



Scientists' warning to humanity: strategic thinking on economic development, population, poverty and ecological sustainability in the Mediterranean and beyond

Helen Kopnina¹ · Haydn Washington² · Ian Lowe³ · Sandy Irvine⁴

Received: 28 October 2019 / Accepted: 27 December 2019 / Published online: 4 February 2020
© Springer Nature Switzerland AG 2020

Abstract

At present, leading international agencies such as the United Nations Environment Programme are largely focused on what they claim to be win–win scenarios of ‘sustainable development’ rhetoric. These combine social, economic and environmental objectives. However, as noted in the World Scientists’ Warning to Humanity, environmental integrity is essential for the healthy functioning of social and economic systems, and thus environmental protection needs to be prioritized in policy and practice. Ecological sustainability cannot be reached without realizing that population growth and economic growth, with attendant increased rates of depletion of natural resources, pollution and general environmental degradation, are the root causes of *unsustainability*. This article argues that to strategically address ecological unsustainability, the social, economic and political barriers to addressing the current economic model and population growth need to be overcome. Proposed strategic solutions to the current neoliberal economy are generic, namely degrowth, a steady-state economy, and a ‘circular economy’. Solutions to demographic issues must be sensitive to the countries’ cultural, social, political and economic factors to be effective, as fertility differs from country to country and from culture to culture. As discussed here, Mediterranean countries have the lowest fertilities in the world, while many countries in Africa and some in Asia and South America have stable but consistently high birthrates. This is discussed using three case studies—Tanzania, Italy and Cambodia, focusing on ‘best case’ policies that offer a more realistic hope for successful sustainability.

Keywords Circular economy · Overproduction · Overconsumption · Population growth · Sustainability

Introduction: what is *unsustainability*?

Several studies have charted a long history of ‘growth criticism’ (Hayes 1976; Kassiola 1990; Smith 1979). The problems of endless growth on a finite planet were recognized as long ago as Marsh (1864) and repeated by Vogt (1948),

Boulding (1966) and Ehrlich (1968). However, in the 1970s, Meadows et al. (1972) pushed the ‘limits to growth’ perspective into the public arena, which has been revisited many times since (Wallich 1982; Turner 2008, 2014). Several scholars—perhaps most of all Georgescu-Roegen (1971) and Herman Daly (1991, 1996)—critiqued, in particular, the fundamental assumptions shared by otherwise rival schools of economic thought, ranging from Marxism to monetarism.

Such analysis highlighted that increases in the human population are the critical driver of environmental impact, normally as part of the so-called ‘I = PAT’ formula (Ehrlich and Holdren 1972; Ehrlich and Ehrlich 1991). In this, environmental impact is the product of the human population, per capita consumption (affluence) and technology (Ryerson 2010). Several studies have vindicated the fears expressed by ‘limits’ authors that the combination of these forces would generate a global crisis of unsustainability that could threaten the very viability of human society, as well as the survival of a myriad nonhuman species (e.g.

Communicated by Mohamed Ksibi, co-Editor-in-Chief.

✉ Helen Kopnina
h.kopnina@hhs.nl

¹ International Business Management Studies, The Hague University of Applied Sciences, Johanna Westerdijkplein 75, 2521 EN Den Haag, The Netherlands

² University of New South Wales, Sydney, Australia

³ School of Environment and Science, Nathan campus, Griffith University, 170 Kessels Road, Nathan QLD 4111, Australia

⁴ Newcastle, England

MEA 2015; Turner 2008, 2014). While some authors argue that population growth in poor countries is not a problem, as the poor consume less than the rich in Western countries (Wijkman and Rockström 2012), such assumptions do not take into account the fact that the world is no longer divided into ‘rich’ and ‘poor’ countries—the middle classes (and the consumption patterns associated with them) are growing especially rapidly in developing countries (Cafaro and Crist 2012). While Malthus did not predict that developments in medical and food production technologies would help sustain billions of people on Earth, the presence of ultimate limits on growth on a finite-resource planet cannot be discounted (Ehrlich and Ehrlich 1991). Also, people from developing countries increasingly (attempt to) migrate to richer countries, which is certainly understandable from human rights and social justice perspectives (Cafaro and Crist 2012). Beyond Malthusian concerns about potential conflict and starvation, the link between population and sustainability is also apparent for one biological reason—whether rich or poor, *Homo sapiens* is a relatively large omnivore, consuming other plant or animal species on a much larger scale than, for example, ants, which are more numerous than humans but are no threat to the rest of the world’s species. Simply put, this Earth is not able to support 8 billion omnivores indefinitely without endangering (wild) species or enslaving domestic ones through intensive feeding operations (Crist 2012).

However, the radical measures that were proposed to address the limits to growth gave way to a more optimistic belief in what has been described as a ‘balanced’ approach to the economic, social and environmental dimensions of sustainable development in the *Our Common Future* report (WCED 1987). In that report, sustainable development is described as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, p. 4). However, the optimistic balancing of economic, social and environmental objectives has not worked. Climate change and biodiversity loss—as testified by the Millennium Ecosystem Assessment (MEA 2015), the Intergovernmental Panel on Climate Change (IPCC 2019) and the IPBES (2019) report on extinction—demonstrate worsening conditions.

Following the First Warning to Humanity issued by a group of concerned scientists in 1992 (UCS 1992), the Second World Scientists’ Warning to Humanity signed by thousands of academic researchers in 2017 states that:

We are jeopardizing our future by not reining in our intense but geographically uneven material consumption and by not perceiving continued rapid population growth as a primary driver behind many ecological and even societal threats ... (Ripple et al. 2017).

One of the central issues is that of endless growth—particularly economic and population growth. Besides growth, the current sizes of our population and our global economy are the root causes of unsustainability. As Engelman (2016) has argued, even if it stopped growing now, our present production and consumption pattern is unsustainable. Thus, we should stop growing and then recede, demographically and economically. The question of population growth is a crucial one, simply because the more consumers there are, the more pressure there will be on the Earth’s life support systems. In the case of economic growth, suggested solutions include degrowth (e.g. O’Neill 2012) and the steady-state economy (Daly 1991, 2014). However, the population issue requires *country-level* solutions. This article will canvass the idea that understanding different countries’ barriers to addressing population growth might build on the generic warning to humanity. In that warning, Ripple et al. (2017) wrote that they:

... believe that prospects will be greatest if policymakers and the rest of humanity promptly respond to our warning and declaration of a climate emergency, and act to sustain life on planet Earth, our only home.

However, humanity seems to have been largely unable to act. Part of the difficulty is the fact that population growth is not the same in all locations. For example, some Mediterranean countries (Cyprus, Italy, Spain, Greece and Portugal) have the lowest fertilities in the world, while many countries in Africa and some in Asia, South America and the Middle East have stable but consistently high birthrates (above the replacement level of a total fertility rate below 2.1) (The World Bank 2017a). Campbell (2012, p. 46) points out that the issue of political correctness regarding population growth has caused the discussion of population growth to become taboo, with derogatory terms such as “Malthusian” and even “demographic” being used. Thus, the topic of population has become very politically loaded (Kopnina and Washington 2016; Washington et al. 2019). Why is it such a contested topic?

This article explores both issues: economic growth and population growth. We reflect on how we can best address environmental unsustainability and poverty through an effective, noncoercive population policy that is sensitive to social and cultural context. We propose a more nuanced and culturally/socially tuned-in reflection on how sustainable population levels may be reached. As this article will argue, demographic solutions must be voluntary and noncoercive, but cultural issues associated with reducing population growth must also be considered.

Economic growth and industrial development

The mantra of endless economic growth underpins neo-classical economics (e.g. Daly 1991; Washington 2014; Victor and Jackson 2015; Rees 2019). However, as noted above, many scholars have questioned the physical feasibility and social desirability of this. The fundamental alternative to growth-focused economics has been the steady-state economy developed by Daly (1991, 1996, 2014). A steady-state economy features three characteristics:

- A sustainable population size for the carrying capacity of its region (Daly 1991)
- A distribution of wealth that is fair and equitable on an intergenerational basis (Daly 1991, 2014)
- Low resource use (Daly 2014).

Czech (2013), Dietz and O'Neill (2013), Washington and Twomey (2016) and Victor (2019) have variously discussed the steady-state economy, ecological economics and degrowth. Reflecting on degrowth, O'Neill (2012) proposes that society can sustainably improve wellbeing but only by discarding GDP growth as the key goal in favor of more comprehensive measures of societal wellbeing.

