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Editorial introduction

David Samways – Editor

While spanning a wide range of topics, all of the papers in this issue of the *JP&S* are, at one level or another, concerned with the role of global economic inequality and its relationship to population growth, human welfare and environmental degradation.

Developed by Ehrlich and Holdren (see Holdren, 2018) in the early 1970s as a response to Barry Commoner's assertion that environmental problems were caused by poor technical choices rather than the pressures of population and affluence, the IPAT equation identifies population (P), affluence (or consumption) (A) and technology (T) as the major driving forces in environmental impact (I). The fact that the absence of affluence, i.e. poverty, is frequently associated with the growth of population is illustrative of the interconnectedness of the components of IPAT. Indeed, low levels of development and high fertility are firmly linked in the demographic literature (see Bongaarts and Watkins, 1996), and the negative relationship between fertility and economic development has become one of the most accepted empirical regularities in the social sciences (Myrskylä, et al., 2009).

Poverty can also be a significant driver of environmental impact in many parts of the developing world (Masron and Subramaniam, 2018). Such impacts are amplified by growth in population, and in some circumstances communities under stress have breached sustainable limits in the short term. In extreme cases the collapse of ecological sustainability has been a significant factor in the demise of a number of societies (for an overview see Diamond, 2005) with perhaps the most celebrated example of this being Easter Island/Rapa Nui. Discussion continues over the precise details of the vast social and ecological changes in Rapa Nui, but

most of the evidence seems to suggest that an increase in population combined with cultural and other factors led to the deforestation of the island, the collapse of the food supply and a huge reduction in population (see Flenley and Bahn, 2003). Although more complex factors are undoubtedly in play, modern-day Haiti demonstrates how communities that experience rapid population growth (Haiti's population has nearly tripled since the 1960s) and are unable to expand into new territories can have a devastating impact on their environment (Hedges et al., 2018). In the case of Haiti it is clear that poverty and the absence of alternative sources of fuel structurally delimit the choices people have, forcing them to engage in deforestation leading to a massive loss of biodiversity.

As Kelly Austin shows in her paper in this issue of the *JP&S*, poverty and subsistence farming are significant drivers of deforestation in many parts of the world. Most of us are familiar with the role of deforestation in local and global environmental disruption. Not only does deforestation have a significant effect on the carbon cycle, but its replacement with cattle ranches amplifies the impact. From an anthropocentric perspective, the loss of what is usually referred to as "ecosystem services" to human beings is becoming increasingly well recognised, and therefore the replacement of diverse flora and fauna with mono-cultures of crops like oil palms is arguably of equal importance. However, it is easy to lose sight of the unintended facilitation of opportunities for species which humankind finds a great deal less welcome. In "Felling Trees, Furthering Malaria", Austin considers the role of population growth in deforestation and consequently on the spread of malaria. While commercial logging and agriculture are often cited as the culprits in deforestation, Austin shows how the growth and migration of poor rural populations engaging in subsistence agriculture is responsible for the majority of primary forest clearance. Due to a number of factors, including issues of land tenure, these "frontier migrant" populations are often displaced by the expansion of large scale commercial agriculture responding to demand for food crops or meat from urban populations in both the developing Global South and the already developed world. The consolidation of deforested land into large commercial agricultural or ranching enterprises pushes out subsistence agriculturalists into areas where they engage in further clearance of primary forest. Austin's paper shows how deforestation also leads to an increase in the populations of the mosquitos that are vectors for malaria by increasing their breeding grounds. We see then that, as with many other environmental problems, a complex combination of population growth, poverty, globalisation and overconsumption

are implicated in significant environmental transformations. The consequences of these transformations (both local and global) are frequently disproportionately borne by the very populations whose structural position drives their actions and who, for the same reason, are least resilient to ecological disruption.

Austin's paper demonstrates that the effects of population growth on the welfare of the local population can be direct and unanticipated. However, the effects of population growth and shifts in demographic structure can lead to more dramatic and socially contingent outcomes. Stewart Britten and Wahida Paikan's paper (published in this issue) shows the links between a "youth bulge" and conflict in the complex social and environmental context of Afghanistan. They argue that the success of programmes aimed at improving maternal and infant health coupled with a neglect of family planning services has led to a demographic youth bulge (over 60% of the population is under 25 years of age) which further threatens the prospects for peace in a country already suffering from prolonged civil strife. At more than 5 births per woman, Afghanistan has the highest total fertility rate outside Africa. Three-quarters of Afghanistan's population live in rural areas, and with the majority engaged in subsistence agriculture or pastoral nomadism it remains one of the least developed countries in the world. Furthermore, Afghanistan faces important challenges in terms of feeding its growing population, with significant environmental problems including vulnerability to climate change among them. With insufficient productive land and few opportunities for employment in the cities, the prospects for Afghanistan's young people are poor. Britten and Paikan argue that the poor opportunities for Afghanistan's youth exacerbates the country's civil conflict as young men often join the Taliban to escape the lack of employment.

While economic and social development is not the only driver of reduced fertility (see Cleland 1987), it is nonetheless an important factor, especially when viewed at an aggregate level (see Bongaarts and Watkins, 1996; Myrskylä, et al., 2009). As Britten and Paikan argue in respect of Afghanistan, the economic development of the least developed countries (LDCs) is likely to be an important factor in their transition to lower fertility rates. However, whether development leads to fertility reductions or not, economic development of the LDCs is necessary to improve the welfare of the world's poorest. Many have attempted to model the complex relationship between population, global economic development,

and environmental sustainability (for recent examples see Motesharrei et al., 2016; McBain et al., 2019) and most recognise that key ecological boundaries have already been breached. McBain et al. have argued that although natural systems demonstrate considerable resilience by continuing to deliver resources at a global scale, this ecological deficit can only be maintained in the short-term. It follows that incremental increases in global ecological footprint, whether from increased consumption in the rich world or from the development so desperately needed in the LDCs, will further deepen the ecological deficit unless systemic changes in the global consumption and distribution of resources are addressed.

O'Neill et al. (2018) have shown that in principle, with equal distribution, it would be possible to meet the physical needs (nutrition, sanitation, access to electricity and the eradication of extreme poverty) of the global population within ecological boundaries. However, the universal achievement of the high quality lifestyles, which the majority of us take for granted in the developed world, would require 2-6 times the sustainable resource level. O'Neill et al. conclude that a pursuit of universal human development as part of the UN's Sustainable Development Goals (SDG's) "has the potential to undermine the Earth-system processes upon which development ultimately depends" (p.93). They suggest that a more optimistic scenario can be achieved through abandoning the goal of economic growth in favour of the pursuit of sustainable and equitable human well-being. Nonetheless, for a good life to be achieved by all within ecological boundaries, this will still require a dramatic reduction in the resources required to meet basic needs. Building on the work of O'Neill et al., Hickel (2019) argues that to remain within ecological boundaries a reduction of the developed world's biophysical footprint of between 40-50% will be necessary, entailing degrowth strategies and a shift toward a post-capitalist economic model. Both O'Neill et al. and Hickel recognise the role of population as a multiplier in ecological footprint and the need to reduce it. As Hickel notes in relation to rich-world degrowth:

> One approach would be to gradually reduce the size of the population (in an equitable, progressive and non-coercive way), so that GDP per capita can be maintained even while total economic activity shrinks. But if we assume that the population grows according to existing projections and stabilises at 9–11 billion, this will require de-growth in both absolute and per capita terms. (Hickel, 2019, p.13)

From this quote it's not quite clear if Hickel is arguing for reduction in global population per se, but this would certainly not be incompatible with his general approach. Unquestionably, population reduction in the developed world would have a considerably bigger impact than shrinking the population of presently poor countries. But if poor countries justly take a larger share of the ecological pie then, as they become more prosperous, their numbers will eventually matter too. The now relatively prosperous countries of east Asia such as South Korea (see WWF Korea, 2016) are a good illustration of the transition from low to high population and consumption. While Hickel is right when he argues that rethinking living within ecological boundaries "requires a fundamental reorientation of development theory, from focusing primarily on the deficiencies of poor countries to focusing on the excesses of rich countries" (p.14), this does not mean that population growth in the developing world is unproblematic. Apart from anything else, the provision of education and sexual health services are of vital importance to the economic and social wellbeing of women in developing countries. The high correlation between female emancipation and lower fertility represents a win-win situation. Human welfare, population and environmental sustainability are inextricably linked.

In this issue of the *JP&S*, Theodore Lianos' paper, "Environment, Poverty and the Steady State Economy", develops ideas from his paper published in our special issue on economic growth (Vol. 3, No. 1) and deals directly with the welfare-population-sustainability nexus. Here Lianos argues that the enormous economic growth experienced after WWII has caused unprecedented environmental degradation and at the same time fuelled massive population growth. While economic growth has improved the welfare of the world's population in general, on a global scale the rewards of growth have been very unevenly distributed and hence one of the most significant issues facing the contemporary world is widening inequality. Central to Lianos' argument is the idea that two major contradictions characterise the modern world. The first is the contradiction between humans and nature where growth of production has led to ecological overshoot, and the second is the contradiction between the interests of labour and of capital leading to the concentration of profits into fewer hands. For Lianos, the two contradictions are directly related to population growth since population is a multiplier of environmental impact and large populations increase the supply of labour, depressing wages and exacerbating inequality. He goes on to

demonstrate that a transition to a steady-state economy with an aim to reduce population size to around 3 billion would begin to address these contradictions. Lianos argues that by reducing population and keeping it constant, the price mechanism, with some state intervention when necessary, will eliminate the ecological deficit and alleviate poverty and inequality.

In their opinion piece, Steven Burr, Katie McManus, and Yee Leung "Sustainability of Equality: a Paradox for Democracy" also pick up on the issue of equitable distribution of resources. However, they argue that while liberal democracy, through the institutions of the state, can be effective in creating conditions that lead to the reduction of the birth rate and hence the rate of population growth, in terms of achieving an absolute reduction in the global population compatible with high welfare and environmental sustainability, liberal democracy appears unequal to the task.

We finish with my own review of the puzzlingly titled *Empty Planet* by Darrell Bricker and John Ibbitson, not so much because it is an argument worthy of consideration, but because it is representative of a journalistic sound-bite approach to the demographic literature that renders complexity into a sanguine view of the future in terms of human environmental impact.

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PEER REVIEWED ARTICLE

Felling trees, furthering malaria: links between deforestation and disease in developing nations

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Abstract

Malaria represents a leading illness and cause of death throughout areas of the Global South. Since malaria is transmitted through the bite of the Anopheles mosquito, environmental conditions are paramount in understanding malaria vulnerabilities. A burgeoning area of research connects anthropogenic deforestation and subsequent land-use changes to the expansion of mosquito habitats and malaria outbreaks. This paper explores those literatures, and also examines the drivers of deforestation in the Global South to demonstrate how population pressures, agricultural production, and rural migration patterns underlie motivations for deforestation and land transformation in poorer countries.

Keywords: Malaria; deforestation; land-use change; rural migration; population growth

Introduction

Malaria is a parasitic disease that has plagued human societies throughout history, and continues to represent a major threat to health and well-being today. In 2017, there were over 219 million cases of malaria, including nearly 500,000 deaths (WHO, 2019). The majority of deaths from malaria are among infants, children, and pregnant women. In fact, malaria claims the life of a child under the age of 5 years every two minutes (WHO, 2019). The continued impact of malaria is somewhat of a conundrum, as malaria represents a preventable and curable infection. However, new trends in antibiotic resistance may threaten this claim. As the female *Anopheles* mosquito transmits malaria to humans, changes to the environment are also paramount in facilitating new and continued vulnerabilities (e.g. Yasuoka and Levins, 2007).

Nearly half of the world's population is at risk of malaria (WHO, 2019). Most malaria cases and deaths occur in Sub-Saharan Africa, but regions of Latin America, South-East Asia, the Eastern Mediterranean, and the Western Pacific also represent malaria hotspots. Ninety countries currently have ongoing malaria transmission (WHO, 2019). Although recent decades have wrought significant gains in controlling malaria and preventing deaths, there are clear signs that these trends are reversing. While malaria rates declined from 2000 to 2015, in the most recent years, rates of incidence have increased. According to the latest World Malaria Report, released in November 2018, there were 219 million cases of malaria in 2017, up from 217 million cases in 2016 (WHO, 2019). The re-emergence of malaria is likely tied to many different factors, such as persistent poverty, insecticide resistance, and perhaps, most notably, anthropogenic environmental change (e.g. Pattanayak et al., 2006).

As mosquitoes represent the disease vector for malaria, malaria vulnerabilities are deeply connected to environmental conditions. Even seemingly minor changes to the environment and local ecologies can have profound impacts on mosquito habitats, breeding cycles, biting rates, and other factors that affect malaria transmission. Over the last two decades in particular, a wealth of research from the fields of public health, epidemiology, and entomology have focused on deforestation and land-use change in explaining heightened malaria susceptibilities for rural populations. This article will explore this vein of research highlighting the factors and diverse processes that link forest loss to malaria.

