

The Eco-Time Capsule Project: POPULATION MATTERS

[September 2021]

“Unremitting growth: it’s the doctrine of the cancer cell” (Sir Crispin Tickell, Patron of Population Matters)
“I have not seen a major environmental problem facing our planet that would not be easier to solve if there were fewer people – or harder, and ultimately impossible, with ever more”

(Sir David Attenborough, Patron of Population Matters)

Family planning “could bring more benefits to more people at less cost than any other single technology now available to the human race”

James Grant (Annual Report UNICEF 1992, p 58)

Successive UK governments’ Chief Scientists and the last President of the Royal Society have all referred to the approaching ***‘perfect storm’*** of crises in this century related to environmentally unsustainable human population growth. In this they were no more than replicating the fully evidence-based wake-up calls of others. A selection of these farsighted individuals is listed below:

200 years of intermittent warnings to the world on the risks of unremitting human population growth

Thomas Robert Malthus - 1798
John Stuart Mill - 1848
Martin Luther King Junior - 1966
Norman Borlaug - 1970
Paul Ehrlich and John Holdren - 1971
Maurice Strong - 1992
Nobel and other World Scientists’ Warning - 1992
[World Scientists’ Warning repeated at + 25 - 2017]
Science Summit on World Population New Delhi - 1993
David Attenborough - 1994, and often repeated since
The Environment Time Capsule Project - 1994

Saying “sorry” to the future

In the Eco-Time Capsule project environment time capsules (Eco-TCs) were buried in 1994 in the Botanic Gardens of Kew, Ness, South Africa, Seychelles, Sydney NSW and Mexico. Generally, time capsules record a particular time and place for posterity, and are buried without establishing any future date for ‘un-burying’. These were different. A population and environment activist since I was a second year med student, I was re-energised in 1992 by the UN’s Environment Conference at Rio and the recent World Scientists Warnings (see Box). Then I came across the saying, as true as its origin is uncertain:

“We have not inherited the earth from our grandparents, we have borrowed it from our grandchildren”

I concluded that the latter will justifiably be furious if by then we have wrecked their loan to us. Therefore the Eco-TCs, buried on or about World Environment Day in June 1994, will be disinterred in 2044 - ie after exactly 50 years, by ‘our grandchildren. They contain relevant 20th century artefacts labelled BAD [eg some fossil fuel and a CFC aerosol] or GOOD [my own cycle pump and – stressing their equal relevance environmentally - a pack of contraceptive pills], along with entries by hundreds of schoolchildren in a nation-wide competition for the best letters, poems and pictures. Along with others contributed by adults, these items apologised for “disruptive climate change”, long before this was a common concern, as well as “the extinction of numberless species” through habitat destruction, and other dire impacts anticipated by 2044 through ever increasing numbers of planet-trashing humans. BUT those involved did not, and do not, just wring their hands and apologise, see on/...

Our Promise? This was to work towards “*changing hearts, minds and policies*” (including population policies) “*before it’s too late*” - with the explicit ultimate objective to achieve long-term sustainability. So that, against the odds, ‘sorry’ in 2044 would not need to be said! There is much more at www.ecotimecapsule.com including Christopher Guillebaud’s video which “encapsulates” this, to see/hear and maybe forward....

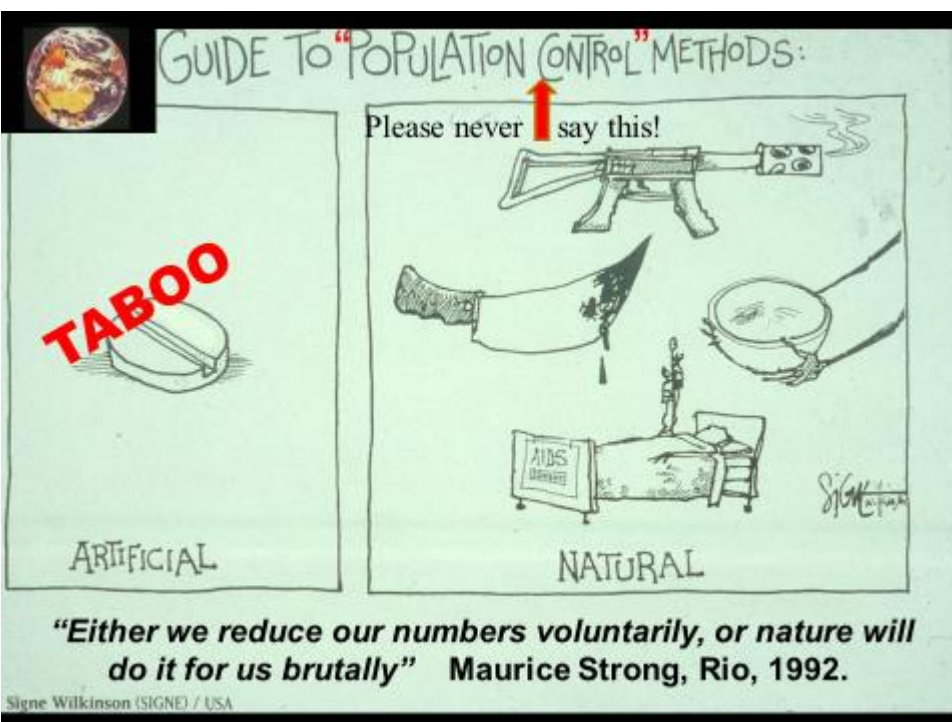
How has the planet fared since the warnings and pledges of 1992-1994?