It seems that 100% decoupling may be just wishful thinking that allows business-as-usual growth to continue (Wallich 1982; Turner 2008; Bithas and Kalimeris 2016, 2018; Washington and Twomey 2016; Kopnina 2019). There is also a debate on whether 'isms' such as capitalism, socialism and communism are compatible with meaningful sustainability, as these political systems remain committed to further economic growth (Washington 2015; Kopnina 2016).

Other ecological-economic models relate to growth, or how growth might be achieved. Chief among these is UNEP's (2011) green economy, the circular economy (building on the cradle-to-cradle approach) and 'doughnut' economics. As promoted by the Ellen MacArthur Foundation (EMF 2014), the circular economy supports further growth via absolute decoupling. However, this is impossible for material resources (Rammelt and Crisp 2014; Washington and Twomey 2016; Kopnina 2019).

The cradle-to-cradle framework (McDonough and Braungart 2002) poses that the current industrial system of production is unsustainable, but also argues that the focus on eco-efficiency and 'cleaning up the debris' does not consider the root cause of unsustainable production. Most products and packaging that are currently used are not made to be biodegradable or even recyclable, let alone infinitely reusable in a circular system in which no new raw material input is needed.

In her book *Doughnut Economics*, Raworth (2017) acknowledges the problems of growth but then states she is 'growth agnostic'. However, as endless population growth and economic growth are the root causes of unsustainability (Daly 2014), an ecologically sustainable economy needs to operate within ecological limits (e.g. Rees 2019). This would require an overall strategy of degrowth (O'Neill 2012) to a steady-state economy, with an ecologically sustainable population and low resource use (Daly 1991). However, while it is true that growth itself cannot be sustained indefinitely on a finite planet, if we had a steady-state economy and population that overwhelmed the capacity and resilience of natural resources, ecosystems and species, these two influences would be unsustainable at their steady-state scales.

Overproduction, overconsumption and poverty

Following the devastation of the Second World War, the USA and Western Europe specifically focused on the expansion of a consumer economy as well as job creation (Assadourian 2013). The subsequent growth in population, consumption and resource use has caused pollution, rapid climate change and biodiversity loss. Critical scholars have noted that the idea of poverty alleviation through economic growth is a euphemism for a transition to an industrial consumerist monetary economy, which is entirely unsustainable in the long term (Daly 1991; Crist 2012). In the context of decolonization and "developing" countries, it was assumed that economic growth would solve poverty, as a 'rising tide will lift all boats' (Johnson et al. 2011). This assumption has been used to justify the excesses of overproduction and overconsumption (e.g. McDonough and Braungart 2002; Daly 1991).

While promoting growth appears to be an almost costless pursuit, the recurring issue is whether this growth reaches the poorest and most vulnerable sectors of society (Johnson et al. 2011). Often, economic growth only seems to benefit the rich or the corrupt as the 'trickle-down effect' is weak, so it does not reduce overall poverty (Ravallion 2001). Poverty due to unemployment is not going to be solved by economic growth, as unemployment occurs due to improvements in technology, automation, and the increasing need for fewer but more highly skilled professionals (Johnson et al. 2011).

Critics have also noted that economic growth cannot solve the root causes of poverty, especially considering that population growth accentuates the challenges of poverty (Washington and Twomey 2016; Washington and Kopnina 2018). Economic growth has resulted in rising income disparities, ignoring the disadvantages women face in many societies (Babacan 2010). The disadvantaged position of women has also often meant that they have no access to family planning,

resulting in unwanted pregnancies and population growth (Engelman 2016; Crist et al. 2017; Lamme et al. 2017). This is not to suggest that gender equality should take priority over other barriers to demographic change or environmental management actions. However, as the literature examined here suggests, the reproductive rights of women and limits on their freedom to terminate unwanted pregnancies are crucially important for understanding population growth, as will be further expanded upon in this article.

Hence, we argue that governments should instead focus on and address the drivers of both population growth and economic growth. That means reducing overproduction and overconsumption, as these degrade the Earth's life support systems, which all of us (especially the poor) rely upon (Washington 2015).

The population question

Population was raised as an issue by Thomas Malthus more than 200 years ago (Malthus 1826 [1798]). Paul Ehrlich (1968) pushed this issue back into the public arena, generating renewed controversy. What is new is the *resistance to* the idea that population pressure causes social and environmental problems (Kopnina and Washington 2016; Washington et al. 2019). Some critics have argued that Malthus and Ehrlich have underestimated human ingenuity, especially regarding technological innovations in medicine, food production and pollution prevention. They suggest that the Earth is presently able to support over 7.7 billion people, and could potentially support 10 billion by 2050 (e.g. Lam 2011; UN 2019). There is a general assumption that the population question will solve itself through a demographic transition (critically discussed in Campbell 2012). Hence, most countries seem to ignore or deny the connection between environmental damage and population.

However, as many scholars note (e.g. Catton 1982; Ehrlich and Ehrlich 1991; Daly 1991; Brown 2011), the Earth does not have unlimited resources if both the economy and the human population keep expanding. Demographic and population expansion, in today's world, add to the risk of destructive interactions with these limits, many of which are already being felt at current population and economic scales. While medical and food production technologies already support a large and growing population, they have their limits on a planet of finite resources (Meadows et al. 1972; Mavrommati et al. 2006; Rees 2010). Currently, refugees are moving out of areas that cannot sustain them because local environmental tipping points have been exceeded due to a convergence of decades of higher than (the global) average population growth and a climate crisis that limits local food production and water supplies. One could argue that there is evidence that actual unsustainability is a driver of

emigration, as in the case of climate refugees. This is overlaid on local political and societal systems that have long histories of ethnic or religious rivalries (Holland 2019).

Population growth has been linked to multiple social and environmental issues, including poverty and environmental devastation due to the increased demand for natural resources (Meadows et al. 1972; UNFPA 1994; MEA 2015; Wijkman and Rockström 2012; IPCC 2019). However, only limited government action on population has been undertaken since the International Conference on Population and Development (ICPD) held in Egypt in 1994. Little action has been taken because it was assumed that a demographic transition would take place universally that would decrease fertility rates across the world, so the population issue would solve itself (Campbell 2012). This theory posits a transition from high birth rates and high infant death rates to low birth rates and low death rates as societies become wealthier. The lack of government concern about population growth and their unwillingness to spend money on a controversial arena of health care that some powerful political constituencies object to have prevented further action.

However, while the shift to low birth rates has occurred in many industrialized countries, and global mortality rates of mothers and infants have decreased, as reported by the World Health Organization (WHO 2018), demographic transition theory does not appear to apply globally. This is due to specific social, political and economic factors (Campbell 2012). While medical advancements have become universal, saving millions of lives, and GDP has risen across the world, including in poorer countries (The World Bank 2017a), not all countries have low birth rates. There are various possible reasons for this.

Some governments have provided access to family planning information and services, as recommended by ICPD conference resolutions (UNFPA 1994). However, the statistics indicate a population increase of more than two billion people between the time of that conference and the writing of this paper—the global population was around 5.5 billion in 1994, it exceeded 6 billion around 1998 or 1999, and is 7.7 billion today (The World Bank 2017a). We point out that it is significant that influential international agencies such as the United Nations and global financial institutions such as the International Monetary Fund (e.g. Kunmakara 2017) and The World Bank (2019b) assume that an increasing population is connected to economic growth, which in turn, is also seen as a good thing (Kopnina and Washington 2016).

While some of these international agencies recently seem to have realized that population growth might be more of a curse than a boon (The World Bank 2017a), even for economic growth, the global rhetoric of the population question remains overwhelmingly optimistic, so there is no concerted effort to address population growth as a problem (Kopnina and Washington 2016; Washington et al. 2019).

It has been argued that it is part of human nature to increase in number when food and medicine are readily available (Rees 2010; Salmony 2019). However, not all humans (or, for that matter, all cultures) behave the same in the age of effective contraception. Another significant issue with an increasing population is the lack or poor availability of contraceptives or a knowledge of how to obtain or use them, particularly in developing countries (Chipeta et al. 2010; Wijkman and Rockström 2012) and in communities with lower economic status in developed nations (Kelly and Fernandez 1993; Lamme et al. 2017). In some cases, there is a lack of basic human/women's rights (e.g. Ratcliffe 2018) that could protect against child bride marriages (Ezer et al. 2006). These occur at a remarkable level of 39,000 a day (UN 2013) and often result in millions of unwanted pregnancies (Wijkman and Rockström 2012; Engelman 2016; Crist et al. 2017; Lamme et al. 2017). Other factors concern cultural or religious taboos against using contraception that promote large families (Chipeta et al. 2010; Sultan 2018).