These factors include alterations to landscapes and local ecologies, changes to the availability or composition of water at breeding sites, and influxes of migrant labor. Furthermore, a focus on the causes of deforestation in developing nations illuminates how population pressures and rural migration patterns spur forest loss and heighten vulnerabilities to malaria for marginalized rural populations. Although growing urban populations and export agriculture operations are often implicated as key drivers of forest loss in the Global South, closer examination reveals these as distal causes that shape rural migration to forest frontier zones. The populations most at risk for frontier migration are also among the most vulnerable to malaria due to their poor socio-economic status and lack of access to healthcare.

Malaria: a parasitic and pervasive disease

Malaria is caused by *Plasmodium* parasites. There are five parasite species that cause malaria in humans, with *Plasmodium falciparum* and *Plasmodium vivax* representing the most common parasite strains (WHO, 2019). These species of parasites have distinct regional zones, as *P. falciparum* is responsible for the overwhelming majority of malaria cases in Sub-Saharan Africa and South-East Asia, and *P. vivax* is most common in the Americas (WHO, 2019). *Plasmodium* parasites rely on two hosts throughout their lifecycle: a mosquito and a human (or another mammal) (Mayxay et al., 2004). Only around 30 of the 400 different species of *Anopheles* mosquito can act as vectors for the parasite, and only the bite of a female *Anopheles* mosquito spreads the parasite from one person to another (Mayxay et al., 2004; Neafsey et al., 2015; WHO, 2019). The different types of malaria parasites cause different variations of the disease in humans, with some forms being milder than other strains. Just as the type of parasite species varies by region, different types of *Anopheles* mosquitoes tend to transmit the parasites on different continents. For example, *Anopheles gambiae* is the main vector for malaria in Africa, while *Anopheles darlingi* is the key mosquito associated with malaria transmission in the Americas (WHO, 2019).

The key malaria vector mosquito species tend to be most active between dusk and dawn. *Anopheles* mosquitoes lay their eggs in still or slow-moving water bodies. Eggs become larvae and eventually transform into adult mosquitoes. While male mosquitoes are essentially pollinators that feed solely on plant matter, the female mosquitoes also need blood to nurture and feed their eggs (Mayxay et al., 2004; Neafsey et al., 2015; WHO, 2019). Rainfall patterns, temperature, and humidity

also impact the number, survival rates, and breeding activity of mosquitoes (e.g. Norris, 2004); transmission generally accelerates in warm, wet places where the mosquito lifespan is longer.

Human immunity represents another important factor affecting whether or not malaria is acquired, and, if so, the severity of the illness. Individuals that have been exposed to malaria several times throughout their life can acquire partial immunity that reduces the chance of severe disease and death (WHO, 2019). For this reason, most malaria deaths occur in young children and among populations that have not been previously exposed to the disease.

Malaria causes fever and flu-like symptoms, including chills, nausea, vomiting, and aches or joint pains (CDC, 2019; WHO, 2019). Symptoms manifest around one to two weeks after the infected mosquito bite. During this incubation time, an *Anopheles* mosquito can bite an infected human and transmit the parasite to another. Especially among youth and non-immune groups, malaria can quickly lead to death. For example, in infants, some deaths have been recorded just 18 hours after initial symptoms appeared. If untreated, malaria leads to severe anemia, respiratory distress in relation to metabolic acidosis, and cerebral malaria, where there is inadequate blood flow to the brain and other vital organs, leading to permanent disability, even if the malaria is eventually able to be treated effectively (CDC, 2019; WHO, 2019).

Early diagnosis of malaria is essential for management of the disease and prevention of death (CDC, 2019; Stratton et al., 2008; WHO, 2019). Microscopy and rapid diagnostic tests are the most common and effective ways of diagnosing the disease (WHO, 2019). However, these methods may be inadequate, especially in poor areas that often lack sufficient expertise, health personnel, and diagnostic equipment (e.g. Bates et al., 2004). Currently, there are many drugs available to combat the infectious parasite, but reduced effectiveness and antibiotic resistance represent major limitations. The most effective and popular drug consists of artemisinin combination treatments (ACTs) (WHO, 2019). Other drug treatments, including quinine and chloroquine, are now largely ineffective at treating malaria due to the development of resistance. In addition, recent studies document increased tolerance to ACTs in many regions, leading to concerns over the potentials of widespread antibiotic resistance (e.g. Hastings and Ward, 2005; WHO, 2019).

Both the malaria parasites and the *Anopheles* mosquitoes that carry them are highly adaptable and resilient species. Their resilience in part explains why malaria has been a leading cause of death among humans for centuries, if not millennia. In fact, the first evidence of malaria parasites was found in mosquitoes preserved in amber from the Paleogene period approximately 30 million years ago. While malaria is an "old" disease, current transformations to the environment may be producing "new" vulnerabilities, including expanding mosquito habitats, intensifying biting rates, and exposing fresh populations that lack immunity and appropriate access to primary health care.

Links between deforestation and malaria

Human transformations to the environment have become so immense that the current geological age is now denoted the "Anthropocene". Forest loss represents one of the most significant global environmental problems, as new estimates now assert that since humans started cutting down forests, around 50% of all trees have been felled (National Geographic, 2018). Global tree cover loss reached a record 29.7 million hectares (or 73.4 million acres) in 2016. The loss is 51% higher than the previous year, totaling an area about the size of New Zealand (Weisse and Goldman, 2017). Deforestation contributes to other environmental concerns, including global climate change and biodiversity loss. Additionally, the felling of trees impacts human well-being, especially as deforestation is linked to furthering malaria vulnerabilities in a wide range of studies (e.g. Norris, 2004; Lima et al., 2017; Yasuoka and Levins, 2007; Vittor et al., 2006, 2009).

Clearing forests alters local ecosystems in a variety of ways, including changing local temperatures, soil conditions, water resources, and the ecology of flora and fauna. These modifications can have a notable impact on mosquito habitats, lifecycles, and behaviors. Additionally, deforestation predominantly involves the conversion of forest land to agriculture and livestock grazing areas (FAO, 2018), and these activities also influence the mosquito disease vector in a variety of ways. While the number of studies exploring such links have burgeoned over the last few decades, the observed connection between forest loss and mosquitoes was articulated over 50 years ago; Livingstone (1958: 554) comments that "it is only when man cuts down the forest that breeding places for *A[nopheles] gambiae* become almost infinite." Other researchers also illustrate links between land cover change and malaria outbreaks at much earlier points in human history, such as in Ancient Rome (e.g. O'Sullivan et al., 2008).

Current studies examining the links between forest loss and mosquitos generally utilize a mix of satellite or remote sensing data to ascertain forest loss. This typically is combined with entomology data that measure mosquito larvae, the presence of parasites, or biting rates, as well as epidemiological data or secondary data on malaria cases, often gathered from local health centers or through direct malaria microscopy testing. Much of this research is conducted in areas of the Brazilian or Peruvian Amazon (e.g. Barros et al., 2015; Hahn et al., 2014; Vittor et al., 2006, 2009; Yanoviak et al., 2006), as well as other areas in South America, Sub-Saharan Africa, and South East Asia (e.g. Afrane et al., 2008; Basurko et al., 2013; Bonneaud et al., 2008; Himeidan et al., 2012; Kweka et al, 2016; Nath et al., 2012; Saxena et al., 2014; Vanwambeke et al, 2007). While these types of studies are typically concentrated in isolated areas within specific countries or regions, the consistencies of the findings across geographic zones speak to the existence of larger-scale patterns. A few cross-national studies linking deforestation rates to malaria incidence support this claim (e.g. Austin, 2013; Austin et al., 2017); however more cross-regional studies of forest loss and the incidence of mosquitoes or malaria would greatly contribute to the generalizability of these findings.

The processes linking forest loss to malaria vulnerabilities are diverse but, fundamentally, many studies find that there are more malaria parasites or mosquito larvae in deforested areas or areas on the forest fringe (the edge of deforested areas) in comparison to areas of intact forest (e.g. Barros et al., 2015; Bonneaud et al., 2008; Caldas de Castro et al., 2006; Nath et al., 2012; Olson et al., 2010; Saxena et al., 2014; Vanwambeke et al, 2007; Wayant et al., 2010). Deforestation's impact on local temperatures is a subject of detailed examination in current research. As forest cover is lost, temperatures increase, and generally, the incubation period of malaria parasites and the speed of larval development is inversely correlated with temperature (Afrane et al., 2008, 2012; Kweka et al, 2016; Himeidan et al., 2012; Nath et al., 2012; Patz et al, 2006). Amazingly, a mere half-degree centigrade increase in temperature can translate into a 30% to 100% increase in mosquito abundance (Pascaul et al., 2006). For example, Afrane and colleagues (2008) find that the overall parasite infection rate of mosquitoes in deforested sites is greatly increased compared with that in forested sites. Overall, due to changes in temperature and humidity, vectorial capacity in the Kenyan highlands is estimated to be 77.7% higher in the deforested sites than in the forested sites (Afrane et al., 2008).

Other studies have found that indoor temperatures increase in dwellings located in deforested and frontier zones (e.g. Afrane et al., 2012; Himeidan et al., 2012; Kweka et al, 2016). A rise in indoor temperatures attracts more mosquitos into dwellings at night during prime biting hours, and can also increase the biting rates of mosquitoes (Afrane et al., 2012; Kweka et al., 2016). An increase in biting frequency means that mosquitoes feed more frequently on humans and, thereby, enhance rates of malaria transmission, potentially exponentially.

Vittor and colleagues (2006) arrive at a similar conclusion in their research conducted in the Peruvian Amazon. They tested fifty-six sites with varying degrees of deforestation over several weeks and found that *Anopheles darlingi* was captured in the greatest quantities at sites with little remaining forest. Furthermore, deforested sites had biting rates that were more than 278 times greater than in areas that were predominantly forested (Vittor et al., 2006).

In addition to a rise in outdoor and indoor temperatures, researchers highlight other processes connecting deforestation to malaria risk. Many emphasize that water mediates the relationship between deforestation and malaria, and that felling trees greatly impacts aquatic environments that promote mosquito development (e.g. Barros et al., 2015). For example, puddles, ponds, and slow-moving streams that exist under thick forest canopy are too heavily shaded for mosquitos and tend to be highly acidic, as much organic debris, such as falling leaves, lands in such pools. But water pools in deforested areas and frontier zones have greater exposure to sunlight and a lower level of acidity, raising numbers of mosquito eggs and larvae (e.g. Norris, 2004). While completely sun-exposed ponds are generally not preferred by mosquitoes, researchers have found that semi-shaded ponds in frontier zones or on forest fringes have elevated levels of mosquito larvae (e.g. Barros et al., 2015). Micro dams, that slow or stop water flow, are also created when fallen trees obstruct streams and rivers, and represent prime mosquito habitats (e.g. Barros et al., 2015). Thus, felling trees can expose ponds and streams to the correct amount of sunlight and potentially expand mosquito habitats (e.g. Norris, 2004).

It is important to emphasize that deforestation simply represents the first step in a series of land-use changes, and that population growth and expansions in agriculture represent the prime motivation for deforestation in most areas (e.g.

Confalonieri et al., 2014; FAO, 2018; Hahn et al., 2014; Norris, 2004; Pattanayak et al., 2006; Saxena et al., 2014). The secondary growth that is created by crops and plantations often affords mosquitos habitats with the right level of shade and protection, and many studies have found an abundance of mosquito larvae in recently deforested agricultural areas (e.g. Basurko, et al., 2013; Yanoviak 2006; Vittor et al., 2006, 2009). Additionally, agricultural production leads to the creation of dams, irrigation systems, ditches, and roads, all of which greatly expand the availability of standing water, thereby proliferating mosquito breeding sites, with a resultant rise in malaria rates (e.g. Basurko, et al., 2013; Bauch et al., 2015; Confalonieri et al., 2014; Hahn et al., 2014; Silva-Nunesa et la., 2012; Yanoviak et al., 2006). Selective logging also provides the right mix of sun and shade that mosquitoes prefer, leading to significant increases in malaria incidence in nearby populations (e.g. Hahn et al., 2014). Remarkably, mosquito eggs and larvae can develop in just a few millimeters of water, thus fallen plant parts, tree-holes (left-behind rotted out stumps), and even the hoof-prints of cattle can quickly become prime mosquito environments (e.g. Norris, 2004; Yanoviak et al., 2006).

Certainly, the proximity of humans and human residences in relation to mosquito habitats shape malaria vulnerabilities (e.g. Vanwambeke et al, 2007). Malaria epidemics can occur when environmental conditions suddenly favor habitat proliferation and hence transmission (WHO, 2019). They also can occur when people with low immunity move into areas with intense malaria transmission, for instance to work on agricultural plantations or cattle ranches. Many studies illustrate the link between deforestation and malaria incidence as facilitated by the migrant workforce, who often come from other rural areas or urban centers, and thus have limited or no immunity to malaria (e.g. Barbieri et al., 2005; Basurko, et al., 2013; Bauch et al., 2015; Pattanayak et al., 2006). For example, Barbieri and colleagues (2005) find that malaria cases in Brazil are often concentrated among work-age males, defying traditional trends in this disease where infants, children, and pregnant women typically are most vulnerable. Indeed, rates of malaria in the Amazon are often highest among migrant workers, and the high mobility of migrant workers also increases the potential spread of malaria to additional populations. They argue that rural settlement areas are susceptible to the outbreak of malaria in their initial stages due to the intense contact between settlers and mosquitoes, especially during land clearance activities (Barbieri et al., 2005).