Since 1994, reliable reports on the planet's health have found water, land, plants, animals and fish stocks all in "inexorable decline". The climate emergency is for real, as shown by ever more extreme climatic events - wild fires, droughts, hurricanes and floods whether by fresh- or sea-water - and the observable positive feedbacks that threaten irreversible chain-reactions (eg the “methane gun” from melting polar permafrost and reduced albedo, the reflecting-effect, as white ice melts). But greenhouse gases (GHGs) including CO₂ and methane are not the only air pollutants of concern: disease-inducing fine particulates, released in city streets everywhere and as indoor pollutants from cooking and heating of dwellings in least developed countries, are estimated to cause over 8 million annual deaths. <https://journal.chestnet.org/action/showPdf?pii=S0012-3692%2818%2932723-5>.

The United Nations' Global Environment Outlook www.unenvironment.org/resources/global-environment-outlook-6 reports regularly warn of a steady progression of unprecedented ecological damage, the principal ‘upstream’ driver of which is human population - which at 7700 million in 2019 "had reached a stage where the amount of resources needed to sustain it exceeds what is available". Each year there are in the world roughly 135-145 million births and 50-60million deaths, or an annual increase of 80-plus million. That increment has resisted reduction for 3 decades, with a billion extra humans arriving every 11 years since 1987 (for more, see www.prb.org/population-change/). Every four days currently a city for 1 million people is appearing, somewhere – with all that that implies for additional energy use, GHG emissions and trashing of habitats for wildlife.

Earth Overshoot Day marks the annual date after which humanity’s aggregate demand on Nature’s renewable resources exceeds what the earth can regenerate in that complete year. Thereafter we are in ‘overshoot’. Calculated to be July 29 in 2019, it was later in 2020 - but only temporarily, because of Covid-19-related recession with less utilization of resources (including fossil fuels) www.footprintnetwork.org/our-work/earth-overshoot-day/. Humankind routinely uses about 170 % of what the earth can renew, i.e. its biocapacity (as in forestry, fisheries, croplands), and is on track to attempt by 2050 to utilize the resources of two planets. **But there is no Plan(et) B....** This one is our only home, it is finite and moreover 70% of its surface is salt water. Half the rest is desert, mountain, or icecap. Achieving sustainability is not an option, it’s all about how we get there. Shall it be, as Maurice Strong pointed out at the Rio environment conference in 1992, through many fewer births or Nature’s

alternative, very many more deaths? See **Figure 1**.



Clearly, those who consume way beyond their share, the rich over-consumers in every country, must massively reduce their environmental footprints. But also relevant is the ‘number of feet’ = people with footprints, everywhere (and as we shall see the number of rich persons’ feet has the greatest impact). **It’s not “either -or” it’s “both-and”**: Reducing over-consumption and the numbers who will do the consuming, are two sides of the same coin.

Figure 1

Biodiversity: The WWF's 2020 Living Planet Index measures biodiversity and each biennial report shows a continuing downward trend among invertebrates (including bees and other pollinators) and vertebrates (birds, fish, reptiles, amphibians and mammals). The average vertebrate population on land and sea was estimated to have declined by about 68 percent since 1970 <https://livingplanet.panda.org/en-US/about-the-living-planet-report> In a business-as-usual scenario, this downward trend in species populations continues into the future. A sixth major extinction event is under way, with one species *H. sapiens* (sic) the culprit: other species are becoming extinct a hundred times faster than the rate in the fossil record. Of the total mammalian biomass on land, in the most recent estimate (2018), a mind-blowing 96 % is the flesh of humankind or our livestock (cows, pigs etc) and pets www.ecowatch.com/biomass-humans-animals-2571413930.html leaving just 4 % for all wild mammals put together.