Additional reasons are identified in the volume *Life on the Brink: Environmentalists Confront Overpopulation* (Cafaro and Crist 2012). This volume has many thoughtful contributions to the issue of population and underlines the realization that human expansion seems to have resulted in a denial of population growth. This is expressed as a crisis of perception in which humanity seems so

“ill-informed of its actual situation, so mesmerized by the imperative of infinite expansion, so deeply in denial of its suicidal trajectory, that it celebrates hitting seven billion ... and looks forward to adding another two or three billion by the end of the century” (Hawkins 2012, p. 202).

The authors of the chapters in Cafaro and Crist (2012) are correct to point out that population growth is a major force behind our most serious ecological problems. However, the question of policy in various countries, or the fact that in some countries the birth rates have not declined—is not discussed in detail in that book. One of the issues is that, simply put, population growth is distributed unevenly across the globe. In some countries, notably most sub-Saharan countries, women have more than 7 children on average (World Population Review 2017; UN 2019); however, as predicted by demographic transition theory (Campbell 2012), there are also countries below the replacement level, including Albania, Bahrain, Belarus, Bosnia and Herzegovina, Georgia, Iran, Italy, Japan, Korea (South), Lebanon, Macau, Malta, Portugal, Qatar, Russia and Australia (World Population Review 1997). The fertility rate in Niger (West Africa) is 7.1, but women on the Mediterranean island of Cyprus are having, on average, just one child (Gallagher 2018; UN 2019).

When discussing population growth, it is important to carefully consider exactly what it is that differentiates countries with high fertility rates. This subject is particularly sensitive in developing countries, as accusations of racism and Western colonial ‘meddling’ are commonly made, especially when it comes to limiting childbirth (even when noncoercive measures are explicitly proposed). A dialogue is thus especially important, since population growth has recently become a taboo topic that is charged with political correctness (Campbell 2012; Kopnina and Washington 2016). Some population-related policies, such as the one-child policy in China (The Economist 2016) and the former sterilization policy in India (Biswas 2014), have caused protests by human rights groups (Biswas 2014; The Economist 2016). Clearly, from almost *any* moral/ethical standpoint, *coercive* population measures can be seen as inhumane. Yet, the issue is not so much about misguided coercive policies but a total lack of *any*—voluntary, humane, noncoercive, positive—policy at all. Indeed, some countries actively stimulate greater population growth. One can argue that, historically, most of the coercion has been directed towards women—forcing them to have more children than they want due to limitations on birth control and abortion restrictions.

In some countries, having children is seen as a great investment in the economy, the military, etc. In many countries, high fertility is seen as a good thing, as demonstrated by the pro-natalism policies evident in, for example, France (Deutsche Welle 2005), Scandinavian countries (The Local 2019), Spain (BFSC 2007), Germany (Kirschbaum 2007), Russia (Theroux 2017), Canada (Serebrin 2018) and Chile (BAT 2019). Generally, higher population growth is seen as good for economic growth (which in itself is a problem if sustainability challenges are to be addressed). A young labor force is perceived as supporting pensioners or providing more people for the army, enhancing a military advantage over other countries.

It is important to get around this problem by stimulating noncoercive measures of family planning that can benefit both the planet and future generations of humans and non-humans. One suggestion is provided by Eileen Crist (2012, p. 146), who has looked at the ‘best case studies’ of policies in countries like Iran:

In numerous countries where such measures have been spearheaded by governments, backed financially and implemented competently, fertility rates swiftly declined. Iran is perhaps the most striking case of the results of a successful population policy: from an average of 5.5 children per woman in 1988, fertility declined to 1.7 in 2009. The catalyst for this transition was the reinstatement of Iran's family planning program in 1989, coupled with an educational, cultural and healthcare crusade to encourage and enable the

choice of smaller families. Among other measures, this all-out effort included the creation of fifteen thousand health clinics to service rural populations, a campaign to raise women's literacy, media programming to raise consciousness and disseminate information, and the provision of all forms of birth control free of charge (Brown 2011 in Crist 2012, p. 146).

When examining this successful policy, it is useful to understand the social and cultural climate that existed in Iran prior to the introduction of this policy, the types of motivation used by local politicians, the media, how was the policy translated into a publicly shared understanding and actual practice, and how the policy was received (to ensure its long-term effects). In the well-documented case of Iran, there was a concerted approach that included education at all levels, the provision of family planning advice and contraceptives, the removal of financial incentives for large families, and even the inclusion of religious leaders to avoid a perception that limiting family size was inconsistent with the teachings of Islam (Derer 2019a).

A similar concerted approach successfully reduced the rate of population growth in Tunisia (Fig. 1) to replacement level (Derer 2019b). As in Iran, the education of women, the provision of family planning services and the enlistment of the support of religious leaders for what was described as a modern version of Islam were critical to the success of the program. These concrete examples show that culturally sensitive and intelligent policy that incorporates a long-term vision of both ecosystem and human wellbeing can succeed in stabilizing the human population in a developing country.

There are some other positive signs. Even organizations that were previously only interested in stimulating economic growth and industrial development in developing countries are starting to be more population conscious (Gates Foundation n.d.; however, we note that the Gates Foundation remains primarily focused on human welfare, as their slogan 'all lives have value' does not extend to billions of nonhuman beings). These include the World Bank (2017a), the



Fig. 1 Tunisian family

IMF, and some NGOs that were formerly only concerned with improving the health and the economic position of poor people. However, we suggest that greater consideration of the cultural backgrounds of countries with high population growth rates is needed.

Noncoercive, voluntary solutions to reduce population growth

Robert Engelman (2016) has proposed several excellent non-coercive solutions to reduce population growth:

1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes
2. Guarantee education through secondary school for all, with a particular focus on girls
3. Eradicate gender bias from the law, economic opportunity, health, and culture
4. Offer age-appropriate sexuality education for all students
5. End all policies that reward parents financially if they are based on the number of children they rear
6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels
7. Put prices on environmental costs and impacts
8. Adjust to population ageing rather than trying to delay it through government incentives or programs aimed at boosting childbearing
9. Convince leaders to commit to ending population growth by exercising human rights and human development.

A key question is: how have these proposed solutions been received? Similarly, to what extent are these policies applied by governments? Table 1 indicates whether each solution is being applied in the three countries researched.

Considering Engelman's nine solutions for three case studies (Tanzania, Italy, Cambodia)

Explanations of the responses for each case study are shown in the "Appendix".

Discussion of the case study results

The three countries discussed above are interesting examples to test Engelman's (2016) nine solutions. In regard to Tanzania, the environmental outlook for this country is clearly unsustainable (The World Bank 2019b), as it has a high birth

Table 1 Implementation of the nine solutions to reduce population growth, as suggested by Engelman, in three countries: Tanzania, Italy and Cambodia (data obtained from research on the internet; see the “Appendix”)

Solution	Tanzania	Italy	Cambodia
1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes	No	Yes	No
2. Guarantee education through secondary school for all, with a particular focus on girls	No	Yes	Debatable
3. Eradicate gender bias from the law, economic opportunity, health, and culture	No	Mostly	Debatable
4. Offer age-appropriate sexuality education for all students	No	No	Debatable
5. End all policies that reward parents financially if they are based on the number of children they rear	Debatable	No	Debatable
6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels	No	Debatable	No
7. Put prices on environmental costs and impacts	No	Unlikely	No
8. Adjust to population ageing rather than trying to delay it through governmental incentives or programs aimed at boosting childbearing	No	No	No
9. Convince leaders to commit to ending population growth by exercising human rights and human development	No	No	No

rate (5.2 babies per woman) that leads to an annual population growth rate of 3% (Worldometer 2019a), with 63% of the population aged 24 or below (Omondi et al. 2019; UN 2019). Among the nine suggested solutions, only solution five could be considered to be implemented in Tanzania, and even this is debatable given that the government actually encourages more births, although this encouragement is not financial in nature. The ‘bride price’ system in Tanzania encourages child marriages and associated high birth rates (Girls Not Brides 2017), and appears to be a cultural practice that strongly supports ongoing population growth. Notably, only 32% of the country’s households use any form of contraception, though many women express a desire for it that remains unmet. It is projected that by 2050 the population of Tanzania could rise from 58 to 138 million (The World Bank 2019b). Population growth in Tanzania is out of control, and while NGOs struggle to assist, the government is failing to attempt to stabilize this.

