7 million m^3, reservoir square 255 km^2, flood control volume 123 million m^3, cost - \$500 million. This dam is for flood control, in addition, it supports a small hydroelectric power plant of 150 MW [9]. Since 2008, this dam has long paid for itself by preventing possible multiple floods in the protected region.

Most regions with high rainfall do not have adequate drainage system. However, the Tokyo Drainage System (TDS) [10] is an example of the largest in the world. The main underground hall of the TDS "Bath for Regulation Water Pressure" (it is sealed) has a size of 178x77 meters and a height of 18 m, and the vault is supported by 59 reinforced concrete columns (Figure 4). Its emergency capacity is over 200,000 m^3 of flood water. The TDS gas turbines pump 185 m^3/sec of rain water to the Edogawa River by big pipeline (diameter is 9.5 m). As a result, the average level on Tokyo's streets of water decreased 9 times. Tokyo's Drainage System was built during 8 years, project cost 1,9 billion dollars.

Figure 4: Tokyo underground drainage system - water pressure control bath.
(size 178x77x18 meters)

Cryogenic underground electrical cables to prevent mass blackout due to natural disasters.

Hurricanes, floods and wildfires, which have become more frequent in the 21st century, among many other troubles, leave huge enclaves without electricity for a long time. The reason is that high voltage power lines are many kilometers long chains of hundreds of metal poles 30-50 meters high, and the lines inside settlements are wooden or concrete poorly fixed poles. Therefore, in all hurricane, flooding, and wildfire hazardous regions, it is better to use cryogenic superconducting underground cables [11]. This is a thin copper cable in an empty pipe of small diameter; the pipe is filled with liquid nitrogen and covered with hydro-thermal insulation on top. Benefits of using cryogenic superconducting underground cables (Figure 5):

- The efficiency of electricity transmission through a cryogenic cable is not less than 98% (losses in conventional high-voltage networks - up to 15%);
- The consumption of copper (aluminum) for a cryogenic cable will be 9 times less than for a traditional one;
- The cryogenic cable underground has an "ground exclusion zone" of 10 m, and the traditional high-voltage line - 200 m;
- The cryogenic transmission line is highly resistant to hurricanes, floods and wildfires.

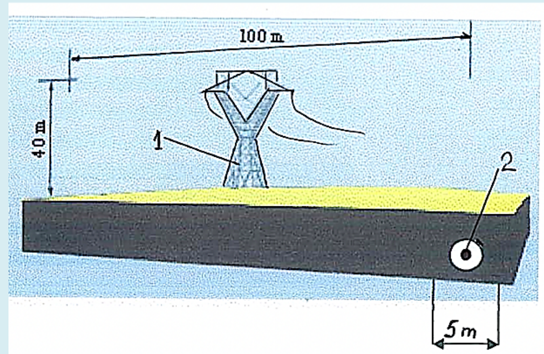

Figure 5: High voltage line (1) and cryogenic superconducting cable (2).

Aviation against wildfires

Wildfires are a huge disaster, and it is extremely difficult to fight them. Huge areas of wildfires (hundreds of hectares) occur almost every year in the US, Canada and Australia. Thousands of houses are destroyed, damages amount to tens of billions of USD, while, alas, dozens of people die [12]. Additionally, about 10 tons of aerosol soot particles and one ton of toxic and greenhouse fire gases are emitted into the atmosphere from each hectare of burned forest; besides, each hectare of a mature forest can absorb from atmosphere 2-3 tons of excess CO_2 per year and releases there about 150-200 kg/year of O_2 (depending on the trees species). Hazardous fire regions should be sufficiently completed by special aircraft (airtankers) and helicopters with a large load capacity for firefighting since a burning forest must be treated with fire extinguishing powder and sprayed water continuously for many hours and simultaneously throughout the fire area [13]. To do this, it is necessary to have about 100 special fire-fighting aircraft (airtankers) and the same helicopters in full readiness, plus huge reserves of fire extinguishing agents (fine powdered ammonium phosphates, "dry water", "foam water", others).