A note on pandemics: Though not 'on the radar' of most commentators, even the Covid-19 virus pandemic had its roots in ecological disruption and over-population. It is hardly unexpected that the microbes of zoonotic diseases, which can only replicate inside living cells, would utilise the vast 'culture medium' represented by all that human flesh <https://emergencemagazine.org/story/shaking-the-viral-tree/>. The 2020 pandemic is in reality another symptom that: ***Too much human life has become an existential threat to all life....***

Agriculture: The need for agricultural land has increased as populations, living standards, meat-consumption (importantly this is responsible for c 20% of GHG emissions including methane) and demand for biofuels all rise. There is no new land: except through continuing deforestation (at over 1 million hectares per month or about a football pitch each second). A hectare that yielded 1.8 tonnes of crops in 1987 now yields 2.5 tonnes, through greater use of fertilisers and water - but often leading to land degradation. The rise in productivity is mainly through relentless forest-burning (a major source of CO₂) plus use of fossil fuels for tractors, transport, refrigeration and more. A major reason for ever more GHGs is because of more mouths to be fed, especially by meat: the world must indeed switch, wholesale, to a primarily plant-based diet.

Global fresh water supply has become a serious threat as the demand for irrigated crops soars. The UN reports³ that only one in 10 of the world's major rivers reaches the sea all year round, because of upstream irrigation, with close to 2 billion likely to suffer absolute water scarcity by 2025. Humans will soon be fighting over water, just as they always did, and will, fight over the resources of land, fuel and minerals.

Marine life: often overlooked, this is similarly in dire straits:

www.ellenmacarthurfoundation.org/publications/the-new-plastics-economy-rethinking-the-future-of-plastics

On current trends by 2050, the total mass of plastics in the oceans may equal the weight of all fish. Toxic pollutants are adsorbed into the micro-plastic 'nurdles' which imitate plankton, so entering the human food chain. While helpfully absorbing CO₂, the oceans are acidifying and warming, bleaching coral reefs and decimating marine habitats. About 30 per cent of global fish stocks, a key protein source for billions, are classed as "collapsed" and > 40 per cent are "over-exploited".

The 'P' in the I=PAT equation.

The Environment time capsules highlighted the (only) three factors that create humanity's environmental (including climatic) impact. These were first identified in 1971 by Ehrlich and Holdren, then in 1972 related by an equation [https://jpopsus.org/full_articles/holdren-vol2-no2/] - surely the most important simple equation ever derived:

$$\text{Environmental impact, } I = P \times A \times T$$

in which **A** is the per person affluence (material resource consumption and the concomitant "effluence" of pollutants such as plastics, industrial chemicals and CO₂); **T** is the technology impact per person (in which for example fossil fuels measure more highly than solar based energy); and **P** is the population (the number of persons). No other factors have been identified, so how come, that the **P**-factor, over-population, remains persistently "the elephant in the room that no-one talks about"?

Sir David Attenborough in his 2011 RSA President's lecture www.youtube.com/watch?v=1sP291B7SCw, quoted **Foresight: The Future of Food and Farming** www.gov.uk/government/collections/global-food-and-farming-futures. That report, he said: *describes the many obstacles to feeding >7000 million people, increasing in numbers by 80 million (the population of Egypt) each year: soil erosion, salinization, the depletion of aquifers, over-grazing, the spread of plant diseases by globalisation, the absurd growing of food crops to turn into biofuels to feed motor-cars instead of people, and so on. It makes a number of eminently sensible recommendations, including the need for a "second*

green revolution". But, surprisingly, it doesn't state the obvious fact that it would be much easier to feed 8 billion people than 10, so measures to achieve this – voluntary accessible family planning and women's education and empowerment - should be a central part of any programme of action for food security. It doesn't mention what every mother subsisting on \$1 per day already knows, that her children would be better fed if there were four of them round the table rather than ten.

Sir David went on: *I meet no-one who privately disagrees that population growth cannot ever continue indefinitely. No-one except flat-earthers can deny the planet is finite. We can all see it in that beautiful picture of our earth taken from the Apollo mission. So why does hardly anyone say so publicly? There is a bizarre, sustained taboo around the subject. The taboo doesn't just inhibit the politicians and civil servants who attend the big conferences. It even affects the people who claim to care most passionately about a sustainable and prosperous future for our children, the environmental and development NGOs. Yet silence implies that their admirable goals can be achieved regardless of how many people there are in the world, even though they all know it can't.*

I simply don't understand it. It is all getting too serious for such fastidious niceties. It remains an obvious and brutal fact that on a finite planet human population will quite definitely stop at some point. And that can only happen in one of two ways. It can happen sooner, by fewer human births – in a word by contraception. This is the humane way, the powerful option which allows all of us to deal with the problem, if we collectively choose to do so. The alternative is an increased death rate – the way which all other creatures must suffer, through famine or disease or predation. That translated into human terms means famine or disease or war – over oil or water or food or minerals or grazing rights or just living space. There is, alas, no third option of indefinite growth.