Migrant agricultural workers also face other sources of susceptibility. They tend to live in poorly constructed or temporary dwellings that do not provide barriers to mosquitoes at night (Barbieri et al., 2005; Basurko, et al., 2013). They are often without mosquito nets, the main form of malaria prevention during nighttime hours (Basurko, et al., 2013). Similarly, many migrant settlements have outdoor kitchens and living spaces, where workers gather at dusk and after dark when *Anopheles* mosquitoes are most active. Furthermore, non-immune migrant workers typically work in remote areas that lack health centers and basic public health infrastructure. Thus, there can be significant delays between contracting malaria and getting adequate medical intervention, which only increases the possibilities of transmitting the disease to others when mosquitoes bite those with active symptoms (Barbieri et al., 2005; Bauch et al., 2015).

Humans can also affect malaria vulnerabilities in newly established agricultural areas and frontier zones in other ways. For example, many note the importance of fish ponds in facilitating close human-mosquito interactions; studies in areas of the Brazilian Amazon link environmental changes wrought by the emerging local aquaculture industry to increased malaria risk (e.g. Olson et al., 2010; Lima et al., 2017). Farmers and local populations often establish water collection sites and fish ponds in semi-shaded areas very near settlements for convenience, but this creates mosquito breeding sites very close to where humans reside (e.g. Bauch et al., 2015). Indeed, some primary deforestation is done specifically to create areas for fish ponds and wells (e.g. Olson et al., 2010; Lima et al., 2017). Although fish can eat mosquito larvae, these studies clearly document that fish pools tend to have very large populations of larvae, and that the fish are not effective in quelling mosquito populations. For example, Olson and colleagues (2010) find that ponds, wells, and fish farms larger than 50 meters in circumference have a significant abundance of *Anopheles darlingi* larvae. Similarly, Vittor and colleagues (2006) find that large ponds and fish farms surrounded by some secondary vegetation were the most common *A. darlingi* breeding sites, and also that mosquito biting rates are especially high in the deforested zones near established fish ponds.

Some researchers carefully point out that during and in the immediate years after deforestation, mosquito larva numbers, parasite levels, or malaria cases tend to be very high, but can then fall off after a site has been completely cleared for many years (e.g. Barros et al., 2015; Caldas de Castro et al., 2006; Guerra, Snow,

and Hay, 2006; Olson et al., 2010). For example, Caldas de Castro and colleagues (2006) argue that rates of malaria begin to decline and remain low about 10 years after complete forest removal. Indeed, the bulk of this research emphasizes that "frontier" zones on the edge of deforested areas or forest "fragments" pose the highest risk (e.g. Lima et al., 2017). As mentioned briefly earlier, this is due to the fact that mosquito larvae do not prefer fully exposed sun-lit areas (e.g. Barros et al., 2015). However, it is important to stress that most areas that are deforested are subsequently used for agriculture and ranching, which do tend to create prime mosquito habitats and introduce non-immune populations. Furthermore, areas that are deforested and left fallow eventually become areas of secondary re-growth, fostering additional mosquito breeding sites, given the shrub and semi-shade conditions that eventually emerge (e.g. Barros et al., 2015; Nath et al., 2012; Vittor et al., 2009).

It should also be acknowledged that not all studies find a link between land cover change and malaria, as some demonstrate no link or point out that deforestation may decrease malaria rates over the long-term, as explained above. Inconsistencies in the literature may be due to differences in research methods, land change definitions, study approach or design, scale, or locational focus (Lima et al., 2017). However, the body of research that asserts clear links between deforestation and malaria is large and growing, and far exceeds the limited number of studies that find no demonstrable link (e.g. Lima et al., 2017).

Trends and causes of deforestation in developing nations

Zones where malaria is endemic are also areas that face some of the highest rates of deforestation, including tropical and sub-tropical regions of Sub-Saharan Africa, Central and South America, and South East Asia (e.g. FAO, 2018). Deforestation is not a natural phenomenon, but rather results predominantly from human activities. The main causes of deforestation in developing nations include expansion in agriculture, fuel wood consumption, livestock ranching, logging, and infrastructure, such as road creation (e.g. FAO, 2018; Population Action International, 2011). It is important to note that these proximate causes tend to vary across regions. For example, logging is very prominent in S.E. Asia, while cattle ranching characterizes many areas of South America, and fuel wood consumption is highest in Sub-Saharan Africa, particularly East Africa (e.g. Carr, Suter and Barbieri, 2005; FAO, 2018; Rudel, 2005). However, agricultural

development characterizes each of these areas and is often emphasized as the main driver of forest loss globally (e.g. FAO, 2018; Population Action International, 2011). Certainly, overpopulation and population growth underlie each of these causes. Population pressures on forests in rural areas can manifest in both direct and indirect ways, as will be explained below (e.g. Carr et al., 2005; Rudel, 2005).

The total world population is expected to increase from 7.6 billion to 10 billion by 2050 and global demand for food is also expected to increase by 50% during this period (FAO, 2018). The nations with the highest rates of forest loss tend to have large populations and high population growth rates, such as in Brazil, Indonesia, DR Congo, and Nigeria (FAO, 2018). Fertility rates remain high among many poor nations, especially for rural residents that live on forest frontiers; for example, family sizes in rural areas of the Global South commonly exceed 7 children (Carr et al., 2005; Clark, 2012). Also, many Sub-Saharan African nations in particular have an extreme "youth bulge" where over 50% of the population is under the age of 18. Such demographic patterns will increase the momentum of population pressures on forests.

Small frontier farmers who live on the edges of forested expanses drive the bulk of deforestation in less-developed nations for settlement and food production (Carr et al., 2005; Lopez-Carr and Burgdorfer, 2013). Subsistence farmers have big families, and large household sizes put immediate pressure on forests (Dolisca et al., 2007; Rudel, 2005). Indeed, many researchers point out that despite increases in commercialized agriculture in developing nations, it is small-scale and subsistence farmers that are responsible for the bulk of direct forest felling (Carr, 2009; Lopez-Carr and Burgdorfer, 2013). While rural to urban migration and upwards trends in urbanization are significant, as will be discussed in more detail below, there is a notable and often overlooked level of rural-to-rural migration which puts extreme burdens on forests (e.g. Carr 2009; Rudel, 2005).

Indeed, the highest rates of fertility and household-level population growth will continue to occur among rural people living in or on the edges of forests. Rural or subsistence farmers in less-developed nations are typically poor and rely on cleared land for household food production (e.g. Dolisca et al., 2007; Rudel, 2005). Their agricultural production is expansive rather than intensive, due to a lack of money to afford fertilizers or farm machinery and the ample availability of

household labor (Lopez-Carr and Burgdorfer, 2013). As household size continues to increase and soils slowly become depleted over time, these rural families move or expand farm areas, deforesting in order to maintain and expand yields (Clark, 2012; Dolisca et al., 2007; Kong et al., 2019; Lopez-Carr and Burgdorfer, 2013).

These populations are often termed "frontier migrants", and although logging industries or commercial agriculture firms are most often implicated as the main culprits in global forest loss, it is these small-scale farmers that are directly responsible for the highest levels of actual felling, especially in tropical and old-growth forests (e.g. Carr, 2009; Lopez-Carr and Burgdorfer, 2013; Kong et al., 2019). As children mature in frontier households, they follow the examples of their parents and expand to new areas to support their growing families (e.g. Carr et al., 2005). Rural frontier migrants tend to be poor, have low levels of education, and have very limited wage labor prospects, thus they aim to establish new farmlands as a source of household security and resource provision (Carr, 2009; Kong et al., 2019; Rudel, 2005). Indeed, the most pressure is put on forests when rural population growth is high and households are poor (Jha and Bawa, 2005).

Although rural population growth overall has declined over the years, largely due to migration to urban areas within developing nations, deforestation rates have remained steady or even increased in most developing nations. In fact, the World Resources Institute reports that 2017 was the second-worst year on record for tropical forest loss (Weisse and Goldman 2018). These trends suggest that even amid declining rural population levels, the rate of forest-clearing per farmer has increased (Lopez-Carr and Burgdorfer, 2013). This is likely due to increased land fragmentation, land consolidation, and heightened soil depletion, facilitating rural-to-rural migration to new areas by established households or second-generation households (e.g. Carr, 2009; Kong et al., 2019' Lopez-Carr and Burgdorfer, 2013; Rudel, 2005).

Many researchers also note the importance of land tenure insecurity in promoting deforestation among rural farmers (e.g. Dolisca et al., 2007; Lopez-Carr and Burgdorfer, 2013; Rudel, 2005). Frontier migrants moving to new areas deforest in order to make claim to land in regions where there are no formal regulations or land titles, or in areas where land ownership is loosely regulated. Those without land titles are thus pressured to convert forested land to agriculture as fast as

possible, leading to rapid felling. Rural people without land titles are more likely to migrate to new areas on the forest frontier in comparison to rural subsistence farmers with land titles (Carr, 2009).

Urbanization and agricultural commercialization or agricultural exports are also recognized as key drivers of deforestation in developing nations, albeit indirectly. Indeed, consumption levels of forest products, such as food and timber, are growing globally, and most of this consumption takes place in urban centers or developed nations far from the sites of forest loss in rural areas of the Global South (e.g. Carr et al., 2005; DeFries et al., 2010). However, this remote demand remains significant. Growing urban populations may be less dependent on solid fuels, but still demand food, and the diets of urban residents are increasingly reliant on meat, which creates elevated forest resource pressures (Carr et al., 2005; DeFries et al., 2010). Researchers emphasize that large-scale cattle ranchers and commercialized agricultural firms may not be responsible for as much primary deforestation as it seems, but rather, are significant in pushing out small-scale rural peasants who have already deforested (e.g. Carr, 2009; Carr et al., 2005; Lopez-Carr and Burgdorfer, 2013). As lands become consolidated and sold off to large-holders, this indirectly motivates deforestation by pushing frontier farmers into new unclaimed areas where they initiate primary forest loss to re-establish production and gain tenure to land (e.g. Carr et al., 2005; Lopez-Carr and Burgdorfer, 2013). In this way, political-economic or core-periphery relationships, related to the acquisition of environmental space in poorer nations to support consumption levels in more affluent areas globally, do play an important role in promoting deforestation in less-developed nations, though this is hard to quantify or measure directly.

Conclusion

The World Health Organization (2016) estimates that nearly a quarter of all deaths worldwide are due to environmental causes. As rates of environmental degradation and transformation continue to grow in scale and scope, this impact is only likely to intensify. Zoonotic diseases, or diseases that affect both humans and insects or other animals, will likely be of growing concern in the coming decades as population growth, increased food consumption levels, and resulting environmental degradation expand human interactions with potential disease pathogens. Malaria, often a disease that is "forgotten" among affluent populations, is experiencing a resurgence, in part due to human impacts on

the natural environment that expand potential mosquito habitats and influence biting behaviors.

This paper brings to light a large and growing body of research that links deforestation to malaria epidemics in poor nations. Research has demonstrated that forest loss can lead to heightened malaria vulnerabilities through a number of mechanisms, such as raising indoor and outdoor temperatures, increasing the availability of mosquito breeding sites, and introducing migrant worker populations that lack malaria immunity into endemic regions. Many of these mechanisms necessarily concern establishing water or altering current water sources in ways that proliferate mosquito larvae, such as creating standing water through micro dams, irrigation ditches, road building, crop residues, tree holes, or wells and fish ponds. Overall, this research finds that "frontier zones" located on the edge of deforestation sites, agricultural sites, areas of secondary re-growth, and selective logging in particular offer the right mix of sun, shade, still water sources, and nearby human settlements necessary to increase malaria parasite levels and disease transmission (e.g. Lima et al., 2017).

Deforestation is caused by population pressures by people both near and far from forested areas in malaria-endemic nations (e.g. FAO, 2018). A number of studies emphasize that it is poor, rural frontier migrants that are most directly responsible for felling trees and living on forest fringes (e.g. Carr, 2009; Kong et al., 2019; Lopez-Carr and Burgdorfer, 2013). It should be emphasized that these marginalized populations are among the least educated, have the highest fertility rates, and are likely to have very limited access to basic health resources. Thus, rural people that live nearest to deforestation sites where malaria vulnerabilities are highest due to entomological and ecological factors are also those that face the highest demographic and socio-economic vulnerabilities to the disease. While commercial agricultural producers and ranchers are likely contributing to forest loss indirectly by displacing rural families, these large farms are also often located on forest fringes, can encourage mosquitoes in other ways (e.g. irrigation, road building), and bring in migrant workers who lack immunity to malaria or proper access to healthcare. Thus, it is important to emphasize that patterns in deforestation and land use in developing nations serve to not only further mosquito habitats, but also invite populations who are most at risk of acquiring and succumbing to malaria.