An obvious problem is the attitude of the government. Fertility rates have come down from almost 7 in the 1960s to the present level of 5.2 (The World Bank 2019a; UN 2019). However, in 2018, Tanzanian President Magufuli said that Western governments with ‘their family planning’ should not meddle in population affairs, and actually urged Tanzanian citizens to have more children (BBC News 2018). As is clear from news articles, the Tanzanian President assumes that having more children is not counterproductive to reducing poverty—that a larger population will in fact serve the economy the way he thinks it did in China and Nigeria (Ng’wanakilala 2019). Ironically, he forgets about China’s one-child policy, which has only recently been altered, and about the fact that the >175 million-strong population of Nigeria is one of the world’s poorest and most unequal (The World Bank 2019a). Magufuli seems to believe that having a larger population will help stimulate economic growth and

lift people out of poverty (Ng’wanakilala 2019). He reassures citizens that they are safe to have more children in his supposedly healthy economy by denying free access to contraception (Ratcliffe 2018), despite data from the UN Population Fund (UNFPA) showing that Tanzania’s population is growing by about 2.7% a year while most public hospitals and schools are overcrowded and many young people lack jobs (Ng’wanakilala 2019). Tanzanians’ own perceptions (prior to the present President’s ‘stimulus package’) (e.g. Mosha et al. 2013) as well as limitations on access to health care (Mbeba et al. 2012), perceptions of early marriages (Mosha et al. 2013) and the social acceptability of certain sexual behaviors (Stark 2013) in Tanzania may all be contributing to the relatively high birth rate in this country.

Italy provides an interesting case study, as its population is officially in slow decline, though this may reflect poor statistics on the extensive influx of illegal immigrants. Indeed, the Italian government is seeking to boost childbirth (Wyatt 2018). However, despite government policy, the Italian TFR remains one of the lowest in Europe at 1.34 children per female. The most interesting aspect of the nine Engelman strategies for Italy is that *only the first three are actually implemented* (and the third not fully so). This suggests that the first three solutions are key to slowing population growth and then stabilizing the population. In an email, Engelman (2019, personal communication, 21 October) suggested that nonstrategic factors are the main reasons for the low fertility in Italy and some other countries—especially a lack of housing, the realization by women of the unfairness of male refusal to bear childrearing and housekeep burdens, etc. Thus, access to contraception (and safe and legal abortion) is essential, but it must be combined with a strong interest by women in not having more pregnancies and births than they desire (R Engelman, 2019, personal communication, 21 October). It should be noted that environmental education

(solution six) is improving in Italy, but it is clear that the low TFR in this country is not due to environmental education, as it has only been implemented for a few years. The same applies to the repricing of environmental costs—changes are underway, but it is hard to say how serious those changes are. They have clearly not caused the low TFR. Although Italian society may be adjusting to population ageing, it is apparent that the Italian government has no formal programs to facilitate this (at least at this stage). Also, while the Italian Department of the Environment is encouraging green growth and the green economy, both are arguably dubious in terms of their ability to sustain the environment (Twomey and Washington 2016; Washington and Maloney 2020). Overall, the results of the case study of Italy suggest that the first three of Engelman's solutions are the most critical for stabilizing the population, while the other solutions can help Italy to become more sustainable as a society without necessarily being essential for population stabilization.

The horrendous genocide of the Khmer Rouge regime claimed two million Cambodian lives out of a population of just over 8 million between 1975 and 1979 (Fitch 2015). Cambodia's population has been recently on the rise, reaching over 16.5 million in 2019 (World Population Review 2019). In 2016, its youth aged between 10 and 24 comprised 35% of its population (UNFPA 2016a, b). The recovery and rise in population are still greeted as signs of political, economic and social success in overcoming the recent traumas of war, and also as a boon—a 'demographic dividend'. This term refers in this case to the (incorrect) perception of a high birth rate as a driving force for financial development, although it can also refer to the reduction in the dependency ratio caused by decreased fertility (Kunmakara 2017).

We suggest that without talking about birth rate, policy and cultural differences between countries, the generic recommendation to curb population for the sake of future generations (not to mention the environment) will not work. Tanzania has a 3% growth rate (Worldometer 2019a) while Cambodia has a 1.46% growth rate (Worldometer 2019c); Italy, in contrast, has a slightly negative growth rate (Worldometer 2019b). It is clear that family planning and contraceptive use is low in Tanzania and Cambodia (as it is not strongly supported by the government) and that child bride marriage is common, with bride price driving this practice. Italy has virtually no (legal) child bride marriages and has excellent access to contraceptives and family planning plus guaranteed access to female education. Italy has also largely addressed the worst aspects of gender bias, while Tanzania has not done so, and Cambodia has only partially addressed them.

From these case studies, it seems clear that there are major cultural barriers in Tanzania and Cambodia that keep population growth rates high. The key cultural practice is child bride marriage, and one can only wonder what a

difference it would make if this was made illegal. The other obvious problem in Tanzania and Cambodia is poor access to contraceptives and family planning, in part due to the failure of their governments to support them. The failure to educate girls in Tanzania and Cambodia is also clearly a major problem, along with the failure to eradicate most gender bias. It is notable that NGOs seem to represent the positive path for change to reduce cultural barriers in both Tanzania and Cambodia. Understanding such cultural barriers is crucial to successfully implementing Engelman's (2016) nine noncoercive solutions to overpopulation.

In addition to these solutions, the cases above warn us to be sensitive to social and cultural contexts. There can be traditional or religious taboos against using contraception or a historical and political background that influences the positive perception of having a large number of children. In Cambodia, for example, which has suffered war and genocide, having children can also be seen as a symbol of literal 'revival' or 'regeneration'. In the case of Tanzania, the traditional practice of child bride marriages and teenage pregnancies conflicts with what can be seen as a Western idea of basic human/women's rights.

The cases of Italy, Iran and Tunisia, which may be considered 'best practices' for lowering fertility to some degree, require an understanding of the roles of local politicians, the media and public perceptions in encouraging smaller families. We suggest here that intelligent and humane policy that is sensitive to country and cultural contexts is needed to achieve a global reduction in population growth. The successful case studies listed above reinforce Lowe's (2016) conclusion that the birthrate is low in countries where women are well educated, secure and in control of their fertility.

Conclusion

We note that past and present growth in population, consumption, resource use and the economy are the key drivers of unsustainability, and that degrowth, the steady-state economy and the circular economy (and the cradle-to-cradle vision) offer solutions for reorienting our economy to one that is ecologically sustainable because it operates within ecological limits.

Regarding population, we praise Engelman (2016) for his nine noncoercive solutions to population growth. However, his strategies, arranged in order of what he perceived to be decreasing effectiveness, require more evidence in order to measure their strength and to identify which of them matter the most (R Engelman, 2019, personal communication, 21 October). However, the case study of Italy suggests that the first three strategies are most important for stabilizing the population. This is consistent with Lowe's (2016) criteria.

The cultural practice of child bride marriage in Tanzania and Cambodia is clearly a key barrier to reducing population growth. This could be addressed by introducing a government ban, or perhaps more successfully by changing what society deems to be acceptable, which could be catalyzed by the education of girls to at least to full secondary level. Education of girls (and their families) thus remains essential (Crist et al. 2017). However, there is a clear political block in Tanzania and Cambodia regarding support for readily available contraceptives and family planning and for eliminating the worst aspects of gender bias. The UN and international organizations can play a role, but national governments and educational campaigns, as well as local media, need to be leaders in this change.

In the case of population growth, we note the fact that birthrates are not equal throughout the world. While the Tanzanian and Cambodian governments might be convinced that having more children is good for their countries, if the citizens themselves can be educated and helped to change, the birthrates in those countries may reduce markedly. We believe that statistics of poverty, mortality and unemployment do not lie, and that smaller families *do* indeed tend to be healthier, wealthier and certainly much better for the environment. In this regard, some of the countries in the Mediterranean present good examples of best practices. We thus suggest that greater consideration of the cultural backgrounds of countries with high population growth rates is needed. Translating the Scientists' Warning to Humanity into culturally acceptable rhetoric is, however, an ongoing challenge.

Funding There are no funding sources to declare for this research.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix: Details of case studies

(A) Tanzania (Fig. 2)

1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes.

No Tanzania's President has urged women to stop taking birth control pills, saying the country needs more people (BBC News 2018). Currently women have more than 5.2 children on average, one of the highest fertilities in the world (MoHCDGEC et al. 2016). Japhet (2018) states that only 32% of the country's households use any form of contraception. Sixty-one percent of married women aged 15–49 want



Fig. 2 Tanzania

to avoid pregnancy, but of those women, 22% are not currently using family planning, and the percentage of women who want to avoid pregnancy but are not using contraceptives has remained constant at around 22–24% since 1999 (Brasileiro 2018). The availability of contraception remains problematic (Mosha et al. 2013; Ratcliffe 2018).

