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Looking Beyond The Implications Of A Nuclear Winter

Think of the images of Hiroshima after the bomb dropped.

Replace them with recent images of famine in Ethiopia and you have a more realistic picture of life on earth after a large scale nuclear war.

That's the sort of perceptual shift the world has to make if it's to understand the implications of such a war, American scientist Mark Harwell says.

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Now scientists believe more people could die from starvation after a nuclear war than from its direct effects. Harwell says.

Millions would die from the direct effects of a large scale Northern Hemisphere war — in a "severe case" scenario perhaps 500 million. What about the survivors?

What about the rest of the world, the people who live in "non-combatant" nations where the bombs don't fall?

That's where Harwell and his team of Scope scientists come in.

They started asking what would happen to those people and their environments.

Results

Harwell explained the results of that part of the Scope study during his visit to Massey University recently.

In the study, scientists considered the consequences of all sorts of nuclear induced stresses on the global environment — fallout, ultra-violet radiation, fires, atmospheric pollution. Harwell concentrated his explanation on

"There was no really good experimental data base to rely on — before this time no one thought it made a lot of sense to take a tropical rain forest and stick it in a refrigerator and turn out the lights to see what happens."

They had to rely on "several lines of reasoning" in building their case. First they looked at history, incidents of abrupt temperature changes in the past.

Then they looked at the statistics — normal events — to come up with the relationship between average temperatures and the length of growing seasons. Lab tests with seedlings followed. But there was nothing on a whole system level.

They developed complex simulation models of entire ecosystems — estuaries, grasslands, forests, deserts and agriculture.

They found different systems respond differently to different stresses.

They found agricultural systems the most vulnerable of all — "and unfortunately ... they are the most important to humans."

"To give you an estimate of how important, we calculated how many people could be kept alive on earth if they lived off just the land, eating nuts, berries, fish and so on."

One Per Cent

"We came to the conclusion, based on several lines of reasoning, that only about one per cent of the current human population could be kept alive if you didn't have agriculture and other support systems."

The agricultural impact question came down to two issues for the

you reduce the number of growing degree days — and if you get below the minimum, you lose the crop."

At times during rice development, for example, the crop is lost if the temperature falls below 15 deg.

The scientists adopted "as a baseline" a calculation that the growing season would be cut by 10 days for each one degree cut in temperature. That varies from locality to locality, Harwell says.

"So you can see if you have reductions in temperature of two or three degrees, you're losing 20 or 30 days of growing season."

Look at wheat. The scientists found that if Canada — a major wheat producer — was subjected to a 2.5 degree drop in average temperature, wheat wouldn't grow.

Dramatic

"It was far more dramatic a result than we had anticipated. It wasn't limited to Canada. We found similar results in soya beans in the south-eastern United States, only there it was more in the range of four to five degrees. Wheat and rice in other countries showed similar results.

"In a summary of these reductions, if the temperature is reduced between one and three degrees below normal you lose quite a few of the crops. If it's three to five degrees extended over a growing season, you'd lose most of the crops. Anything above a five degree reduction, forget it — you're not going to produce."

Temperature wasn't the only factor with an impact on production. Human input — fertiliser, pesticides, herbicides, fuel for the

also assumed if it turns out you can only keep half the population alive, the other half will very graciously not eat for a year.

"By doing that you obviously overestimate the maximum number that can be kept alive. Clearly, following a nuclear war, there would be hoarding. We've done sensitivity analyses on that and it's made a tremendous difference to the outcome.

"But in the first case we wanted to see what the maximum physical limits of human population support would be."

They analysed detailed storage data from 15 countries and not-so-detailed data from 120.

Sufficient

Of the first 15, they found that after a post-harvest war, the United States, the Soviet Union, Britain (barely), Canada, Australia and Argentina would have sufficient food to keep their people alive for one year. The rest didn't.

At pre-harvest levels, only Canada, the United States and Australia would have sufficient for one year. The others had supplied sufficient for only three to six months.

The situation doesn't change substantially for the 120 — "for the vast majority of countries and people, there is simply less food available than is required to keep them alive."

Countries which import food are particularly vulnerable. Japan, for instance, supports half its population on food imports. If imports were closed off, half could not be fed — even with normal production levels.