Despite significant improvements in malaria prevention, diagnosis, and treatment over the last several decades, global malaria rates are now rising and this disease remains a leading cause of death in many areas of the Global South (WHO, 2019). In addition to deforestation, many scholars note potential influences of climate change in spreading mosquito habitats (e.g. Pattanayak et al., 2006). Heightened environmental change and population dynamics in rural areas, coupled with increasing insecticide and antibiotic resistance, likely mean that concerns over malaria and other mosquito-borne diseases are only going to magnify in the coming decades. Undoubtedly, understanding and mitigating the underlying anthropogenic causes of malaria transmission deserves vigilant attention.

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PEER REVIEWED ARTICLE

The impact of reproductive health services on armed conflict in Afghanistan

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Abstract

Reduction of child mortality while coverage of family planning services remains low may render Afghanistan a testing ground for the theory of demographic transition. Meanwhile there is a vicious circle: young men lacking employment join the Taliban and so increase national insecurity, discouraging industry and reducing employment opportunities. For progress towards peace to be made and sustained, family planning, education and employment need to be major parts of the peace effort, and UN reports need to emphasise more which way the scales tip.

Keywords: Armed conflict; family planning; demographic transition; Afghanistan.

Introduction

The observation that after reduction in mortality rates societies also experience reduction in birth rates is well established. However, for countries experiencing civil strife, such as Afghanistan, progress through the stages of this demographic transition is more problematic and uncertain. In particular the presence of a "youth bulge" in Afghanistan's demographic structure, itself a result of the success of interventions to reduce child mortality rates, poses particular challenges to the ability of the country to move through its present stage of demographic transition towards stabilisation of population. We argue that Afghanistan's youth bulge leads to a vicious circle where young men lacking employment opportunities join the Taliban, thereby increasing national insecurity and discouraging economic development which in turn further reduces employment opportunities.

This paper is divided into three sections. In the first we examine the notion of "youth bulge" and its relation to conflict. In the second section we explore the issues, problems and prospects of family planning provision in Afghanistan. Finally, we attempt to understand the possible consequences of Afghanistan's increasing population and in particular of the "youth bulge". We conclude that to achieve a lasting peace, family planning, education and employment are central. There is little hesitation amongst agencies in the provision of resources to reduce infant mortality. However, we argue that providing adequate and cost-effective family planning will be of comparable significance in securing the future welfare of Afghanistan's citizens, and this needs to be said loudly and clearly by all agencies concerned.

1. How a youth bulge may increase armed conflict

Improvement of mother and child health has led to significant reductions in under-5 mortality. Those reductions, with Afghanistan's total fertility rate of approximately 5.3 live births per woman in 2015 (Central Statistics Organization (CSO), et al., 2017), the highest in South Asia (though earlier surveys have been inconclusive about the exact level of fertility), are leading to increasing numbers of young people. At this first stage of population transition, from high to lower mortality rates, the increased numbers of young men and women often lack productive land to sustain them or employment in cities. Some of the young men, frustrated at lack of earnings, especially given the high bride price and huge cost of weddings, which can lead to debt, can be expected to turn to insurgency,

especially when armed opposition groups pay more than the Afghan National Army. Others emigrate.

There is evidence that a youth bulge – and here we use the definition of a youth bulge as a high proportion of those aged 15 to 24 in the total population – significantly raises the probability of civil conflict, at least while acting with certain other factors. A report of Population Action International states: "The likelihood of experiencing conflict is highest among countries with "very young" age structures, where up to 77 percent of the population is younger than age 30. Between 2000 and 2007, two-thirds of all new outbreaks of civil conflict occurred in countries with very young age structures…" (Madsen, et al., 2013, p.2). The US think tank, the Council on Foreign Relations, reported in 2007 that there were then 67 countries with youth bulges, of which 60 were experiencing social unrest and violence (Beehner, 2007). Youthful populations, some have found, are risky populations (Wilson Centre, 2013). Others have contested a causal link between a youth bulge and increased social instability. From their study of events of major political instability between 1955 and 2003 Goldstone et al. (2010) concluded that youth bulges reveal the level of pre-existing vulnerability by actualizing 'potential' instability that is already present and largely determined by other factors. In other words a youth bulge is not sufficient cause of armed conflict. However, the purpose of these authors was to identify factors predictive of civil conflict rather than causal factors. We do not suppose that a youth bulge is a stand-alone causal factor of armed conflict. It is, in our view, one of a number of interacting factors, such as poverty, but a significant causal factor. In an analysis of disorder in 55 major Asian and African *cities* Urdal and Hoescher (2009) similarly found that large male youth bulges were not generally associated with increased risks of social disturbance. However, the authors note that most armed conflicts take place in peripheral and often rural areas. Buhaug & Rød found that while territorial conflict is more likely in sparsely populated regions, conflict over state governance is more likely in regions that are densely populated and near the capital city (Buhaug & Rød, 2006). Buhaug and colleagues found that the risk of conflict is positively associated with the extent of rough terrain in the peripheral group's home region and its distance from the political centre (Buhaug, Cederman & Rød, 2007).

Urdal and Hoescher (2009) also found that low secondary education levels among young males aged 20-24 and low economic growth consistently increased the risk of social disturbance and reflected that periods of economic downturn that limit new job creation are likely to affect youth the most since they have just entered the labour market. In summary, although the effect of population age structure is contested, there is an emerging consensus that economic stagnation, poverty and unemployment can lead to high levels of violence and unrest. All three factors are at work in Afghanistan, and poverty and unemployment are likely to impact youth the hardest.

The second stage of demographic transition, reduction of birth rate, has never happened without earlier reduction of child mortality (Dyson, 2015). The interval after the start of the first stage may be a generation, but can be reduced if reduction of child mortality is accompanied, or soon followed, by provision of family planning services to enable parents to space births and reduce the birth rate. There are strong indications that, in urban areas at least, Afghanistan has entered the second stage of demographic transition with decrease in the total fertility rate (UNFPA, 2015). But despite that, the reduction in child mortality leading to increase of youth population but without matching improvement of prospects for employment, poses increased risk of armed conflict.

The theory of demographic transition has by and large worked to date. But, by reducing child mortality and increasing life expectancy, healthcare enormously increases pressure on food resources. And the adverse effects that global warming is already having on food production may render past experience of population transition a poor guide for the future (Bourne, 2015). Afghanistan will be one of the testing grounds which will determine whether under these circumstances the theory of demographic transition holds true or there is a reversion to the Malthusian trap. Also, there is no certainty that increased birth spacing achieved by use of contraception, and improved child survival rates will result in any reduction in total numbers of surviving children a couple has.

2. Family planning in Afghanistan and its obstacles

Family planning services, enabling parents to decide on family size or to space births, with information on the benefits, provides high value for the resources invested (Carvalho et al., 2012). Birth spacing enables women to recover their

health before the next birth as well as improving the health and lives of children. Family planning enables parents to avoid pregnancy early and late in a woman's reproductive life, which are the times of greatest risk. The Maternal Health Task Force at Harvard Chan School estimated that in 2008 contraceptive use averted approximately 44% of maternal deaths worldwide (Maternal Health Task Force, 2008).

Increasingly, however, new analyses have pointed to the conclusion that the primary barriers to use of family planning are large desired family size and fear of health effects of contraceptives (Ryerson, 2018). Researchers at the Guttmacher Institute found from a decade of data from 52 developing countries that actual lack of access to contraception accounted for only 5% of the reasons for non-use (Sedgh, Ashford, and Hussain, 2016). Fear of adverse effects on health or opposition to contraception made up 49% of non-use. In Afghanistan, as in many other countries, high fertility enhances self-esteem and standing in the community for men and women. In a patrilinear society people want sons to carry on the family name and, for rural people, to cultivate the family's land. But Afghanistan stands apart from all other Asian countries in the small percentages of women wishing to have no more children (Central Statistics Organization (CSO), et al., 2017, p.91). When child mortality is high, people can't rely on having only one son, and to have two sons they will on average need to have four children.

Islamic teaching has generally been interpreted as encouraging birth, but interpretations vary on contraception, which is approved in appropriate circumstances. The general principle in the Qur'an is to work for the welfare of humanity. It promotes two years of breast feeding, which reduces fertility. The general consensus of scholars is that family planning is permitted, but the preferable means are debated. There are limited prescriptive or proscriptive rules. Some hold a belief that Islam does not allow preventive measures, but other clerics claim, based on religious studies, that the mother's health has priority and that contraception is generally permitted. Several Hadiths, the sayings of the Prophet Muhammad, suggest that he approved of *azl*, the withdrawal method, which apart from abstinence was the only means of contraception in his time. Scholars in Egypt argued that any method of preventing conception is acceptable according to Islam and indeed most Muslim scholars agree with the principle of family planning (Chaudhuri, 2018). Family planning programmes have been vigorously pursued in

such Islamic countries as Iran, Indonesia and Bangladesh. However, some religious scholars have argued that contraception is sinful in Islam as it reduces the increase of the Muslim population (Shafiqullah, Keiko and Seino, 2018).

Lack of availability of public health education on family planning and of provision of contraception for much of the population of Afghanistan is, in our view, an important limiting factor in reducing fertility. Yet the cost of family planning is small compared with what is spent on aid and arms (Parsons, 1996). Supply of contraception may be the "low-hanging fruit" (Bruce and Bongaarts, 2010), and it makes sense to prioritise what can be delivered most cost-effectively.

Globally, family planning and population are contentious subjects and worldwide interest in both has declined, especially since the UN International Conference on Population and Development in Cairo in 1994, which resolved rightly that family planning was the responsibility of parents. But where there are no accessible family planning services, leaving decisions to parents is just a nice idea. Also, the Cairo conference tucked family planning away inside the wider concept of "reproductive health", on which all could agree, largely removing any need to refer to it. A result was apathy. Population, has "sort of fallen off the world's agenda" (Gerland, 2014, pp.234-237), though in more recent times the pendulum has swung back somewhat in favour of family planning. It is on the agenda in Afghanistan, but as in much of the world, lower down than it should be.

Since the Cairo conference transferred family planning into the domain of reproductive health services, the proper central person for its delivery has been considered to be the midwife. However, based on our experience of working in Afghanistan it is apparent that although many midwives have been trained, results have been limited by, as elsewhere, the reluctance of many midwives, after training in the city, to serve the 73% rural population in remote villages as well as by the distance of many villages from health centres and midwives' lack of transport for outreach. Couples living three hours or more by donkey from a health centre are unlikely to make the journey for a month's contraception.

The plan of the Ministry of Public Health (MoPH) is to train "community midwives" to provide services in their home clusters of villages (Mohmand, 2013). But recruiting midwives for all health centres is hard enough. In 2016 we were told of a

recruitment shortage of 50 midwives in just one of the 34 provinces, and we have known of health centres which were nominally fully staffed, while the midwife was actually in the city most of the time. Added to that, in 2016 because of armed conflict 150 out of 360 districts were no-go areas for government contracted staff (Najafizada, 2017). Risks can be high even for health workers unless much work has been done to establish strong relations with the Taliban.

The Demographic and Health Survey 2015 found that 20% of currently married women used a modern method of contraception (Central Statistics Organization (CSO), et al., 2017). The Afghanistan Multiple Indicator Cluster Survey (AMICS) found a contraceptive prevalence rate of 21% of married women in 2010–2011 (World Bank, 2014). Reports on levels of use of family planning vary greatly; UNFPA reported that the use of family planning methods doubled in the decade to 2015 (UNFPA, 2015). However, the Demographic and Health Survey 2015 found that 25% of currently married women had an unmet need for family planning (Central Statistics Organization (CSO), et al., 2017). A more recent paper reports that contraceptive use by women has been stagnant since 2012, in part linked with the low average educational standard of women (Das et al., 2018).

The AMICS data showed a strong correlation between a girl's or woman's level of education and her use of contraceptive methods (World Bank, 2014). The Demographic and Health Survey 2015 found that women with more than a secondary education were more likely to use modern methods of contraception (30%) than those with no education (19%) (Central Statistics Organization (CSO), et al., 2017). There is a multiplier effect here; fewer pregnancies and births per woman can in turn enable improved education of her children (Carvalho, Goldie and Salehi, 2012). Conversely, that would mean that the more births a woman has, the less education her children will have, and when they reach adulthood, they in turn will have more children.

In the MoPH's Basic Package of Health Services male and female Community Health Workers (CHWs), after training for 18 days, provide basic healthcare, including family planning, in their own villages on a voluntary basis (Ministry of Public Health, 2010). CHWs are better placed than midwives to provide family planning services to women in rural areas. Women have ready access to them and they know the reproductive status of all women in their village and can

discuss contraception with them in the privacy of their homes, whereas a visit to a midwife in a health centre is more public. On the other hand, in a culture in which some women are afraid to cry out in childbirth because that would indicate to neighbours that they have had sexual intercourse, we may wonder whether all women are willing to divulge their contraceptive needs to a CHW who is a neighbour. Nevertheless, it has been found elsewhere that where other family planning approaches have failed, female CHWs have increased the uptake of contraception among rural women (Douthwaite and Ward, 2005).