2. Guarantee education through secondary school for all, with a particular focus on girls.

No The secondary school enrolment rate in Tanzania is as low as 31%, and the percentage for girls in Tanzania is even lower. An estimated 5.1 million children aged 7–17 do not attend school. Only 52% of the children in Tanzania are enrolled in secondary school, and even fewer complete it. The World Bank reports that less than one-third of all girls in Tanzania graduate. One of the greatest obstacles to the education of girls is that a child may have to walk up to 2 h to attend school (Hine 2018). Another obstacle to the education of girls is *child bride marriage*. Two of every five girls in Tanzania are married before they turn 18. This inevitably leads to young pregnancies and thus the need to drop out of school (ibid).

3. Eradicate gender bias from law, economic opportunity, health, and culture.

No The FAO (2014) notes that Tanzania is primarily a rural nation, and women in rural areas are often disadvantaged in terms of decent work and income-generating opportunities owing to limited access and control over resources. USAID (2019) notes that Tanzanian women and girls remain among the most marginalized and underutilized citizens in sub-Saharan Africa.

4. Offer age-appropriate sexuality education for all students.

No Tanzania has one of the youngest populations in the world, with 63% of the population aged 24 or below

(Omondi et al. 2019). Young people in Tanzania are interested to learn about topics such as sexual decision-making, sexual pleasure and contraception, but only the topic of HIV/AIDS and other sexually transmitted infections is covered by the Tanzanian school curriculum (ibid).

5. End all policies that reward parents financially if they are based on the number of children they rear.

Debatable While the Tanzanian President encourages more births (BBC News 2018), there does not appear to be a financial reward for doing so *from the government*. However, 37% of girls in Tanzania are married before their 18th birthday, largely because of family poverty and the fact that the bride price helps families economically (Girls Not Brides 2017).

6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels.

No Makundi (2003) notes that the school curriculum is not adequately implemented due to the poor definition of environmental education in early policy documents. Palangyo (2007) points out that environmental laws do refer to ‘environmental education’, but these laws do not adequately address environmental issues. Beatus and Mzinga (2008) note that education authorities have failed to integrate environmental education into the formal education system. There is no reference to ‘population’ in the above references. While good work is being done by environmental NGOs, there is little integrated teaching about population and environment in the curricula (AAEA 2017).

7. Put prices on environmental costs and impacts.

No The World Bank Group (2019, p. 16) notes that Tanzania might be shifting toward an unsustainable development trajectory, but there is no reference to environmental pricing being used in Tanzania other than the Equitable Payments for Watershed Services scheme in the Uluguru Mountains.

8. Adjust to population ageing rather than trying to delay it through governmental incentives or programs aimed at boosting childbearing.

No The Tanzanian President is promoting higher birth rates (BBC News 2018), and Tanzania has a TFR of 5.2.

9. Convince leaders to commit to ending population growth by exercising human rights and human development.

No Tanzania’s President is encouraging further population growth (BBC News 2018). Also, the poor record of Tanzania in regard to gender equity indicates that it is not promoting human rights (nor considering its environmental degradation, the ‘rights of nature’).

(B) Italy (Fig. 3)

1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes.

Yes In 2013, The World Bank (2013) reported that 65% of women aged 15–49 used contraceptive methods. However, it has been reported by Statista (2019) that this was 95% in 2018.

2. Guarantee education through secondary school for all, with a particular focus on girls.

Yes, secondary education for all, though there is no specific focus on girls. 96% of women in Italy undertake secondary education and 72.4% undertake tertiary education (World Economic Forum 2018, p. 188).

3. Eradicate gender bias from law, economic opportunity, health, and culture.

Mostly While the legal infrastructure to promote gender equality is in place in Italy, there is insufficient help for many women to combine paid work with caring for children, and wage gaps continue to be significant (up to 25%). The Italian fertility rate is one of the lowest in the world. It is claimed that increasing accessibility to childcare, in terms of both affordability and regional availability, will help mothers to enter the workforce earlier (WikiGender n.d.).

4. Offer age-appropriate sexuality education for all students.



Fig. 3 Italian family

No, as Italy is one of the few EU member states where sex education is *not* compulsory, and to date there has been no law enacted on the matter. As such, sexuality education is still not formally part of any teaching and education ministerial program. The consequence is that initiatives and activities remain uneven across the country and dependent on the willingness of and financial capacity of schools, associations and nongovernmental organizations to provide this education (GENPOL 2018). This does not mean that there is not significant sexuality education taking place, only that it is not being promoted by the government.

5. End all policies that reward parents financially if they are based on the number of children they rear.

No, as Italy's right-wing government is now offering plots of state-owned land to be managed by families for 20 years if they have a third child between 2019 and 2022 (Wyatt 2018).

6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels.

Debatable Change does seem to be occurring, as environmental education became a compulsory subject from nursery to upper secondary education in 2017. It is said that the program will range “from the recycling of waste to the protection of the sea and the territory, from biodiversity to sustainable food” (ANSA 2015). However, there is no mention of whether it will teach about the relationship between *population* and the environment. A National System for Environmental Education, Information and Training (INFEA) has been established with 140 Environmental Education Centres (IMET 2015).

7. Put prices on environmental costs and impacts.

Unlikely, though some changes may be afoot. In 2016, UNEP and the Italian Ministry for the Environment published the document *Financing the Future* in which it was claimed that “a shift towards sustainable finance is underway” (UNEP 2016), albeit without focusing on population or reducing consumerism (Twomey and Washington 2016). The other focus of this document is climate change and renewable energy. The report concludes that it is a “first milestone in what must become a robust ongoing process”.

8. Adjust to population ageing rather than trying to delay it through governmental incentives or programs aimed at boosting childbearing.

No, the Italian government is lamenting what it sees as its flagging birthrate and is seeking to boost childbirth by

offering land to families if they have a third child (Wyatt 2018).

9. Convince leaders to commit to ending population growth by exercising human rights and human development.

No, the Italian government is clearly not trying to convince leaders in business or the community to end population growth. Rather, it is seeking to reinstate more growth (Wyatt 2018).

(C) Cambodia (Fig. 4)

1. Assure universal access to a range of safe and effective contraceptive options and family planning services for both sexes.

No Despite the increase in contraceptive use in Cambodia over the last decade, it has the lowest contraceptive prevalence rate in Asia (PRB 2003), with the unmet needs of family planning among the general population consistently high (Nakaie et al. 2014; WHO 2017). Almost one in five girls in Cambodia are married before their 18th birthday, and 2% are married before the age of 15 (Girls Not Brides n.d.).

2. Guarantee education through secondary school for all, with a particular focus on girls.

Debatable While efforts to provide universal education have been made countrywide, there are high (rural) school dropout rates, and gender inequality in access to education remains poor (Velasco 2004; No et al. 2016; OECD



Fig. 4 Cambodia

(n.d., 2018). The Cambodian government has, however, attempted to eliminate gender disparities in access to education (Open Development 2019).

3. Eradicate gender bias from law, economic opportunity, health, and culture.

Debatable Cambodia has made some progress in addressing women's rights and adjusting laws (Licahdo 2014), is striving towards gender equality in the labor market (ADB 2013), and is providing more equal economic opportunities (ADB 2015) as well as greater access to healthcare (WHO 2015). As far as "cultural services" are concerned, the situation is unclear, and there is gender bias in Cambodia and violence against women (Eisenbruch 2018).

4. Offer age-appropriate sexuality education for all students.

Debatable Access to quality sexual and reproductive health education for adolescents and youth remains limited in Cambodia (UNFPA 2016a, b). This limited access to sexual education is compounded by other factors that restrict educational opportunities, as mentioned above (Velasco 2004; No et al. 2016; OECD 2018).

5. End all policies that reward parents financially if they are based on the number of children they rear.

Debatable No such government policies seem to be in place. Intergenerational relations and financial support are still ad hoc and family-based (ILO 2006; OECD (n.d., 2017; OECD Development Centre 2017). However, child bride marriage is a cultural assister of population growth, as it provides financial assistance to the girl's family.

6. Integrate teaching about population, environment, and development relationships into school curricula at multiple levels.

No Some progress has been made on environmental education, but the environment and population are not really discussed (Smith and Bunthan 2016).