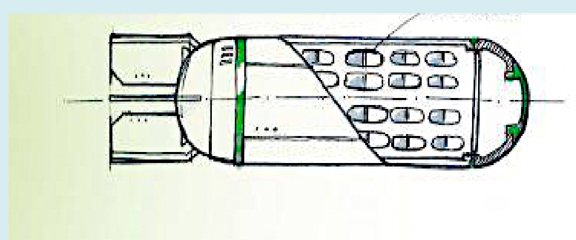

Figure 6: "Seed bomb".
(the capsules with tree seeds are inside container)

Also, it is proposition restoring burned-out forests and creating new forests using "seed bombs" [14] (Figure 6). Each seed bomb contains hundreds of soluble containers, and each container contains sapling seeds. It can be done using the obsolete military airplanes by bombing with seed bombs. They can plant several thousand capsules with a sapling a minute across around all damaged forest.

Building codes must be tightened to make buildings more resilient to natural disasters.

It is necessary to allow the construction of only "hurricane-resistant" or "fire-resistant" residential and public buildings in any hurricane-prone or fire-prone areas. It should be monolithic reinforced concrete (plus a well-fortified foundation); in case of fire-prone area, it will be the so-called refractory or heat-resistant concrete or fireclay. A prime negative example of ignoring adaptation is the United States: every year, hurricanes on the East Coast and fires on the West Coast cause dozens of deaths and bring tens of billions of damage because the US builds 1-2-3-storey residential and office buildings from combustible and fragile wooden elements that any fire can burn and any hurricane will destroy (together with outdoor electrical networks) [12,15].

Conclusion

Governments of all countries, International Organizations, the business community, the scientific community, and "the green movement" must accept "Mankind adaptation to a changed climate" as a new separate crucial branch of world science, economics, and politics, therefore, they must shift at least half of their attention, financial and intellectual resources toward urgent adaptation to an already substantially changed climate that will inevitably continue to worsen. Just fighting for "1.5° C" is absolutely not enough for mankind to survive the 21st century safely. Ignoring the above points 2.1-2.9 will lead mankind not to prosperity, but to extinction. As the known proverb says: "*If the World Deluge is inevitable, one must spend the remaining time learning to live underwater.*"

References

1. Van Delden SH, Kumar SM, Butturini M (2021) Current status and future challenges in implementing and upscaling vertical farming systems. Nature Food 2: 944-956.
2. Post MJ, Levenberg S, Kaplan DL (2020) Scientific, sustainability and regulatory challenges of cultured meat. Nature Food 1: 403-415.
3. Roy B, Hagappa A, Ramalingam YD (2021) A review on lab-grown meat: Advantages and disadvantages. Journal of Medical and Health Sciences 4(1): 19-24.
4. Noyes A (2023) GOOD Meat, the World's First-to-Market Cultivated Meat Company, Receives U.S. FDA Clearance.
5. The Food and Agriculture Organization of the United Nations (2023) Food loss and waste.
6. Hensel K (2022) Facing the Food Waste Crisis.
7. Wu W, Skue HM (2021) Residential Net-Zero Energy Buildings: Review and Perspective. Renew Sustain Energy Rev: 142.
8. Rosenow J, Gibb D, Nowak T, Lowes R (2022) Heating up the global heat pump market. Nature Energy 7: 901-904,
9. The Tokuyama Dam (2012) Japan Water Agency. Archived from the original.
10. Nakamura H, Oosawa M (2021) Effects of the underground discharge channel/reservoir for small urban rivers in the Tokyo area. IOP Conf Ser: Earth Environ Sci: 703.
11. Doukas DI (2019) Superconducting transmission systems: review, classification, and technology readiness assessment. IEEE Trans Appl Supercond 29: 5.
12. Wildfire Statistics 1993-2022 (2023) The US Congressional Research Service (CRS).
13. Krasnyansky M. (2006) Remote Extinguishing of Large Fires with Powder Aerosols. Fire and Materials 30(5): 371-382.
14. Skyz S (2016) Planes Can Plant 1 Billion Trees A Year With Seed Bombs.
15. Nussbaum S (2013) The Top 3 Worst Hurricanes of the Last 20 Years. American Red Cross.