A bigger bucket – or turn the tap off? If the world were run by biologists like Sir David rather than economists, our leaders would recognize what all species get to know by hard experience: that multiplication beyond ecological limits leads to a crash. If population gets 'on their radar' at all, political leaders commission demographers to monitor their country's growth, but treat that as a "given": something to be (with increasing difficulty) adapted to, not as something amenable to intervention. This is analogous to watching the filling of a bucket and, when it's close to overflowing, discussing complex measures to make the only available bucket larger - rather than turning off the tap! For more, see my BMJ *Analysis* article www.bmj.com/content/bmj/353/bmj.i2102.full.pdf

Population Matters: 'Too many people, not enough planet'

"The world has enough for everyone's need, but not enough for everyone's greed!" - Are both parts of Mahatma Gandhi's famous saying still true? Or is the first statement no longer true? Doesn't the evidence above indicate that we now have too many 'everyones' for all the need to be met, given our one finite world?

How did this come about? Mostly, not by people actively planning to increase numbers (though some groups, mostly religious or political, do just that, to increase their voice or voting strength). It was the unintended consequence of medicine finally becoming effective, primarily through public health and sanitation since the mid-19th century, and then of antibiotics since the mid-20th. Whereas from the dawn of history a couple would have to have 5 or more children for 2 to reach adulthood, now most children do this. The world has been painfully slow to act, to correct the resulting massive imbalance once the extra births became unnecessary.

Even when that need for balance is accepted, a common myth originating in some bad programmes of the past (eg India in the 1970s, China since 1980) is that *any quantitative concern about population must necessarily and intrinsically be coercive* – particularly of poor people. **Not so**, as well as being abhorrent, compulsion in reproductive health has usually proved counter-productive anyway. This damaging myth can be perpetuated by the misleading and avoidable (see Figure 1) phrase "population control". We are inadequately resourcing the voluntary things that work: primarily, ensuring that any sexually active woman on the planet who wants to use contraception has that choice. Not doing this is probably the ideal way to ensure that more future Governments will legislate, deplorably, for birth control policies that really do involve coercion. Others distrust that 'quantitative concern' as inevitably exclusive - of other key humanitarian interventions: climate justice, poverty alleviation, measures to improve child survival and eliminate gender-based violence and discrimination, promoting women's education and rights. But this is not an "either-or" matter, it can be "both-and": by making contraceptive care a fully-funded and priority component of optimal development aid.

Current good news and bad news about population growth

Small thanks to worldwide opponents of family planning, since mid-20th century the world's mean total fertility rate (TFR, signifying "mean family size") has reduced impressively, from 5.2 to 2.4 in 2018. About 50 % of humans now live where mean family size is at or below replacement levels (UN and PRB data). Indeed, in 2013 an influential TV film by Hans Rosling gave many the impression that the population problem is essentially 'sorted'. His complacency was concerning: *one does not call off the firefighters when a forest fire is showing signs of coming under control.*

Some "bad news" hides within that mean world TFR of 2.4 www.bmj.com/content/bmj/353/bmj.i2102.full.pdf
First, about 45% of the world's people live in countries with TFRs that continue to be above 2.1 (replacement) going up to 5; and 9% have TFRs above 5. In the 48 UN-designated Least Developed Countries (LDCs) the population was projected in 2015 to triple by 2100. In much of sub-Saharan Africa fertility reduction has stalled. The UN's median projection of 11.2 billion by 2100 is predicated on continuing reductions in TFR: in their absence the constant fertility variant projects to an ecologically apocalyptic total of 28 billion by 2100. Secondly, a major problem is inexorable "demographic momentum", due to the population 'bulge' of young people who have yet to start their families, born when TFRs were higher. In (for example) Niger and Uganda, 50 % of the population are not yet grown-ups: all under age 15. They will be tomorrow's parents.

Solutions that work: first need is an understanding that it's really all about SEX!