7. Put prices on environmental costs and impacts.

No The Cambodian government seems mostly concerned with economic development (OECD n.d.; UN 2012).

8. Adjust to population ageing rather than trying to delay it through governmental incentives or programs aimed at boosting childbearing.

No There is no indication of such a shift (OECD 2017).

9. Convince leaders to commit to ending population growth by exercising human rights and human development.

No There is no indication in the literature that population growth is linked to the issues discussed above.

References

- AAEA (2017) Environmental education in Tanzania. Arizona Association for Environmental Education. <https://www.arizonaee.org/ee-around-the-world/environmental-education-tanzania/>
- ADB (2013) Gender equality in the labor market in Cambodia. Asian Development Bank. <https://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1349&context=intl>
- ADB (2015) Promoting women's economic empowerment in Cambodia. Asian Development Bank. <https://www.adb.org/sites/default/files/publication/156499/promoting-womens-economic-empowerment.pdf>
- ANSA (2015) Educazione ambientale sarà obbligatoria a scuola. Agenzia Nazionale Stampa Associata. http://www.ansa.it/web/notizie/canali/energiaeambiente/istituzioni/2015/01/14/educazione-ambientale-sara-obbligatoria-a-scuola__cc6fd18e-37fa-4b63-8048-b91ad282f4d3.html
- Assadourian E (2013) Re-engineering cultures to create a sustainable civilization. In: Starke L (ed) State of the world 2013: is sustainability still possible?. Island, Washington, DC
- Babacan H (2010) Women and development. Peace Econ Peace Sci Public Policy V:364–381
- BAT (2019) Piñera announces law to motivate Chileans to have more children. Buenos Aires Times. <https://www.batimes.com.ar/news/latin-america/pinera-announces-law-to-motivate-chileans-to-have-more-children.phtml>
- BBC News (2018) Tanzania's President Magufuli calls for end to birth control. <https://www.bbc.com/news/world-africa-45474408>
- Beatus D, Mzingi M (2008) Integrating environmental education into formal education systems of Tanzania. Masters thesis. Institute of Rural Development Planning, Dodoma. https://www.academia.edu/6339035/ENVIRONMENTAL_EDUCATION_Article
- BFSC (2007) Spain adopts a baby bonus. Barcelona Field Studies Centre. <https://geographyfieldwork.com/SpainBabyBonus.htm>
- Biswas S (2014) India's dark history of sterilization. BBC News. <https://www.bbc.com/news/world-asia-india-30040790>
- Bithas K, Kalimeris P (2016) Revisiting the energy—development link: evidence from the 20th century for knowledge-based and developing economies. SpringerBriefs in Economics. Springer International, Cham
- Bithas K, Kalimeris P (2018) Unmasking decoupling: redefining the resource intensity of the economy. *Sci Total Environ* 619–620:338–351
- Boulding K (1966) The Economics of the Coming Spaceship Earth. In: Jarrett H (ed) Environmental quality in a growing economy. Resources for the Future/Johns Hopkins University Press, Baltimore, MD, pp 3–14
- Brasileiro J (2018) Tanzania could see big returns on family planning investments. VITAL. <https://www.intrahealth.org/vital/tanzania-could-see-big-returns-family-planning-investments>
- Brown L (2011) World on the edge: how to prevent environmental and economic collapse. W.W. Norton and Co., New York

- Bruner AG, Gullison R, Rice E, da Fonseca GAB (2001) Effectiveness of parks in protecting tropical biodiversity. *Science* 291(5501):125–128
- Cafaro P, Crist E (2012) *Life on the brink: environmentalists confront overpopulation*. University of Georgia Press, Athens
- Campbell M (2012) Why the silence on population. In: Cafaro P, Crist E (eds) *Life on the brink: environmentalists confront overpopulation*. University of Georgia Press, Athens, pp 41–56
- Catton W (1982) *Overshoot: the ecological basis of revolutionary change*. University of Illinois Press, Chicago
- Chipeta EK, Chimwaza W, Kalilani-Phiri L (2010) Contraceptive knowledge, beliefs and attitudes in rural Malawi: misinformation, misbeliefs and misperceptions. *Malawi Med J* 22(2):38–41
- Crist E (2012) Abundant Earth and the population question. In: Cafaro P, Crist E (eds) *Life on the brink: environmentalists confront overpopulation*. University of Georgia Press, Athens, pp 141–151
- Crist E, Mora C, Engelman R (2017) The interaction of human population, food production, and biodiversity protection. *Science* 356:260–264
- Czech B (2013) *Supply shock: economic growth at the crossroads and the steady state solution*. University Press of Colorado, Colorado
- Daly H (1991) *Steady-state economics*, 2nd edn. Island, Washington, DC
- Daly H (1996) *Beyond growth: the economics of sustainable development*. Beacon, Boston
- Daly H (2014) *From uneconomic growth to a steady state economy*. Edward Elgar, Cheltenham
- Derer P (2019a) The Iranian miracle: the most effective family planning program in history? <https://overpopulation-project.com/the-iranian-miracle-the-most-effective-family-planning-program-in-history/>
- Derer P (2019b) The first population policies implemented in Africa: the case of Tunisia. <https://mahb.stanford.edu/blog/first-population-policies-implemented-africa-case-tunisia/>
- Deutsche Welle (2005) France moves to encourage large families. <https://www.dw.com/en/france-moves-to-encourage-large-families/a-1720921>
- Dietz R, O'Neill D (2013) *Enough is enough: building a sustainable economy in a world of finite resources*. Berrett-Koehler, San Francisco
- Ehrlich PR (1968) *The population bomb*. Ballantine, New York
- Ehrlich P, Ehrlich A (1991) *Healing the planet: strategies for resolving the environmental crisis*. Addison-Wesley, New York
- Ehrlich P, Holdren J (1972) One-dimensional ecology. *Ecologist* 2(2):11–21
- Eisenbruch M (2018) Violence against women in Cambodia: towards a culturally responsive theory of change. *Cult Med Psychiatry* 42(2):350–370
- EMF (2014) *Towards a circular economy: accelerating the scale-up across global supply chains*. Ellen MacArthur Foundation, Cowes
- Engelman R (2016) Nine population strategies to stop short of 9 billion. In: Washington H, Twomey P (eds) *A future beyond growth: towards a steady state economy*. Routledge, New York
- Ezer T, Kerr K, Major K, Polavarapu A (2006) Child marriage and guardianship in Tanzania: robbing girls of their childhood and infantilizing women. *Geol J Gender L* 7:357
- FAO (2014) *Gender inequalities in rural employment in Tanzania Mainland: an overview*. Food and Agriculture Organisation. <http://www.fao.org/3/a-i4083e.pdf>
- Fitch H (2015) Forty years after genocide, Cambodia finds complicated truth hard to bear. *The Guardian*. <https://www.theguardian.com/world/2015/apr/16/forty-years-after-genocide-cambodia-finds-complicated-truth-hard-to-bear>
- Gallagher J (2018) 'Remarkable' decline in fertility rates. *BBC News*. <https://www.bbc.com/news/health-46118103>
- Gates Foundation (n.d.) Family planning. <https://www.gatesfoundation.org/what-we-do/global-development/family-planning>
- GENPOL (2018) Mapping sex and relationship education (SRE) in Italy. *Gender & Policy Insights*. <https://gen-pol.org/2018/10/mapping-sex-and-relationship-education-sre-in-italy/>
- Georgescu-Roegen N (1971) *The entropy law and the economic process*. Harvard University Press, Cambridge
- Girls Not Brides (n.d.) Cambodia. <https://www.girlsnotbrides.org/child-marriage/cambodia/>
- Girls Not Brides (2017) What we've learnt from the national survey on child marriage in Tanzania. <https://www.girlsnotbrides.org/weve-learnt-national-survey-child-marriage-tanzania/>
- Hawkins R (2012) Perceiving overpopulation: cannot we see what we're doing? In: Cafaro P, Crist E (eds) *Life on the brink: environmentalists confront overpopulation*. University of Georgia Press, Athens, pp 202–213
- Hayes S (1976) The limits-to-growth issue: a historical perspective. In: Cooper C (ed) *Growth in America*. Greenwood, Westport
- Hine H (2018) What's hindering girls' education in Tanzania? The Borgen Project. <https://borgenproject.org/girls-education-in-tanzania-2/>
- Holland G (2019) Have we reached a planetary tipping point? A MAHB dialogue with paleobiologists Elizabeth Hadly and Anthony Barnosky. MAHB Blog. <https://mahb.stanford.edu/blog/reached-planetary-tipping-point-mahb-dialogue-paleobiologists-elizabeth-hadly-anthony-barnosky/>
- ILO (2006) Decent work for women and men in the informal economy: profile and good practices in Cambodia. International Labour Organization. https://www.ilo.org/wcmsp5/groups/public/—asia/—ro-bangkok/documents/publication/wcms_bk_pb_134_en.pdf
- IMET (2015) Italian activities on education for environment and sustainable development. Italian Ministry for the Environment and Territory. [www.unece.org > fileadmin > DAM > env > esd > regactivit > Italy](http://www.unece.org/fileadmin/DAM/env/esd/regactivit/Italy)
- IPBES (2019) Nature's dangerous decline: 'unprecedented' species extinction rates 'accelerating' (press release). Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. <https://www.ipbes.net/news/Media-Release-Global-Assessment>
- IPCC (2019) Reports. The Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/reports/>
- Japhet B (2018) Tanzania's unmet need for contraceptives at crisis levels? *Pesacheck*. <https://pesacheck.org/is-tanzanias-unmet-need-for-contraceptives-at-crisis-levels-50375a467707>
- Johnson C, Formby JP, Kim H (2011) Economic growth and poverty: a tale of two decades. *Appl Econ* 43(28):4277–4288
- Kassiola J (1990) *The death of industrial civilisation*. State University of New York, Albany
- Kelly M, Fernandez P (1993) Underclass and immigrant women as economic actors: rethinking citizenship in a changing global economy. *Am UJ Int L Pol'y* 9:151
- Kirschbaum E (2007) Germans going "ga-ga" over new baby subsidy. *Reuters*. <https://uk.reuters.com/article/oukoe-uk-germany-babies-idUKL2981801820070102>
- Kopnina H (2016) Of big hegemonies and little tigers: ecocentrism and environmental justice. *Special Issue: On the politics of policy-making for education for sustainable development*. *J Environ Educ* 47(2):132–150
- Kopnina H (2019) Towards ecological management: identifying barriers and opportunities in transition from linear to circular economy. *Philos Manag*. <https://doi.org/10.1007/s40926-019-00108-x>
- Kopnina H, Washington H (2016) Discussing why population growth is still ignored or denied. *Chin J Popul Resour Environ* 14(2):133–143