We have found in two rural districts of Afghanistan that, when well-trained, sufficiently supplied, supervised and supported, CHWs pursue their work enthusiastically and effectively (Parsa, 2018). A study in rural Afghanistan which assessed the impact of health education and the delivery of injectable contraceptives by CHWs over an 8-month period in 2005 to 2006 found that contraceptive use increased by 24% to 27% across three sites (Huber, Saeedi and Samedi, 2018). Though many men and women had started with the belief that contraception carried more risk than pregnancy and that modern contraception caused infertility, men as well as women supported use of modern contraceptives once they understood their safety and effectiveness. Approximately 30,000 CHWs are listed as having been trained and as supported and supervised, but the Community Based Health Care Program, which is responsible for CHWs, does not have high priority within the MoPH and many women have no knowledge of a CHW working in their community. When CHWs are not well-trained, sufficiently supplied, supervised and supported, their work is sustained poorly or not at all.

3. The tribulations of Afghanistan's youth

Cincotta has said "The highest probability of civil conflict (often protracted) is associated with very young populations – the Afghanistan… situation" (Population Reference Bureau, 2011). Afghanistan has one of the most youthful age structures in the world. In 2014 63.7% of the population was below the age of 25 and 46% was below age 15 (Central Statistics Organization, 2014). Lacking a recent census, the population was estimated by the UN in 2011 to be 32.4 million. In 2014 the Central Statistics Organization estimated population growth rate of 2.03% per year (Central Statistics Organization, 2014a). The arithmetic is not rocket science. If the total fertility rate is five, and child mortality is reduced to 67.9 per 100,000 live births (UNICEF, 2019), the population will at least double in each generation

unless war escalates. The 2017 UN population projections give a total population of 62 million by 2050 (United Nations DESA, Population Division, 2017).

It is unlikely that Afghanistan could sustain such a high population. Though there are fertile valleys and plains with irrigation, much of the rural population is in mountainous or semi-mountainous areas, where the soil is shallow loess, a sediment formed by accumulation of wind-blown dust. Snowmelt and spring rains often lead to serious erosion and in many parts there are few trees to hold back the loss of topsoil, a problem which is exacerbated by lack of other fuel for cooking and domestic heating. Where crops are rainfed, two droughts in succession can necessitate a family's move to the nearest city. Most smallholders and sharecroppers can't afford improved, drought-resistant seed and have to rely on their own homegrown seed, which attenuates from year to year. Afghanistan's revenue still comprises well under half of total budget expenditure, most of which continues to be financed by aid (Byrd, W. and Payenda, M.K., 2016). If Afghanistan's home-grown food stocks run out, at present it could not afford to import food crops to feed its population.

Poverty and lack of education are major determinants of armed conflict. UNFPA's 2014 Afghanistan State of Youth Report (UNFPA, 2014) warns that youth employment has to be looked at in the context of poverty and the quality of available work – and the National Risk and Vulnerability Assessment 2011–2012 reports that 81% of jobs can be classified as vulnerable employment as they do not secure stable and sufficient income (National Risk and Vulnerability Assessment, 2014). The Afghan economy has not developed enough to be able to absorb the country's 400,000 annual labour market entrants in the foreseeable future. With a high proportion of the population either poor or at risk of being poor (UNFPA, 2014), most people, in particular young people, who are expected to contribute to household incomes, simply cannot afford to be unemployed. Everyone has to find some way of gaining a living, but many are underemployed. As during the industrial revolution in Europe and the USA, child labour is much the cheapest for unskilled work which is not excessively heavy, and this militates against youth employment.

Mobility then becomes a key factor for employment, but young Afghans, with no or few qualifications and little financial support, are not welcomed in other

countries and find migration to any higher income country so challenging that they may realistically feel imprisoned in Afghanistan. In time they could find themselves imprisoned in a country which will not have the resources to feed them, which would amount to famine enforced by border controls.

The UNFPA's Afghanistan State of Youth Report 2014 speaks of a window of opportunity for a country arising from population change, strategic investment and accelerated economic growth (UNFPA, 2014), but in Afghanistan there is no prospect in sight of such a dividend. There is instead a vicious circle: young men can't find employment and join the Taliban, and that increases national insecurity and discourages industry, contributing to unemployment. And there is an additional vicious circle: while fertility levels and population growth remain high, the dependency ratio, the ratio of people below 15 plus those over 64 to people of working age – between 15 and 65 – also stays high and families and governments typically do not have the resources to invest in their young population.

The Afghanistan Living Conditions Survey, a joint government and EU report, found the national poverty rate rose from 38% in 2011-12 to 55% in 2016-17 (Central Statistics Organisation, 2018). 41% of Afghan children had moderate or severe stunting (UNICEF, 2019). More than 20% of the population cannot afford to meet their minimum nutritional requirements. In a country where there is great poverty, relatively good payment is the main reason for families allowing their children to join the Taliban (Landinfo, 2017). It is unclear what the Taliban pay their recruits, but representatives of NGOs have estimated that it is in the region of 300 US dollars per month (Afghanistan Crossroads, 2009). Some, however, join the insurgency to fight for the Taliban's interpretation of Islam and others to combat the US presence on Afghan soil.

It appears that reduction in child mortality has contributed to poverty, and poverty has increased the opportunity for the Taliban to recruit (UNFPA, 2014). Truly the beds of poverty are fertile. They have to be in order to have some children survive to reproduce.

In Britain in the time of Thomas Malthus a significant factor in limiting fertility was late marriage (Malthus, 2015 [1798]). The UNFPA report of 2015 says that Afghan youth were then marrying later than previously. It refers to marrying later "extending their

education period", but without evidence for that link (UNFPA, 2015). For young men marrying later is often due to the time needed to earn and save the bride price. It is largely in order to gain the bride price (not mentioned in these UNFPA reports) and have one less mouth to feed that parents arrange the marriages of their daughters at young ages. So poverty can be a factor both for young men in marrying later and for girls in being married earlier. And where older men marry young girls, fertility is likely to be high. Saving or borrowing the bride price and paying for the customary enormous wedding impoverishes the already poor, and it is the poor who most lack contraception and education about family planning.

The Taliban has recruited 60,000 core fighters, a quarter of the level of the Afghan defence forces (Giustozzi, 2012). The majority of the fighters recruited by the Taliban and many by government security forces were born after the US-led invasion of 2001 and thousands of child fighters are recorded among the Taliban (Agence France-Presse, 2017). According to President Ashraf Ghani 45,000 security force personnel were killed between 2014 and 2019 (BBC, 2019).

On average in Afghanistan women with no education have two more children than women with more than a secondary education (Central Statistics Organization (CSO), et al., 2017). If the sons of women who have lacked education also receive less than average education, they may be expected to have less success in finding employment and to be more likely to join the Taliban.

4. Discussion

Even after more than two hundred years we still can't get away from the harsh but rather obvious forecast of Thomas Malthus that population grows until it reaches the limit of the capacity of the land to feed people, whereupon increasing mortality returns it to equilibrium: the "Malthusian trap" (Malthus, 2015 [1798]). Population studies in the present era have, however, tried to turn it on its head. The UNFPA has set out increase in child survival as the first stage of the demographic transition which, with family planning information and services and education *should* constitute a "window of opportunity" (UNFPA, 2014). Yes, of course. But increase in child survival without family planning, education and employment opportunities can be a window not to the second stage of the demographic transition, but to armed conflict. The dismal truth of the Malthusian trap is still with us.

The UNFPA's Investing in Youth report aims for a "balanced perspective …. recognizing that fast population growth, under a context of constrained resources, may reproduce and expand poverty; yet, under conditions of abundant resources and relevant investments in new technologies, infrastructure, research and human development, a larger and highly qualified population would represent an important factor to increase productivity and wellbeing" (UNFPA, 2015, p.13). This theory is based on evidence from countries where the demographic transition has taken place, the now-rich countries, but how can Afghanistan achieve this aspiration? Without addressing the enormous gap between the aspiration and the present reality of Afghanistan, it would not be difficult for those in government and donor agencies alike to take from this report that stabilisation of population growth is a process which will be, contingent on a few factors, almost automatic. That could lull them into believing, in a country where many issues daily call for urgent action, that stabilisation of population requires no higher priority than any other call for additional effort or resources. Add to this that population growth is a long-term matter and that issues to which politicians give highest priority are those which require their response this week, if not today. Permanent Afghan staff in ministries and foreign delegations may better understand the import of population growth, but most expatriates are in Kabul for the short term only. Statements of balance need weighting and emphasis so that all concerned can see which way the scales tip.

We do not contest the need for UN agencies to set out the prospects for a country in diplomatic terms, but the enormous risk here is that the optimistic gloss will be taken at face value. UN reports are written and edited by people with many years of experience not only in their technical specialisms but also in diplomacy. The risk is that they may be read by those in government ministries or by representatives of foreign donor governments and international organisations such as the World Bank whose specialisms and experience are far outside the realm of population studies. Those readers will not have the background necessary to assess either the nuanced language, perhaps in a foreign tongue, or the full impact of the figures themselves.

For example, the UNFPA report says candidly "even if Afghanistan continues to make progress in meeting family planning needs and if population growth continues to decline, the country remains decades away from a possible

demographic dividend" (UNFPA, 2014, p. 14). The statement "population growth *continues* to decline" is too comforting for the politician or diplomat whose training and skills lie in other fields. Yes, when fertility starts to decline, if adult and child mortality do not decrease, the *rate of growth* of population also declines, but demographic momentum means the population continues to grow for decades to come, and all the faster when child mortality if reducing. Given the restricted access to, and very low uptake of, family planning, messages such as this need to be in words which convey the urgency of the problem if decision makers are to understand fully, sit up and respond. Reports on important issues like this, in other words, need to be written with full attention to the likely priorities, workloads and time scales of the main target readers. Authors need to bear in mind that population growth is still a dismal science that few will wish to attend to.

The UNFPA's Investing in Youth report says "The largest benefits [of the demographic bonus] are obtained when the favourable age structure combines with job opportunities for the new entrants to the labour force, as well as investments in health, education and technical skills …" (UNFPA, 2014, p. 15). If only it were so in Afghanistan! Even more liable to be misunderstood is the gloss that Afghanistan's "population dynamics provide a unique potential for accelerated and sustainable development" (ibid. p. 4). Even the most prosperous economies would tremble before a population surge such as Afghanistan faces: witness the high barriers to immigration put up by European countries and their "offshoots" like the United States and Australia. Even China with its rapidly growing economy still has stern controls to population growth in place, even if less punitive than before.

Certainly, the UNFPA's Afghanistan State of Youth Report 2014 does allow that the demographic dividend is not an automatic process but depends on the right kind of policy environment, but much more than policies are needed. Policies, where the means to implement them are lacking, may be little more than good intentions.

The UNFPA reports provide important analyses of the situation, but they do not take sufficiently into account the obstacles stacked against making the youth bulge a force for the good in Afghanistan. The circumstances are very different

from those of Silicon Valley, where a youth culture is highly productive. There will be little investment in industry, excepting some extraction of minerals, and little job creation until the armed conflict is greatly reduced. Even then, Afghanistan will remain a landlocked country with its capital 1394 kilometres from the nearest port, Karachi. And mountains have so far confined its three short lengths of railway to the North.

Security requires that the expatriate staff of UN agencies based in Kabul can only leave their compound in a convoy of at least three vehicles. When they do get out, they will have seen able young men selling a few mobile phone scratch cards on the streets. Many expatriates will have experienced the disappointment at job interviews of the many university graduates struggling to find work.

The massive inflow of funds for aid and development, with insufficient monitoring and audit, has fostered corruption at all levels where there is power (Chayes, 2015), and that extends to corruption of data. It should be no surprise if recipient organisations aim to please their international donors by reporting high achievements. Responding to the felt need for success stories by manipulation of data can do massive harm to the work of government ministries and to wider society. A report by the Afghan government in 2016 said "fraud, falsification, fakes, and forgeries have become a routine aspect of documentation in the Public Health sector. This has had dire consequences for the integrity and reliability of each of the main elements of the health system", including finance, health services delivery and management information systems (Independent Joint Anti-Corruption Monitoring and Evaluation Committee, 2016, p. 20).

Let us illustrate how that falsification of data harms. The USAID-funded Afghanistan Mortality Survey 2010 estimated maternal mortality ratio (MMR) of 327 deaths per 100,000 live births (Afghan Public Health Institute, et al. 2011). If this and the primary survey of 2002, which found MMR of 1,600 per 100,000 live births (Bartlett, et al., 2005) were approximately accurate, Afghanistan would have achieved Millennium Development Goal 5a, a 75% reduction in MMR from 1990 to 2015, five years early. Could it have been achieved so fast? In countries which have successfully reduced high MMR it has taken decades (Koblinsky, 2003). Some have asked if this decline in MMR was "too good to be true?" (Marcus, Pavignani and Hill, 2013; Britten, 2017). For the donors such a good outcome would spell

mission accomplished, enabling withdrawal of funding. Detection of falsification in scientific fields in most of the rich nations is the fast route to the end of a career. But those funding a survey in a least developed country do not always apply such high standards and sometimes appear to turn a blind eye to falsification. Standards are not invisible; implementing agencies in a least developed country like Afghanistan see the standards required by their donor agencies. For them, as for the donors, a favourable result is success, but for the population it could spell withdrawal of funds from a programme less than half accomplished. In the year of the Afghanistan Mortality Survey 2010 two-thirds of deliveries in Afghanistan took place on the floor at home without a skilled birth attendant.