Economists who argue that poor people need and choose to have large families ignore one vital fact: that potentially fertile intercourse occurs far more frequently than the minimum needed for desired conceptions. blueplanetunited.org/archives/populationpress/do-economists-have-frequent-sex-by-martha-campbell-and-malcolm-potts/ Hence having a large rather than a small family is usually not, as portrayed, a planned decision - couples in low resource settings (LRSs) actively setting out to have many children for economic and 'social security' reasons, or, given expected high child mortality in such settings, to 'be on the safe side'. It is instead an automatic outcome of human sexuality. Something active needs to be done to separate sex from conception - namely, family planning (FP). Without that being accessible, the 'default state' for absolutely all fertile couples is a large family: quite simply that's what happens when you are not able to not have a large one... It's not the poor having more sex. If fertile, sex at normal frequency plus absent FP equates to a large family. No "trying" needed! Access to FP being often difficult for poor people, many children arrive by chance not by choice (though then often, and naturally, welcomed). The primary cause is the many barriers to women being able to choose a smaller family - including the basic barrier of no access to a good range of the FP methods. <https://srh.bmj.com/content/39/1/44> Obviously, increasing per-capita wealth usually removes that and other barriers. Yet there is no need to wait in the (often forlorn) hope of that happening, or use compulsion to hasten change. There is no country with above replacement fertility which cannot now, with zero coercion, make a good start in enabling couples to reduce average family size:

- For a start, there is a wide-open door of need. Despite the well-known cultural and religious endorsement for large families in many LRSs, very few women want the maximum biologically possible number of children (>8), and teenage and late-order births are frequently regretted. Between a 1/3 and 1/2 of all conceptions are not planned, totalling c 80 million per year, about half of which are (often unsafe) abortions. Survey data show that about 215 million women without access to modern contraceptive methods want no more children.
- To change the context of decision-making in LRSs requires contraceptives to be available and accessible and promoted, by good use of the Media www.populationmedia.org/ Primarily by education, the multiple barriers to their use need to be removed. These include fatalism ('God has planned my family size'), misinformation about contraceptive side effects, religious prohibitions, political correctness¹³. Eliminating the barriers to women, caused largely by men, in a rights-based way, is the tried and tested means which worked in the many success-story countries (eg Iran or Thailand) & states (eg Kerala).

See also my 2013 lecture: 'Sex and the Planet' www.youtube.com/watch?v=XjiLYUqnvTQ .

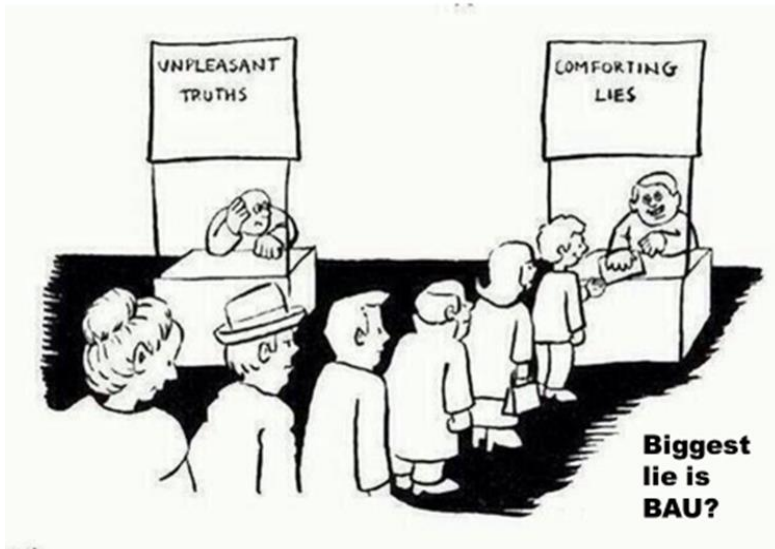
As Jim Grant said "family planning "could bring more benefits to more people at less cost than any other single technology now available to the human race" (ref on Page 1). He went on to say, crucially: "it is not appreciated widely enough that this would still be true if there were no such thing as a population problem," because it is also

preventive medicine, a directly humanitarian intervention. People suffer – mostly women and children – if family planning is inaccessible.

There is a rightful concern about coercive contraception, but coerced conceptions are bad too: when women are forced to conceive through obstruction of their modern-day human right to control their own fertility. Without unwanted conceptions the world's outrageous maternal mortality – c 800 mothers dying, nearly all avoidably, every 24 hours - could reduce by 35%. You cannot die of a pregnancy you don't have.