- Kunmakara M (2017) IMF: make youth a demographic dividend. *Khmer Times*. <https://www.khmertimeskh.com/8720/imf-make-youth-a-demographic-dividend/>
- Lam D (2011) How the world survived the population bomb: lessons from 50 years of extraordinary demographic history. *Demography* 48(4):1231–1262
- Lamme J, Edelman A, Padua E, Jensen JT (2017) Evaluation of the challenges faced in increasing contraceptive access within a community college population. *Contracept Reprod Med* 2(1):25
- Licahdo (2014) The situation of women in Cambodia. Cambodian League for the Promotion and Defense of Human Rights (Licahdo). https://www.fidh.org/IMG/pdf/kh2004_women-en.pdf
- Lowe I (2016) Population: better, not bigger. In: Washington H, Twomey P (eds) *A future beyond growth: towards a steady state economy*. Routledge, New York, pp 21–23
- Makundi E (2003) Environmental education curriculum policy in Tanzanian schools. *South Afr J Environ Educ* 20:135–141
- Malthus T (1826) *An essay on the principle of population*, 6th edn. John Murray, London
- Marsh GP (1864) *Man and nature; or, physical geography as modified by human action*. Scribner, New York
- Mavrommati G, Bithas K, Borsuk ME, Howarth RB (2006) Integration of ecological-biological thresholds in conservation decision making. *Conserv Biol* 30(6):1173–1181
- Mbeba RM, Mkuze MS, Magembe GE, Yotham WL, Obeidy Melah A, Mkuwa SB (2012) Barriers to sexual reproductive health services and rights among young people in Mtwara district, Tanzania: a qualitative study. *Pan Afr Med J* 13(Suppl 1):1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3589247/>
- McDonough W, Braungart M (2002) *Cradle to cradle: remaking the way we make things*. North Point, New York
- MEA (2015) Report. Millennium Ecosystem Assessment. <https://www.millenniumassessment.org/en/index.html>
- Meadows DH, Meadows DL, Randers J, Behrens WW III (1972) *The limits to growth*. Universe, New York
- MoHCDEGEC et al (2016) Tanzania demographic and health survey. Ministry of Health, Community Development, Gender, Elderly and Children/Ministry of Health/National Bureau of Statistics/Office of Chief Government Statistician/ICF International, Dar es Salaam/Zanzibar/Dar es Salaam/Zanzibar/Rockville. <https://dc.sourceafrica.net/documents/117955-2015-16-TDHS-MIS.html>
- Mosha I, Ruben R, Kakoko D (2013) Family planning decisions, perceptions and gender dynamics among couples in Mwanza, Tanzania: a qualitative study. *BMC Public Health* 13(1):523
- Nakaie N, Tuon S, Nozaki I, Yamaguchi F, Sasaki Y, Kakimoto K (2014) Family planning practice and predictors of risk of inconsistent condom use among HIV-positive women on anti-retroviral therapy in Cambodia. *BMC Public Health* 14(1):170
- Ng'wanakilala F (2019) President urges Tanzania's women to 'set ovaries free', have more babies to boost economy. *Reuters*, July 10. <https://www.reuters.com/article/us-tanzania-politics/president-urges-tanzanias-women-to-set-ovaries-free-have-more-babies-to-boost-economy-idUSKCN1U51AZ>
- No F, Taniguchi K, Hirakawa Y (2016) School dropout at the basic education level in rural Cambodia: identifying its causes through longitudinal survival analysis. *Int J Educ Dev* 49:215–224
- OECD (n.d.) Key Issues affecting youth in Cambodia. Organisation for Economic Co-operation and Development. <https://www.oecd.org/countries/cambodia/youth-issues-in-cambodia.htm>
- OECD (2017) Social protection system review of Cambodia. OECD Development Pathways. Organisation for Economic Co-operation and Development Publishing, Paris. https://www.oecd.org/countries/cambodia/SPSR_Cambodia_ebook.pdf
- OECD (2018) Education in Cambodia: findings from Cambodia's experience in PISA for Development. Organisation for Economic Co-operation and Development. <http://www.oecd.org/pisa/pisa-for-development/PISA-D%20national%20report%20for%20Cambodia.pdf>
- OECD Development Centre (2017) Youth well-being policy review of Cambodia. EU-OECD Youth Inclusion Project, Paris
- Omondi F, de Haas B, Oulu K, Van Enck J (2019) School-based sexuality education in Tanzania: a reflection on the benefits of a peer-led edutainment approach. *ShareNet Netherlands*. <https://share-netinternational.org/wp-content/uploads/2019/07/Dance4LifeReport.pdf>
- O'Neill DW (2012) Measuring progress in the degrowth transition to a steady state economy. *Ecol Econ* 84:221–231
- Open Development (2019) Cambodia: gender equality. <https://opendevdevelopmentcambodia.net/topics/sdg-5-gender-equality/>
- Pallangyo D (2007) Environmental law in Tanzania: how far have we gone? *Environ Dev J* 3/1:26. https://www.tnrf.org/files/E-INFO-LEAD_%20Environmental_Law_In_Tanzania_Pallangyo_2007.pdf
- PRB (2003) Recent fertility and family planning trends in Cambodia. Population Reference Bureau. <https://www.prb.org/recentfertilityandfamilyplanningtrendsincambodia/>
- Rammelt C, Crisp P (2014) A systems and thermodynamics perspective on technology in the circular economy. *Real-World Econ Rev* 68:25–40
- Ratcliffe R (2018) No need for birth control: Tanzanian president's views cause outrage. *The Guardian*. <https://www.theguardian.com/global-development/2018/sep/11/no-need-for-birth-control-tanzanian-presidents-views-cause-outrage>
- Ravallion M (2001) Growth, inequality and poverty: looking beyond averages. *World Dev* 29(11):1803–1815
- Raworth K (2017) *Doughnut economics*. Cornerstone, London
- Rees W (2010) What's blocking sustainability? Human nature, cognition, and denial. *Sustain Sci Pract Policy* 6(2):13–25
- Rees W (2019) End game: the economy as eco-catastrophe and what needs to change. *Real World Econ Rev* 87:132–148
- Ripple WJ, Wolf C, Newsome T et al (2017) World Scientists' Warning to Humanity: a second notice. *Bioscience* 67(12):1026–1028
- Ryerson (2010) Population: the multiplier of everything else. Post Carbon Institute, Santa Rosa
- Salmony S (2019) The root cause of human population growth. *Mother Pelican* 15(8). <http://www.pelicanweb.org/solisustv15n08page1.html#feature>
- Serebrin J (2018) More than one child? Expect more cash from Quebec, Legault says. *Montreal Gazette*. <https://montrealgazette.com/news/local-news/more-than-one-child-expect-more-cash-from-quebec-legault-says>
- Smith GA (1979) Epilogue: Malthusian concern from 1800 to 1962. In: Finnin W, Smith GA (eds) *The morality of scarcity*. Louisiana State University Press, Baton Rouge
- Smith J, Bunthan K (2016) Live and learn environmental education. Cambodia's Environmental Education Status Report 2005. https://livelearn.org/assets/media/docs/resources/Cambodia_EnvEdu_report.pdf
- Stark L (2013) Transactional sex and mobile phones in a Tanzanian slum. *Suomen Antropologi* 38(1):12–36
- Statista (2019) Most used contraceptive methods among women in Italy in 2018. <https://www.statista.com/statistics/612705/most-used-contraceptive-methods-italy/>
- Sultan S (2018) The effects of education, poverty, and resources on family planning in developing countries. *Clin Mother Child Health* 15(1):1–6
- The Economist (2016) China's two-child policy is having unintended consequences. <https://www.economist.com/china/2018/07/26/chinas-two-child-policy-is-having-unintended-consequences>