To their credit, UN agencies initially rejected the Afghanistan Mortality Survey's figure, which resulted in a year-long discussion before agreement and publication of the Survey's findings, bearing the logos of WHO, UNICEF, and UNFPA. The UN agencies appear to have done their diplomatic best in arbitration to reduce falsification and possibly to keep donors engaged. The truth about population, like that of maternal mortality, needs to be told as it is.

Conclusion

In many developing countries demographic transition is compressed and taking place a lot faster than it did over centuries in the now-rich countries, but it is still likely to take almost a century before the new equilibrium is reached, and in some instances of social instability fertility decline is likely to be slower than it was in Europe (Dyson, 2015). In Afghanistan the benign progression to a demographic bonus outlined by some demographers is unlikely to be achieved for a long time to come. The challenge is, by provision of countrywide and effective family planning services and employment opportunities and by continuing progress in education, to reduce the wastage of armed conflict and prevent a malign cycle growing.

No one hesitates to pick the low-hanging fruit of the first stage of population transition, reducing child deaths. In Afghan villages little input is needed to make large reductions in post-weaning under-five deaths. Provision of improved water and oral rehydration salts can reduce deaths from dehydration in summer drastically, and antibiotics can greatly reduce deaths from pneumonia in winter, though neonatal deaths remain harder to reduce. Why not pick the low-hanging

fruit of the second stage of population transition by providing highly cost-effective family planning services? It should not be an after-thought.

In 2016 the government of Afghanistan introduced the Citizens Charter to improve multi-sectorial collaboration across certain key ministries, including the Ministry of Public Health and the Ministry of Education (Islamic Republic of Afghanistan, 2016). The Citizens Charter marks an important step forward, but such inter-ministerial collaboration could achieve much more if it took into account the part which family planning could play, alongside the improvement of education and employment, which the Charter addresses, in reducing armed conflict. Family planning, education and employment should be major parts of the peace effort.

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PEER REVIEWED ARTICLE

Environment, poverty and the steady state economy

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Abstract

Environmental degradation and inequality of income and wealth are two major global problems at the present time. This paper suggests that a steady state economy offers solutions for both problems. It argues that if the world population is drastically reduced and remains constant at a low level ecological balance can be achieved and, at the same time, income distribution will be greatly improved. The basis of this argument is that a smaller population will reduce the use of natural resources for production and consumption and at the same time reduce the supply of labor and thus increase wages. Also, a brief review of the idea of the steady state economy from the ancient philosophers to modern writers is provided.

Keywords: Ecological balance, overpopulation, income inequality, steady state economy.

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1. Introduction

After the Second World War one of the main concerns of economists, governments and international organizations was the economic development of all nations leading to increasing gross domestic product (GDP) and per capita consumption. The apparent success during the 1950-1970 period, often called the golden age of capitalism, reinforced the enthusiasm for economic growth. However, others were drawing the attention of the public and governments to the rising difficulties because of the rapidly growing population and the limited natural resources (Ehrlich, 1968, Meadows et al. 1972, Daly, 1973). Even before that time, Nelson (1956) and Huxley (1956) were suggesting that much of the problems of poverty in less developed countries were a result of increasing population worldwide.

After many years of impressive growth, it is now generally accepted that sustainable growth for an infinite or very long period is impossible. This is because economic growth cannot exceed the limits imposed by a finite earth ecosystem. Resources are limited and some of them cannot increase by investment or by new technologies. For instance, land, water, and fossil fuels are limited resources (Pimentel et al. 2010). Copper and other metals, potassium, and phosphorous are also limited. Recycling may delay exhaustion of a non-reproducible resource but can never increase it. Of course, some resources are substitutable and while the price system may provide the motive for the use of one or the other, it cannot increase the upper limits of either. More forests may be created, but more land is required and land is limited. New technologies may improve the use of resources. Better irrigation systems may increase crops that need irrigation, but cannot increase the quantity of water. Certainly, the possibilities of technological advances should not be underestimated but the fact remains that resources are finite with limited possibilities of substitution. Nothing can be substituted for water or for soil and greenhouse gas emissions, climate change, extinction of species, rising temperature, etc. are all severe and intractable problems.

The causes of the disequilibrium between the economy and the physical ecosystem are related to growing consumption levels and the increasing population. Studies have shown that the size of optimal world population compatible with an acceptable and comfortable standard of living is around 2.5 billion people (Daily,

Ehrlich and Ehrlich 1994, Pimentel et al. 1994 and 2010, Lianos 2013, Lianos and Pseiridis 2016). However, world population could rise to around 10 billion by the end of the century (Gerland et al. 2014).

Modern Marxists do not deny the critical point which the environmental problems have reached but, probably because of Marx's antipathy[2] for Malthus, they tend to ignore the effect that population growth has on the demand for resources and consequently on the environment. The problems of the environment are attributed to "the destructive dynamic [of] capital's inherent drive to accumulate on an ever greater scale" (Foster, 2015, p. 6). They offer first stage suggestions that may improve the conditions in which the natural environment is today but population control is not one of them. The long run aim is an "advanced planetary movement of the twenty-first century: ecosocialism" (Foster and Clark, 2018, p. 18). The crucial question of how ecosocialism (or socialism in general) would restore ecological balance without population control is never answered[3].

All the available evidence leads to the conclusion that except for a *Deus ex machina* no one and nothing can save our planet from ecological catastrophe without population reduction and/or dramatic reduction of the standard of living.

2. Some facts

One way of appreciating the condition of the global environment is to examine the changes in ecological footprint (EF) and biocapacity (BC). It can be seen from Table 1 that during the last fifty years, from 1961 to 2014, the ecological footprint has increased by 200% while biocapacity has increased only by 27%. The ecological deficit is due to the fact that the demand for resources is increasing

2 Marx had much stronger negative feelings for Malthus than just antipathy. He had no hesitation to call him a plagiarist, a shameless sycophant, a sin against science, and a libel on the human race (Petersen, 1988, p. 80). I may risk to suggest that Marx, in using irony and derision when he was referring to other writers, was imitating the ancient philosopher Epicurus on whose philosophy of nature he had written his doctoral dissertation. According to Diogenes Laertius (1969, p. 211), Epicurus was calling Plato's Academy "the toadies of Dionysius", Protagoras "a village schoolmaster", Democritus "Derocritus (the idle-gossip)", the Cynic philosophers "foes of Greece", and even Aristotle "a profligate who became a soldier and a drug-peddler after dissipating his inheritance".

3 Marx and Engels have not given a description of how a socialist society should be organized or what are the principles on which the economy should be run.

much more rapidly than the growth of productivity. This is also shown by the fact that the ratio EF/BC has more than doubled in the same period. Table 1 also shows that during the same period, Gross World Product (GWP) has increased by 529% but GDP per capita has grown only by 166%. Obviously, the difference is due to the fact that population also increased at the same time from 3,075 million to 7,269 million, an increase of 136%. If population were constant at the 1961 level, per capita GWP in 2014 would be 23.9 thousand dollars instead of 10.1 thousand. Table 1 also shows that the last year that Biocapacity was approximately equal to Ecological Footprint was 1970. Since that year, ecological footprint exceeds biocapacity and the ecological deficit is rising.

Table 1. Ecological footprint, biocapacity, gross world product and population, 1961–2014

Year	EF million hectares	BC million hectares	EF/BC	GWP US$ billion	GWP/pop thousand USD	Pop million	GWP/ pop yearly increase USD
1961	7035	9611	0.73	11682	3.8	3075	
1965	8155	9736	0.84	14609	4.39	3325	147
1970	10052	9992	1.01	19040	5.17	3685	158
1975	11070	10117	1.10	23003	5.66	4066	98
1980	12283	10336	1.19	27840	6.27	4438	122
1985	12778	10752	1.19	31662	6.54	4843	54
1990	14220	11056	1.27	37887	7.17	5285	126
1995	14716	11173	1.32	42198	7.39	5710	44
2000	15749	11484	1.37	50000	8.17	6118	156
2005	18001	11691	1.54	58108	8.92	6517	15
2010	19862	11938	1.66	65955	9.52	6931	120
2014	20602	12221	1.69	73590	10.12	7269	150

SOURCES: GLOBAL FOOTPRINT NETWORK (2018), WORLD BANK (2019)

Ecological footprint is caused by the process of producing goods and services for human use and it grows with increases in GWP and population. Increases in GWP can be used either for higher consumption of the same number of people

or for consumption of more individuals as population grows, or for both. It is, thus, interesting to see what is the effect of each cause on the ecological footprint. Regressing EF (measured in million hectares) on GWP (measured in billion 2010 US$) and population (measured in millions) gives the following regression equation:

EF = 3743.8 + 0.147 GWP + 0. 868 POP R square=0.98 d.f.=54
(t=3.81) (t=6.99) (t=2.56)

Equation 1

According to this regression, the changes in GWP and population both have a significant effect on the ecological footprint. An increase of GWP by one billion increases the ecological footprint by 147 million hectares and an increase of population by one million increases the ecological footprint by approximately 868 thousand hectares. Gross world product (GWP) and population (POP) move in different ways. Population grows all the time but at slowly declining rates and GWP increases and declines depending on the phase of the business cycle.

The above regression equation can be also used as the trade-off between population and GWP for any value of the ecological footprint. Thus, for 2014 ecological balance requires EF = BC = 12,221 and for that year the trade-off is: Population = 9766 – 0.169 GWP. In 2014 GWP was 73,590 billion US dollar and for ecological balance population should be 2,697 million. In 2014 population was 7,269 million and according to the trade-off GWP should be 12,225 billion for ecological equilibrium. These results show the very difficult situation in which we are in terms of ecological balance. They also suggest that the restoration of the disturbed ecological balance should be based on sufficient reduction of world population and/or per capita consumption, or both. For obvious reasons the better choice is a reduction of population.

In addition to the degradation of the environment (global warming, pollution, etc.), overpopulation is connected with the danger for the satisfactory functioning of democracy and with the restrictions imposed on our everyday life because of lack of space. Bartlett (2000) uses the number of persons per Representatives as a proxy for the quality of democracy and estimates that in the last two hundred

years in the USA this number has increased at least twenty times, thus making contact between people and those who represent them in the parliament extremely difficult[4].

Another disturbing fact about the present economic situation worldwide is the extremely unequal distribution of income and wealth. It is reported that the poorest 10% of the world population has less than 480 dollars[5] per capita per year and the richest 10% has more than $14,500 (Roser, 2016). Another side of the same situation is that in 2015 about 706 million people (9.6 percent of the world population) lived in extreme poverty, i.e. with less than 1.9 international dollars a day (Roser and Ortiz-Ospina, 2017). Equally disturbing is the distribution of wealth globally. The richest 1% own 45% of the world's wealth (Credit Suisse, 2018) and this unequal distribution of wealth is certainly the main factor for the inequality of incomes. Thus, although growth may have increased the absolute level of income and consumption of many people, it may have at the same time increased inequality in relative terms.

3. The two major contradictions

The facts presented above testify to the existence of two major contradictions in the modern world. The increasing divergence between the supply of resources, i.e. biocapacity, and the demand, i.e. ecological footprint, shows a major contradiction that has developed between humans and nature as a result of growth in production. The enormous income and wealth inequalities are the result of a second contradiction (or antithesis), that between capital and labor in the capitalist economies. One does not have to be a Marxist or left-winger to see that, despite (or, perhaps, because of) the progress of technology and the development of the social policies in the modern capitalist states, capital and labor have conflicting interests that are not easily reconciled. Strikes, unrests, riots, local conflicts, revolutions, contradictions among political parties, etc. attest to the fact that the capital-labor contradiction is very intense in modern society.

4 In his *Politics* (1326 b 10-20), Aristotle was arguing that if the size of population is too big it will be difficult to run the city effectively and to enforce the law. Also, it would be difficult to make the correct decisions regarding the distribution of public offices according to merit, because this requires adequate knowledge of individuals, something difficult in an overpopulated city.

5 The dollar here is international dollar, a US dollar adjusted for purchasing power in the various countries. Thus, an international dollar is a monetary unit that would buy a comparable amount of goods and services that a US dollar would buy in the USA in 2011.

The size of population is related to both contradictions. Increasing population means increasing production and thus increasing use of natural resources. Given that resources are limited, after a point, population growth becomes the basic factor for the increasing intensity of the man-nature relationship. Also, increasing population means increasing labor supply and therefore a long-run tendency for wages to stay low or not to rise as it would be the case if population were constant. In Marxian terminology, the industrial reserve army will never be depleted if population increases. Of course, wages depend on many other factors that affect the demand side of the labor market but a constantly increasing population will be a permanent downwards pressure on the level of wages. It will be argued later in this paper that if population were to remain constant at an environmentally sustainable level the capital-labor contradiction would become much weaker and the man-nature contradiction would disappear. These are the motivating ideas for examining the desirability of the steady state economy as an alternative to the present economy whose functioning is based on growth.