“The Tragedy of the Unregulated Commons”

When the proverbial camel collapses with a broken back, remember, the last straw did not really do it. It was the fault of all the straws. We all share the planet in common, so for environmental sustainability everyone must be involved. Garret Hardin https://en.wikipedia.org/wiki/Tragedy_of_the_commons documented a seemingly inevitable ‘tragedy’, in previous centuries, whenever a field of common land was about to be over-grazed. He explained how each herdsman finds it advantageous, personally and for his family, to put yet another cow on the land - and another and another. This continues despite each farmer noticing that the later arrivals are manifestly thinner and less productive than before as he sees the grass steadily disappearing - right to the point that the grazing limit is exceeded. Then all the cows die and all the families suffer. *The personal self-interest of the individual is thus at the common cost of the whole group, progressively and ultimately, without intervention, catastrophically.* This is Hardin's ‘tragedy’.



A more modern example is: to each fisherman it remains acceptable to take his boat to the nearly over-exploited fishery - even as he sees he is catching ever smaller and fewer fish, and tries to believe the reassuring lies of his peers (Figure 2). But still he says “my boat is my livelihood, it’s those other fishermen that are doing the over-fishing” - right until, predictably, the fishery collapses. The situation is encapsulated in the sayings: “My car is my car – everyone else’s car is traffic!” and in the context of human numbers: “My extra baby is my right, (OR, my own group’s right, my religion’s right) - everyone else’s baby is over-population.”

Figure 2

What to do? To avoid inevitable and ‘tragic’ collapse, Hardin said the correct intervention was “Mutual coercion, mutually agreed upon”, meaning everyone recognising their own contribution to the problem and agreeing to be regulated, whether by peer-pressure or fiscal ‘sticks and carrots’. So in the fishery example, each fisher takes an agreed, smaller, sustainable quota.

However, when push comes to shove, “Why do I bother to do the right (often inconvenient) things to help humankind or the environment, when seemingly no-one else does?” The environmental ‘cheats’ demotivate the potential “good guys” so even they, sometimes at least, do the same “business as usual” (BAU) things: things that are easier, but environmentally unsustainable. There will always be people reassured by lies (Figure 2) - or simply self-interested regardless of others – so how can this mutually assured per-person reduction of environmental impact by everyone possibly happen? See box, page 7.

More on climate change - and education

In 2009 it was estimated www.biologicaldiversity.org/programs/population_and_sustainability/pdfs/OSUCarbonStudy.pdf that by adopting available 'eco-friendly' actions, including meticulous recycling, an American couple could curb their lifetime carbon footprint by 486 tonnes. Simply by having one less child, an American woman would reduce her 'carbon legacy' - ie the summed emissions of herself and her descendants weighted by relatedness - by 9,441

Loving your future neighbour? Once the potential for environmental ‘tragedies’ is fully understood, one hope is that the necessary altruism will be reinforced by ‘calculated self-interest’. Might religious or spiritual motivation help? All religions encourage love for one’s neighbour. Faith communities and, indeed, many non-religious groups promoting the same maxim, must perceive that we can hardly claim to be truly ‘loving our neighbour’ if we deny environmental and climate justice to our neighbour overseas (who already suffers most from climate change); OR, as the Eco-TC project highlights, our future neighbour (likely to receive from us an unsustainably over-populated and thereby trashed planet)? Besides the use of ‘greener’ technology and less consumption per-person, this requires a change of mind-set for many theists, to accept that their god’s command to multiply and “fill the earth” has been well obeyed... Plus there was no order to overfill it! relentlessly appropriating the habitats for most non-human life... Ensuring best practice in rights-based contraceptive care for all so that - competing for what’s left of the finite earth - there are not overwhelmingly too many future ‘neighbours’: is that not a mighty good way to ‘love’ them?

tonnes. This is about 20-fold (in the UK c 10-fold) more than saved by the other positive eco-actions, good though they are. Such calculations highlight how wrong it is to advocate only for poor people in the LRSs to have small families, thereby disregarding **climate justice, in a crisis which they suffer the most from, and for which they have had the least responsibility**. In this world of (in 2021) 7,900 million, the affluent *in any country* must NEVER use such advocacy as a diversion from consuming less to reduce their own excessive carbon footprints. The data makes it logical, rather, for the rich to be having small families, regardless of their ability to provide for an extra child, as in the voluntary guideline of a maximum of two children advocated by Population Matters <https://populationmatters.org/>.

Two facts are incontrovertible: our finite planet will not support unending growth; and once a mean TFR of 2 (or slightly higher, with current mortality rates) becomes the mean world family size, population growth will eventually cease. So why should it be controversial to propose that parental replacement fertility by two offspring becomes the accepted upper-limit norm, with full ‘ownership’ by Civil Society, everywhere?

The obstacles are massive, not least that in all settings, for probably most women and very many men, there is a feeling - often reinforced by culture and religion - that they cannot satisfy their parental instincts by having two children, leave alone just one. These instincts often trump, sadly, the altruism to change one’s preferences in the interests of posterity and the biosphere.