A Nuclear Winter

(Page 2)

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The "nuclear winter" scenarios — visions of a world plunged into freezing darkness after it is enveloped in clouds of smoke produced

It was the Scope team's task to look beyond that at what reductions in temperature, sunlight and rainfall would do to whole ecological and agricultural systems.

Scope's analysis indicates temperatures would fall sharply after a nuclear war "for a relatively short time," Harwell says.

"These temperature reductions would start with a sudden onset, peak within a few days and last for a few days, or a week, or maybe months. The specific reduction is not predicted. For us, what counts is that there are episodes of chilling or freezing temperatures lasting at least a few days. That's what counted biologically."

Sudden temperature drops fall into what Harwell and team define as the acute phase of climatic change. The second phase — chronic — involves falls in average temperature of a few degrees. The chronic phase would last much longer than the acute, Harwell says, at least months, through one growing season, maybe more.

The Scope scientists then looked at what those lower temperatures would do to entire biological systems.

It wasn't that easy.

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One Per Cent

"We came to the conclusion, based on several lines of reasoning, that only about one per cent of the current human population could be kept alive if you didn't have agriculture and other support systems."

The agricultural impact question came down to two issues for the scientists — how vulnerable food production was to the sorts of stresses they were talking about and how much food was stored.

When it came to production they looked mainly at grain crops — about half a dozen grains make up the bulk of the human diet, and after a nuclear war, grains are likely to be more important because they store better than, say, fruits.

Temperature reduction was the main factor they looked at but precipitation falls also showed some impact on crop production.

Their analyses of temperature factors was fairly straightforward — "if these crops experience subfreezing temperatures, you lose the crop." But there are different ways crop production will be affected if temperature reductions extend over a growing season, Harwell says.

Each crop has its own minimum requirements for growing season length — if it's shorter, it won't mature and it won't produce.

Thermal Time

Then there's what is called thermal time — the amount of heat a crop needs to absorb over an entire growing season. That's measured in growing degree days.

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Temperature wasn't the only factor with an impact on production. Human input — fertiliser, pesticides, herbicides, fuel for the tractors — were considered because they had substantially raised production.

Take them away and production falls, Harwell says.

"Even independent of the climate effects, nuclear war is likely to lead to the cessation of exports and imports of these materials, even for countries far removed from nuclear detonations."

Take all the factors into account and the bottom line is "... the potential exists to lose the bulk of agricultural production — maybe all the production in the Northern Hemisphere — during the first growing season after a nuclear war."

Storage

The next issue for the scientists was how much food would be in storage at the time of a war and how long it would keep the poulation alive.

They looked at two time frames — if the war occurred when stores were at their mean, post-harvest level or at their lowest, just before harvest.

And they assessed how much food people needed to stay alive — not healthy, just alive. Another factor they had to consider was distribution.

"We assumed perfect distribution — that everybody only ate the minimum calories required, that there was no hoarding, nobody ate more than they needed to. We also assumed if it turns out you can only keep half the population alive, the other half will very graciously not eat for a year.

"By doing that you obviously overestimate the maximum number that can be kept alive. Clearly, following a nuclear war, there would be hoarding. We've done sensitivity analyses on that and it's made a tremendous difference to the outcome.

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Countries which import food are particularly vulnerable. Japan, for instance, supports half its population on food imports. If imports were closed off, half could not be fed — even with normal production levels.

Assume no bombs fall on Japan but that its crops suffer climate effects and fertiliser imports cease — Harwell says only between 10 and 15 per cent of the population could be kept alive.

Take all the results the scientists came up with and what you have is millions of people at risk of starving to death.

Harwell hasn't put a percentage figure on it but "it must be something like 80 per cent" of the surviving population.

Indirect

"The global picture is that the indirect effects of nuclear war can be far more consequential than the direct effects.

"It means instead of thinking of Hiroshima and Nagasaki as examples of what a modern nuclear war would look like, for most of the people on earth the situation in Ethiopia and the Sudan would be far more representative.

"It gives us a new perspective when you think that more people could die in India than in the United States and the Soviet Union combined, that more people could die in Africa than all of Europe.

"That's a fundamentally different perception of nuclear war than we've had before."

The next step for Harwell and colleagues is to get that new picture into the minds of the policymakers and the public around the world.