4. The steady state economy: review

4.1. The ancient philosophers

The idea of a steady state economy is very old. In the 4th century BC, Plato and Aristotle both developed the idea of a steady state by specifying the proper relationship between land and population that is necessary for a just and happy state. At that time, land was the approximately equivalent of capital in modern economies and therefore a constant land–population ratio corresponds to a constant capital-labor ratio. Because the size of the city and its land was given, so should be the size of population.

Plato's treatment is very brief. In the *Laws* (book V) he says: "The sufficient size of population could not be properly determined except in relation to the land… And the land should be of such a size that would be enough to feed so many wise men, and no more land is needed… In other words, men and land form a common factor" (my translation). Also, Plato recognized that because of differences among individuals in motivation, effort and ability as well as in good luck, wealth may be distributed unevenly and this in turn may lead to division among the citizens and to social unrest. Thus, he suggested that the land property of the richest should be no more than four times the minimum property of the poor. Any excess should be given to the state.

Aristotle has devoted Book VII of his *Politics* in establishing the foundations of a state that would be self-sufficient and stable and in which citizens could live a good life. He develops the idea of "best life" on the basis of which he constructs a complete model of a steady state economy. The best life, also referred to as life of happiness, "is the life conjoined with virtue furnished with sufficient means for taking part in virtuous action" (1323b40 – 1324a2). In Aristotle, this means a comfortable but not a luxurious and wasteful lifestyle. This should be true for each individual separately and collectively for the state. The elements of his model are private land (property), public land, and population. These elements can be properly combined to produce enough wealth for all individuals that possess land, and enough proceeds from public land to take care of the poor, to finance religious ceremonies, and to cover the costs of administration.

Aristotle believes that there is no limit to the growth of population if it is left uncontrolled. Therefore, the optimum land-population combination cannot be sustained unless population controls are introduced. In fact, he suggests various methods for keeping population constant at the proper size (for a detailed analysis see Lianos, 2016). The problem of overpopulation in the ancient Greek city-states was solved by creating colonies all around the Mediterranean Sea, but Aristotle saw that this was only a short-run solution.

The reader can easily see in these ancient writers the concern expressed in modern literature about limited natural resources and the first models of a steady state economy.

4.2. J. S. Mill and K. Marx

The pragmatic basis on which the idea of the steady state economy model was developed in more recent times was the existence of limits on resources, first recognized by John Stuart Mill, and the problems that capitalist growth creates for the environment, first to be mentioned explicitly among economists by Karl Marx.

As early as 1848, Mill wrote: "It must always have been seen, more or less distinctly, by political economists, that the increase of wealth is not boundless" (1970, p.111). He praises Malthus' essay on population and he repeats that "[e]ven in the progressive state of capital, in the old countries, a conscientious or

prudential restraint on population is indispensable, to prevent the increase of numbers from outstripping the increase of capital…" (p.112). Mill believes that "the stationary state of capital and wealth… would be, on the whole, a very considerable improvement on our present condition" (p.113). His vision of the final state is that in which "while no one is poor, no one desires to be richer, nor has any reason to fear being struck back, by the efforts of others to push themselves forward" (p.114). Mill was very concerned about income distribution and he thought that for the needed improvement two conditions were necessary: (i) "a stricter restraint on population" and (ii) "a system of legislation favoring equality of fortunes" (p.115). However, people were entitled to the fruits of their work. Mill argued in favor of a system that would place limits to what a person may acquire by inheritance or gift (p.115 and 376-387).

A few years later Marx expressed his concerns about the detrimental effects of industrial and agricultural development on the land. Marx wrote: "Capitalist production… disturbs the circulation of matter between men and the soil, i.e. prevents the return to the soil of its elements consumed by men in the form of food and clothing; it therefore violates the conditions necessary to lasting fertility of the soil" (1954, p.474). Also, "[i]t thereby creates conditions which cause an irreparable break in the coherence of social interchange prescribed by the natural law of life. As a result, the vitality of the soil is squandered, and this prodigality is carried by commerce far beyond the borders of a particular state" (1954, p.813). For Marx, ecological problems and poverty were both the unavoidable results of the capitalist mode of production[6]. Control on population growth was not necessary as, for him, over-population was not a result of "the eternal laws of Nature, [but] rather… the historical laws of capitalist production" (1954, p.495, fn 1). Poverty was a result of exploitation and could be abolished only by the socialist transformation of society. Marx gave a very short description of his vision of the socialist-communist society to come. In the higher phase of the communist society, very briefly mentioned in the Critique of the Gotha Program (1875), the economy will have greatly developed its productive powers, work will

6 Engels (1969, p.56) made the following observation without generalizing its significance for the contradiction between the environment and the capitalist mode of production., "A dark-coloured body of water, which leaves the beholder in doubt whether it is a brook or a long string of stagnant puddles, flows through the town and contributes its share to the total pollution of the air, by no means pure without it".

have become a necessity, not just a means to live, and each member of society would offer to production what they can and take what they need. This situation can be said to be a steady state in the sense that further economic growth is meaningless. According to Marx, human history ends at that phase of the truly communist society where the word scarcity is removed from the lexicon.

Strictly speaking, Marx does not have a steady state model. His simple reproduction scheme cannot be sustained because profits, according to Marx, will always be reinvested and thus simple reproduction will become expanded reproduction forever as long as the capitalist system continues to exist. It is interesting that Marx's expanded reproduction scheme is mathematically equivalent to Domar's growth model (Lianos, 1979).

4.3. The classical magnificent dynamics

The classical model of the steady state economy is based on four elements: (a) the law of diminishing returns in production, (b) Malthus' law of population, (c) the propensity of capitalists to accumulate by investing profits, and (d) the Ricardian law of the natural and the money wage, and the effect of their divergence on labor supply. Baumol's (1951) presentation of "magnificent dynamics" shows that the need to accumulate will tend to minimize profits but entrepreneurs will earn normal profits which are just sufficient to induce them to stay in business.

4.4. H. E. Daly's steady state

In recent times, Daly (e.g. 1973, 1991) has revived the idea of a steady state economy and defines it as:

> ...an economy with constant population and constant stock of capital, maintained by a low rate of throughput that is within the regenerative and assimilative capacities of the ecosystem. This means low birth equal to low death rates, and low production equal to low depreciation rates… Alternatively, and more operationally, we might define the SSE in terms of a constant flow of throughput at a sustainable (low) level, with population and capital stock free to adjust to whatever size can be maintained by the constant throughput that begins with depletion of low-entropy resources and ends with pollution by high-entropy wastes. (Daly, 2008, p.4)

He also proposes "a minimum income financed by a negative income tax", "upper limit to the total, and consequently an upper limit to per capita income as well", "a maximum limit on wealth", depletion quotas auctioned by the government that "should be low enough to prevent excessive pollution and ecological costs" (Daly, 1973, 1991) transferable birth licenses as proposed by Boulding (1964, p.135) and nationalization of money but not of banks (Daly, 2017) (for a critique see Lianos, 2018).

5. Neoclassical steady state economy

In combination with natural resource availability, cultural and technical factors, population size is an important factor in the development and sustainability of any society. In our current situation, reducing population size will be necessary to achieving sustainability and high living standards. This is compatible with neoclassical growth theory. It can be shown that the neoclassical growth theory leads to a steady state economy if the rate of growth of population becomes zero.

In the well-known Solow model, a growing economy would reach the steady state position when the amount of capital per worker remains constant although capital and labor both increase at the same rate. The condition for steady state is

$$s\left(\frac{Y}{L}\right) = (n + d)\left(\frac{K}{L}\right)$$

Where s=saving rate, Y=output, L=labor, K=capital, n=rate growth of L, and d=depreciation rate.

Equation 2

According to Equation 2, a steady state position is reached when savings per worker is equal to capital per worker which is needed to replace depreciation of capital plus new capital needed because of the addition to the labor force because of population growth. Thus, in Solow's neoclassical growth model income, capital, and labor grow at the same rate and the capital-labor ratio and the output-labor ratio remain constant. It is interesting at this point to compare the neoclassical model with Daly's model. In both, the capital-labor remains constant but in Solow's model capital and labor are both changing while in Daly's model capital and labor are constant (at unspecified levels). The difference may be due to the fact that these models were developed at different times.

When Solow was developing his model the limitation of natural resources was not an issue[7], development in all countries was a desideratum and the size of world population was 2.55 billion. When Daly was proposing his steady state economy the prospect of resource limitation was real, environmental problems were present and population had grown to 4.06 billion. Also, in Solow's model the steady state is determined by the saving behavior of individuals, the rate at which population grows, and a technological parameter (the depreciation rate of capital). In Daly's model there is no explanation of how the steady state position will be determined or by what mechanism it will be reached.

5.1. Steady-state economy with ecological equilibrium

The steady state economy that we propose is one in which two variables must be determined a priori, i.e. gross output and gross output per capita. The size of gross output is the maximum level of production compatible with ecological equilibrium given the available technology of production. Its value (Y*) can be estimated approximately, on the basis of equality between ecological footprint and biocapacity. The choice of gross product per capita involves value judgment and can be estimated by accepting, as a society, a standard of living for the average citizen in developed countries. If we know the maximum gross product and the accepted output per capita we can determine the optimal size of population (L*). If Y* and L* are determined the production function and the technology will determine the required quantity of capital.

If Y is at its maximum value required for ecological equilibrium (Y*) and an acceptable standard of living is Y*/L*, then L* is the optimal size of population and should remain constant at that level. Now the steady state position of the economy with population growth equal to zero will be

$$s(Y/L) = d(K/L) \qquad [3] \quad \text{or}$$

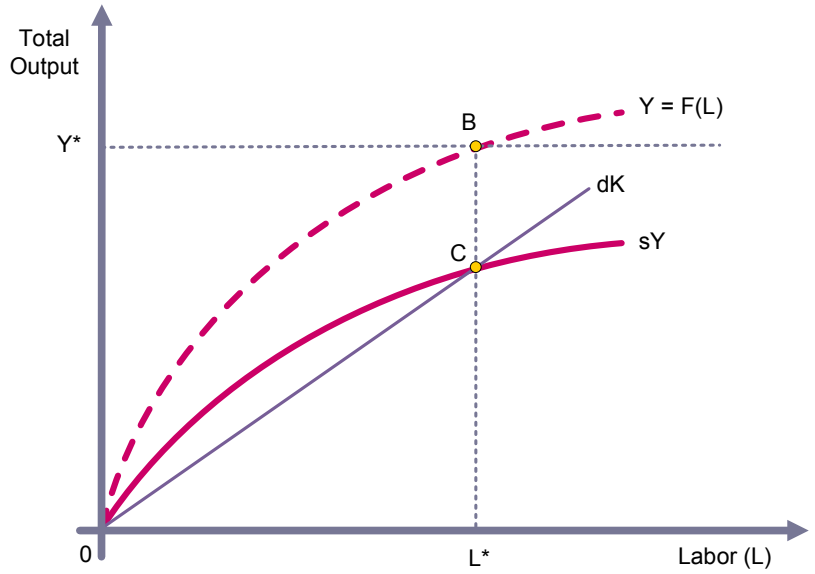
$$sY = dK \qquad [4]$$

Equation 3 and 4

7 Later Solow wrote "If on the other hand real output per unit of resource is effectively bounded-cannot exceed some upper limit of production which is in turn not too far from where we are now- then catastrophe is unavoidable" (Solow 1974. p.11).

This economy is shown on Figure 1. The maximum output Y* determines, via the production function and the chosen standard of living, the optimal population size L*. Output per worker is given by the ratio 0Y*/0L*. At that level of output, gross investment will be equal to depreciation as shown by the intersection of lines dK and sY at point C. The level of consumption is equal to BC and the level of consumption per capita is given by the ratio BC/0L*.

Figure 1. The neoclassical steady state



5.2. Changes in technology

In the above model, technology is kept constant because it is not a focal point in this discussion. While technical change raises questions that cannot be examined within the narrow scope of this paper, a few comments about its effects may be made. The improvement in production technology creates several opportunities. If technical change raises the productivity of labor and at the same time raises the maximum gross product, then per capita product may increase keeping population constant. Of course, society may now choose to increase population and keep the standard of living constant. If technology increases the productivity of labor without raising maximum product, then the working hours per day may

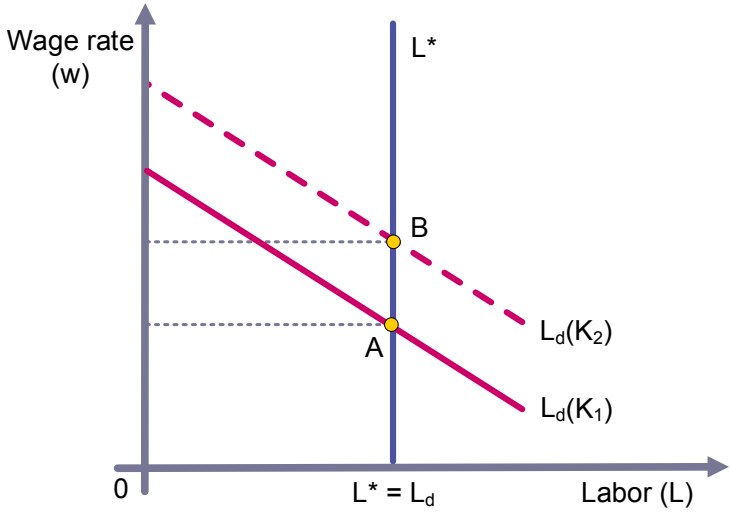
be reduced while keeping population constant. Individuals will now have more leisure and thus a higher standard of living. Thus technological advances create opportunities for higher standard of living or population increase or fewer hours of work per day or a combination of these choices.