The obstacles are not insuperable: education is key: including population & environmental education and good use of media - see Box below. Out of over 80 climate change interventions *available now*, combining women’s education with voluntary family planning came second in Scenario 1 of *Project Drawdown*. <https://drawdown.org/solutions/health-and-education>.

That said, despite having, usually, higher education, many affluent couples - in all countries – are inexplicably uneducated environmentally, lacking a concept of finitude of the planet or the unsustainability of unremitting growth of human numbers. They can acquire this. It is patronising to suggest moreover that less prosperous and literate people lack the intelligence to do the same, if given the opportunity by education and the media - see Box - as indeed was demonstrated by interviews about adaptation to climate change in Ethiopia. www.bmj.com/content/bmj/353/bmj.i2102.full.pdf

Environmental and reproductive health education via the media

- *Sexual and reproductive health has been successfully promoted in many countries through radio and TV ‘soap operas’.* www.populationmedia.org
- *These long-running culturally-embedded dramas educate through their popular characters who are torn between good and bad influences.*
- *Studies show societal benefits: demeaning attitudes and abusive behaviour towards women are thereby changed and the listening audience discovers inter alia the benefits of family planning and small family norms.*
- *This “Sabido methodology” utilising “info-tainment” can also be used, as in Rwanda, to promote environmental conservation and sustainable agriculture.*

The affluent do at least have the means to be able to access contraceptives, unlike many in Africa, the continent of my birth. However the shocking incidence of unplanned conceptions in both teenagers and adults - 40% in the world and 49% in the affluent US - shows there is much more to it than access! Any contraceptive may fail. Any guideline on family size norms must never penalise large families. There must always be a good safety net for unintended/late-order births.

Crucially, to criticise parents at any level of affluence, anywhere, who have already had larger families is decidedly unfair if this environmental dimension was not remotely in their mind-set, having never previously been brought to their attention (however well-informed many of them are about almost everything else!).

How many wake-up calls does humanity need?

They come almost daily now, from Extinction-Rebellion and Greta Thunberg on each Friday-for-the-Future, all endorsed by the 99% of climate scientists who become collectively more frantic with each IPCC report, showing global warming increasing inexorably to or above 2 degrees Celsius, the level which poses an “existential threat to the human race”. Scary words, yet disregarded they cannot be. They are evidence-based. Among the most authoritative and most scary of alarms were:

World Scientists' Warning to Humanity - a First then a Second Notice (1992 repeated at +25 in 2017) - <https://academic.oup.com/bioscience/article/67/12/1026/4605229>

In 1992 the following was signed by over half of all living Nobel Laureates:

The earth is finite. Its ability to absorb wastes and destructive effluent is finite. Its ability to provide food and energy is finite....Pressures resulting from unrestrained population growth [Then: 5.4 billion. In 2017: 7.6 billion] put demands on the natural world that can overwhelm any efforts to achieve a sustainable future. If we are to halt the destruction of our environment, we must accept limits to that growth....No more than one or a few decades remain before the chance to avert the threats we now confront will be lost and the prospects for humanity immeasurably diminished.

In 1993 the Statement from the Science Summit on Population declared: *we must achieve zero population growth within the lifetime of our children.* www.interacademies.org/statement/iap-statement-population-growth

In 2017 over 20,000 scientists worldwide reiterated the urgency re population growth and signed off with: *To prevent widespread misery and catastrophic biodiversity loss, humanity must practice a more environmentally sustainable alternative to BAU 'business as usual'. This prescription was well articulated by the world's leading+ scientists 25 years ago, but in most respects, we have not heeded their warning. Soon it will be too late to shift course away from our failing trajectory, and time is running out. We must recognize, in our day-to-day lives and in our governing institutions, that Earth with all its life is our only home* (URL above).

An existential threat to all life, not only human life? A personal conclusion

It gives me zero pleasure to be proved right. There are now more than enough humans already born to comprehensively trash the habitats for plant and animal life in this fragile, beautiful blue and green planet before the end of this century. Climate change alone may suffice to make a major proportion of it uninhabitable. What is totally unavoidable and certain is an eventual return to some form of sustainability. Can we avoid “Nature’s route” to effecting this, as in Figure 1 and the quote from Maurice Strong?

Relevantly, in all the worst-case “perfect storms”, advocacy for birth reduction, through access to voluntary contraceptive care, does not cease to be crucial. It simply then becomes a last-resort measure, to reduce suffering. How? Through lowering possibly by billions the number of humans to die prematurely in later decades of this century, along with much other non-human life, through the expected mayhem: an apocalyptic mix of hellish heatwaves and hurricanes, firestorms, floods (of fresh- or sea-water), famines, pandemic diseases and violence with social collapse (See www.frontiersin.org/articles/10.3389/fcsc.2020.615419/full). Fewer humans born now to suffer in that ghastly future can only help.