- The Local (2019) Babies wanted: Nordic countries crying out for kids. <https://www.thelocal.com/20190117/babies-wanted-nordic-counties-crying-out-for-kids-denmark-norway-sweden>
- The World Bank (2013) Contraceptive prevalence, any methods (% of women ages 15–49)—Italy. <https://data.worldbank.org/indicator/SP.DYN.CONU.ZS?locations=IT>
- The World Bank (2017a) Population, total. <https://data.worldbank.org/indicator/sp.pop.totl>
- The World Bank (2017b) Tanzania: births. <https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=TZ>
- The World Bank (2019a) The World Bank in Africa. <https://www.worldbank.org/en/region/afr/overview>
- The World Bank (2019b) Achieving the demographic dividend: an operational tool for country specific investment decision making in pre-dividend countries. <http://documents.worldbank.org/curated/en/781891550815372274/Achieving-the-Demographic-Dividend-An-Operational-Tool-for-Country-Specific-Investment-Decision-Making-in-Pre-Dividend-Countries>
- The World Bank Group (2019) Tanzania 2019 country environmental analysis. <http://documents.worldbank.org/curated/en/356211556727592882/pdf/Tanzania-Country-Environmental-Analysis-Environmental-Trends-and-Threats-and-Pathways-to-Improved-Sustainability.pdf>
- Theroux M (2017) Why Putin is paying women to have more children... inside Russia's super families. The Telegraph. <https://www.telegraph.co.uk/news/2017/03/10/putin-paying-women-have-children-inside-russias-super-families/>
- Turner G (2008) A comparison of “the limits to growth” with 30 years of reality. *Glob Environ Change* 18(3):397–411
- Turner G (2014) Limits to growth vindicated: is global collapse imminent? University of Melbourne, Melbourne. <https://sustainable.unimelb.edu.au/publications/research-articles/is-global-collapse-imminent>
- Twomey P, Washington H (2016) Relating the steady state economy to the green, circular and blue economies. In: Washington H, Twomey P (eds) *A future beyond growth*. Routledge, London, pp 129–145
- UCS (1992) World Scientists' Warning to Humanity 1992. Union of Concerned Scientists. <https://www.ucsusa.org/about/1992-world-scientists.html>
- UN (2012) National Report for Rio+20 United Nations Conference on Sustainable Development. United Nations. <https://sustainabledevelopment.un.org/content/documents/1022cambodia.pdf>
- UN (2013) Child marriages: 39,000 every day—more than 140 million girls will marry between 2011 and 2020. Office of the Secretary General's Envoy on Youth, United Nations. <https://www.un.org/youthenvoy/2013/09/child-marriages-39000-every-day-more-than-140-million-girls-will-marry-between-2011-and-2020/>
- UN (2019) World population prospects 2019. United Nations. https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf
- UNEP (2016) Financing the future: report of the Italian National Dialogue on Sustainable Finance. United Nations Environment Programme. http://unepinquiry.org/wp-content/uploads/2017/02/Financing_the_Future_EN.pdf
- UNFPA (1994) Cairo Declaration on Population and Development. United Nations Population Fund. <https://www.unfpa.org/resources/cairo-declaration-population-development>
- UNFPA (2016a) Education for a healthy future. United Nations Population Fund. <https://cambodia.unfpa.org/en/publications/education-healthy-future>
- UNFPA (2016b) Education for a healthy future: integrating comprehensive sexuality education into the school curriculum. United Nations Population Fund. <https://cambodia.unfpa.org/sites/default/files/pub-pdf/CSECountryProgrammeBrief%28Windowsver%29%20%281%29.pdf>
- USAID (2019) Gender equality and women's empowerment. United States Agency for International Development. <https://www.usaid.gov/tanzania/our-work/gender-equality-and-women%E2%80%99s-empowerment>
- Velasco E (2004) Ensuring gender equity in education for all: is Cambodia on track? *Prospects* 34(1):37–51
- Victor P (2019) *Managing without growth: slower by design, not disaster*, 2nd edn. Edward Elgar, Cheltenham
- Victor P, Jackson T (2015) The problem with growth. In: Starke L (ed) 2015 State of the world report, confronting hidden threats to sustainability. Worldwatch Institute, Washington, DC
- Vogt W (1948) *Road to survival*. William Sloan, New York
- Wallich HC (1982) “The limits to growth” revisited. *Challenge* 25(4):36–42
- Washington H (2014) Addicted to growth? CASSE NSW, Sydney. <https://steadystatensw.files.wordpress.com/2015/01/addictedtogrowthdocfinalboxesprintfinaloct17th.pdf>
- Washington H (2015) *Demystifying sustainability: towards real solutions*. Routledge, London
- Washington H, Kopnina H (2018) The insanity of endless growth. *Ecol Citizen* 2:57–63
- Washington H, Maloney M (2020) The need for ecological ethics in a new ecological economics. *Ecol Econ* 169:106478. <https://doi.org/10.1016/j.ecolecon.2019.106478>
- Washington H, Twomey P (eds) (2016) *A future beyond growth: towards a steady state economy*. Routledge, London
- Washington H, Lowe I, Kopnina H (2019) ‘Why do society and academia ignore the ‘scientists warning to humanity’ on population?’ *J Futures Stud*. <https://jfsdigital.org/why-do-society-and-academia-ignore-the-scientists-warning-to-humanity-on-population/>
- WCED (1987) *Our common future*. World Commission on Environment and Development. Oxford University Press, London
- WHO (2015) Cambodia: success factors for women's and children's health. World Health Organization. https://www.who.int/pmnch/knowledge/publications/cambodia_country_report.pdf
- WHO (2017) Cambodia: identifying actions for scaling up long-acting reversible contraceptives. World Health Organization. https://apps.who.int/iris/bitstream/handle/10665/259992/9789290618218_eng.pdf?sequence=1&isAllowed=y
- WHO (2018) Maternal mortality. World Health Organization. <https://www.who.int/en/news-room/fact-sheets/detail/maternal-mortality>
- Wijkman A, Rockström J (2012) *Bankrupting nature: denying our planetary boundaries*. Routledge, New York
- WikiGender (n.d.) Italy. <https://www.wikigender.org/countries/europe-and-central-asia/gender-equality-in-italy/>
- World Economic Forum (2018) The global gender gap report 2018. http://www3.weforum.org/docs/WEF_GGGR_2018.pdf
- World Population Review (2017) Births by country 2017. <http://worldpopulationreview.com/countries/births-by-country/>
- World Population Review (2019) Cambodia's population. <http://worldpopulationreview.com/countries/cambodia-population/>
- Worldometer (2019a) Tanzania's population. <https://www.worldometers.info/world-population/tanzania-population/>
- Worldometer (2019b) Italy's population. <https://www.worldometers.info/world-population/italy-population/>
- Worldometer (2019c) Cambodia's population. <https://www.worldometers.info/world-population/cambodia-population/>
- Wyatt T (2018) Italy's far-right government offers free land to parents who have third child in ‘neo-medieval’ policy. The Independent. <https://www.independent.co.uk/news/world/europe/italy-far-right-free-land-third-child-family-government-matteo-salvini-birth-rate-children-a8616781.html>