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APPENDIX 1: Removal of the barriers to an individual's control of their fertility

[Updated summary, presented in 2007 by JG to Dr Damascene, Minister of Health of Rwanda, the country of my childhood].

The rapid fertility declines in many countries during the 1970s and 80s are attributable to voluntary family planning programs driven by overt concern about population numbers. Costa Rica, Cuba, Iran, Korea, Mexico, Sri Lanka, Taiwan, Thailand and SOUTH India (even) are examples of countries which reduced their Total Fertility Rate (TFR or “average family size”) to close to 2, replacement - **as quickly as China**, but through a rights-based approach and *without* the coercion that has featured in China.

What do these vastly different developing countries with initially very high TFRs have in common? Their governments recognized the population-poverty connection and *removed the barriers to family planning (FP)*. Vanishingly few women desire the biological maximum of children (> 8). Most want far fewer. So there is always some perceived *unmet need* (varied, often >25 % acc to Demographic Health Surveys). Also through education and the media, family size preferences can actually reduce.

Some barriers to optimal Reproductive Health (RH) plus FP provision (not a complete list!)

- **Pronatalism:** operating at a deep level through culture and increased by competition between tribal or religious groupings (“numbers give power”) or enlarging markets – affecting both genders but esp male.
- **Gender inequality and abuse. Also double standards:** “if my wife has contraception I won't be able to trust her not to go with other men” (Fact that he often goes with other women not seen as relevant!)
- **Religion:** mainly but not only Roman Catholic (RC), with Vatican prohibiting all but Natural Family Planning (NFP) which fails ++ because requires MUCH abstinence to work. [Yet another “double standard” here: in developed nations use of the non-NFP methods by RCs who have money is *same* as by non-RCs!]
- **Misinformation:** eg the Pill or injection permanently harm future fertility; or are adulterated (understandable as indeed reported in Sub-Saharan Africa (SSA) for *other* drugs); FP more dangerous than being ‘natural’ [yet life-time risk of dying from pregnancy is between 1:10 and 1:20 in SSA whereas is 1: 30,000 in Sweden where contraceptives are universally used!]
- **Deliberate disinformation:** eg condoms have tiny holes to transmit HIV.
- **Lack of supplies of contraceptives:** eg not available (or only condoms and sterilization), not accessible (husband or priest stopping use), not affordable (eg Implant, needs subsidy), and not predictably obtainable (supplies run out but sex continues!).
- **Perception that using condoms within marriage must mean “either you have HIV or you think I'm a risk to you”** [argues for availability of more effective FP like injections to be used AS WELL]

Removal of barriers

1. Benign government endorsement measures + education + the varied appropriate use of all Media

- **Women's education** helps much; but many **MEN need sex & gender RE-education** too! And **every human needs better ecological education**, to accept the finiteness of the planet and hence the eco-concept of replacement fertility (= a norm that family size should be no more than 2).
- **Media crucial:** both direct and indirect promotion, best using humour (eg Mechai's weekly radio chat-show in 1970s Thailand) and health-promoting radio ‘Soaps’. These info-tainments inform and *correct misinformation*, as popular characters discuss taboo issues (see www.populationmedia.org). The ‘morning-after pill’ can be discussed (even how to make it yourself from widely-available FP pills).
- Using **text-messaging** to give correct information, eg to counter rumours about FP side effects. Endorsement by “celebs” like football stars and TV personalities, and by peers – esp for the young
- Endorsement by religious leaders, re-examining the issues (eg in Iran they issued edicts that FP is NOT against the Koran): and saying in public that God wants us to have only the children we can properly care for, so FP is truly a good thing *not* sinful.
- Successful in Iran: *requiring couples to learn about family planning before obtaining a marriage licence!*

2. Resourcing of supplies – making a wider choice available, accessible and affordable.

- Removal of the “medical barrier” by direct social marketing of Pill and injections through dukas (small local shops). This IS good practice especially when combined with simple check-lists - and works!
- Means less reliance on sterilization, so people accept 'strong' long-acting FP methods (including IUDs *as appropriate*) at lower parity than they are bound to do when sterilization is so final.
- Vasectomy – can be a relevant option in Africa. As far back as 1987 ONAPO in Rwanda reported to the IPPF that more than 50 Rwandans had accepted this and were beginning to tell their friends about it....
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