5.3. The labor market

Constant population under normal conditions means a constant labor supply. People may enter or leave the labor market, but the supply of labor will be approximately constant. The constancy of labor supply will have important changes on the level of wages and on the distribution of income. Capital accumulation with constant labor will increase the wage rate, reduce the return to capital, and increase labor's absolute and relative share.

These changes can be easily seen on Figure 2. As capital increases from K_1 to K_2, the wage rate increases and so does the absolute share of labor shown by the rectangles under the wage lines as well as its relative share.

Figure 2. The labor market



These are all common knowledge in economic theory but they acquire an important significance in the context of a policy that imposes restrictions on the size of population when the economy grows beyond the level which corresponds to full employment of resources and causes increasing ecological deficits.

6. The two major contradictions in the steady state economy

It should be clear by now how the intensity of the two major contradictions we mentioned earlier in section 3 is reduced considerably or disappears in a steady state economy defined by the constancy of population at a level compatible with ecological equilibrium. The man-nature contradiction will disappear by definition because population is reduced to the level that guarantees a maximum product with ecological equilibrium. It is important to note that simply constant population, as Daly suggests, is not sufficient for ecological equilibrium. A population size constant at its present size of 7.6 billion will not bring equality between ecological footprint and biocapacity unless the standard of living is reduced drastically. If an acceptable standard of living is to be preserved, population must be constant at a much smaller size. As we have already indicated, that size is around three billion humans.

The capital-labor contradiction cannot be eliminated as long as the steady state economy remains a capitalist economy. The class conflict between capital owners and laborers will remain but its consequences may be minimized by the fact that labor will not be an abundant factor of production. The industrial reserve army will disappear and a long run tendency for wages to increase will become real. I do not imply that labor would be the dominant player vis-à-vis the capitalists in their wage and other negotiations but simply that labor would be in a much better position than in an economy with increasing population and labor surpluses. Also, a tight labor market will bring into the market peripheral workers who would otherwise remain outside the market, by offering them jobs and better terms of employment. Thus, there would be a strong tendency for the distribution of incomes to become less unequal. Of course, to some extent this would depend on the effects of automation and other technical changes in the economy.

7. The role of the state in a steady state economy

The steady state economy presented above is actually a neoclassical model where a restriction is place on the size of population. Thus, at the theoretical

level the fundamental elements that define the steady state economy are three: (i) Stable population at a size compatible with ecological balance and also with an acceptable average standard of living, (ii) Flexibility of prices of products and factors of production, and (iii) Internalization of external diseconomies so that prices reflect the real costs of production in terms of resource use[8].

However, the steady state economy is a capitalist economy and in real life it will have all the problems that capitalist economies have today with the exception, of course, of environmental problems and those created by external diseconomies. Economic fluctuations of a minor or major scale, attempts to monopolize markets, unemployment and poverty, crime, natural disasters, etc. will be part of life in a capitalist economy. Good things will, also, be happening such as scientific discoveries, new technological applications, new methods of production, new and better products, etc. Neutral developments such as changing consumer tastes are also very likely to take place.

Some of these changes and the problems which they might possibly create could be solved, in the short-run or in the long-run, by the rational behavior of individuals and the flexibility of the price system. However, not all problems can be solved automatically in the best way. Also, individuals do not always behave rationally either because of lack of the necessary information or because they do not have the ability to make the right decisions.

Constant population at the optimal size would not be a panacea, a remedy for all the ills of capitalist society, but the solution to these problems would be easier. In a steady state economy "there would be as much scope as ever for all kinds of mental culture, and moral and social progress" (Mill, 1970 p.116), but there is nothing to guarantee that the problems modern society faces would disappear. It is clear, therefore, that there would be plenty of space for the state to play an important corrective role in a steady state economy.

8 A reviewer of this paper has suggested that if this requirement "were fully accomplished the problem of climate change would likely go away as fossil fuels are driven from the market, bringing EF into balance with BC without the need to limit income and population". However, even if externalities are eliminated and prices reflect all costs, the problem of scarcity will persist and will become more pressing as population grows and living standards do not fall.

8. The transition to steady state

The time period needed for the transition from the present population size of 7.7 billion to the optimal size of 3 billion depends on the age structure of the present population, on the average lifespan and on the reduction of birth rates. Assuming a uniform distribution of ages, an average lifespan of eighty years and one-and-a-half child per family[9] on the average, simple calculations show that the reduction of population to three billion would take five generations or one hundred years. In this long adjustment process two main problems may arise, one in the short-run and one in the long-run. The first problem that is likely to appear is the fall in demand of products and services for the babies and younger people. This is equivalent to a change in tastes as people would now spend their income on other products and services instead of buying things for the children they have decided not to have. As in all other cases of changing consumer tastes, competition and the price mechanism should prevent this problem from becoming serious or persistent. Pediatricians, gynecologists and related professions may lose some customers but this can also be prevented by proper educational planning.

The other problem that will appear is that of funding the pension systems. If the main source of pension funds is the contributions of the working population, the changing age structure of the population will necessitate new sources of funds or increasing the age limit for retirement or both. The government budget, that is, the general tax proceeds is the usual source of the extra funds even today in many countries. However, if pension funds for each individual are the payoff of his savings during his working life, the problem will be minimal. Even so, there will be many cases in which earlier savings would not be sufficient for a decent standard of living because of low wages, unemployment, sickness, etc. Thus, a mixture of measures would be necessary for addressing the problem that the changing age structure will create for the funding of the pension system. Social problems are best solved when all concerned participate, directly or indirectly, to their solution.

9 The choice of one-and-a-half child per family is not accidental. Fertility rates (births per woman) have been reduced substantially worldwide during the last fifty years from 4.77 in 1970 to 2.44 in 2016. Therefore, population will continue to increase until the fertility rate falls to approximately 2.1. The urgency of dealing with environmental problems makes necessary fertility rates much below 2.1. Education and economic growth are expected to lead to smaller family sizes but at the same time will increase the demand for resources, increase the ecological footprint, and negatively affect the environment. Therefore, waiting for education and growth to have their effect on population size may prove fatal.

The problem which is created by the reduction of population is the solution to the severe problems created by the continuing increase of population or by its stability at the present size. Therefore, it is a welcome problem that can be solved by social consent and appropriate policies.

As soon as the above problems begin to appear, the good things of a declining population size will also become apparent. Disposable income and wealth and living space per capita will increase and therefore a higher standard of living will be possible for most people. But the most important benefits will be environmental. Declining population means less demand on the scarce resources (energy, land, water, etc.), fewer negative effects of the economic activity of people, and, in general, a smaller footprint[10].

The transition from the present situation to a steady state economy with a population reduced to a size compatible with ecological equilibrium will not be without some problems. But this is not an argument for continuing population growth. It seems clear that the benefits of population reduction will outweigh the negative effects for the present generations and certainly for the future ones.

9. The decrease of population should be universal

The size of world population is not likely to decline if it is left to follow its own dynamics. But if the existing trend continues in its present path, sooner or later probably sooner catastrophes of an unprecedented extent are very likely to occur. Some of them are already making their presence known[11]. If, in fact, the human species has the wisdom we claim it has, an emergency plan for the reduction of population should now be undertaken. Such a plan will probably involve education, persuasion, dissemination of information, monetary incentives for reducing the number of children per family and /or disincentives for large families, and, if necessary, obligatory rules (Lianos 2017, 2018).

Whatever would be the plan adopted, it should be applied to all countries. If it is impractical to require a small country to reduce its population, some exceptions

10 For a recent review of the problems and benefits of population decline see Gotmark et al.(2018).

11 Grounds for fear of overpopulation are raised by many researchers in the field of ecological economics. For a review, see Alcott (2012), who argues that a decline in population growth should be actively included in policy agendas of all countries.

may be made. It is to be noted that the fifty most populous countries have 80% of the world population. A universal application is necessary for three reasons. First, countries in conflict and military antagonisms with neighbors may not be willing to agree to reduce their population unless their neighbors also agree to do so. Second, if some countries, particularly the populous ones, do not reduce their population while others do, sooner or later, important in size migration flows will be generated thus making space for population increase. At the same time, social discontent may increase in the receiving countries raising doubts about the effects of the attempted population reduction. Third, the negative environmental effects are not distributed among countries according to the quantity of products consumed in each country. The production of commodities may affect the environment of a country but with international trade these commodities may be consumed in another country. Therefore, all countries should be subject to the rules imposed for population control independently of their share in the creation of environmental problems.

10. Is there any chance for population control?

The practical and crucial question that should be asked now is if there any chance for a plan of population reduction to be adopted[12]. Children are born within families and therefore their number will be decided by factors that affect the welfare of the entire family. There are some countries where population shows a tendency to stability or a small decline. These are mostly small European countries with relatively large out-migration flows. To these Japan, Russia, Germany, and Italy should be added. However, in less developed countries where children are part of the labor force and security for the old age is inadequate (due to the absence of adequate social security systems) population is very likely to increase.

12 It may be argued that the emphasis on population reduction may be misdirected given that the contribution of carbon emissions to footprint is 60 percent and thus efforts for more efficient techniques of production and better management could be more effective that efforts to reduce population. However, the others contributors to footprint, i.e. food, housing, and goods and services make up the rest 40 percent and these cannot be reduced without a reduction of population and /or substantial fall in consumption. In addition, an attempt to reduce carbon emissions may not be easy as the USA withdrawal from the Paris agreement has shown. Also, it should be kept in mind that the ecological footprint does not include nonrenewable resources (oil and metals) which will become scarcer as population increases, and if renewable resources are used as substitutes the footprint will increase. It seems that the reduction of population is one-way street.

Governments might influence the decisions made by families by providing economic incentives such as subsidies of various types to families with, let's say, one child or disincentives by imposing a tax on the second, third, etc. child. These and other types of incentives and/or disincentives may have an effect on the desired direction but it seems unlikely to have a strong effect unless the monetary rewards from the incentives are huge or the punishment resulting from the disincentives are severe. Governments are not likely to take so drastic measures. If incentives and/or disincentives do not work, it may be necessary for arbitrary rules to be adopted, such as the Chinese one-child policy or some variation of it like the creation of a market for reproduction rights[13].

In addition to general unwillingness of governments to take measures which are unpopular, even if these measures appear to be beneficial in the long-run, there is the opposition of strong economic, military and religious interests. Leaders of these interests groups believe that population reduction will undermine their position relative to their antagonists, competitors, and even enemies, and therefore reduce their power and expected benefits, be they economic, ideological, social status, etc. Therefore, they would oppose policies of population reduction. Their opposition may be strengthened by the fact that people in position of power and owners of wealth would be the last to suffer from the negative consequences of population growth.

In conclusion, the chances of population control initiated by governments, by other powerful institutions such as the Church or by international organizations like the United Nations are minimal. It is left to the academics, independent thinkers, Non-Governmental Organizations and activists to carry the burden of informing the general public of the bleak prospects ahead of us if the size of world population does not decline considerably.

11. Conclusions

The arguments presented in this paper support the idea of a steady state economy in the sense of holding population constant at a level compatible with ecological balance. The idea of constant population is very old. In Plato and Aristotle, the size of population is related to the available land. In Malthus and more clearly in Ricardo the size of population is related to the discrepancy between the natural and the

13 See, Lianos (2018) for how such a market may operate.

money wage. The beginning of the modern view is found in Mill who recognized the limits imposed to economic growth and to population increase by the limits of resources. In present times, the environmental problems have drawn the attention of many scientists to the problem of overpopulation. Daly, has argued in his many writings for the need to keep population as well as capital constant.

The present paper intends to show that it is not sufficient to stabilize population at its present size. Population should be reduced to about three billion people as several studies have estimated that this is the size that would bring ecological equilibrium. It also suggests that other proposals made by Daly are not necessary. Constant population and the price system, assisted by the State when needed, will do the job, i.e. the ecological deficit will disappear by definition and the problems of poverty and economic inequality would be alleviated.

Although the severity of the environmental problems is of maximum urgency, governments, churches, and international organizations pay lip service without actually taking any serious steps to meeting the challenge. Political and religious leaders find it easier to continue to talk about growth and a happy after-life than to speak the truth about the present huge environmental problems. The burden of changing the course of events falls, as already argued, on the shoulders of missionaries such as academics, independent thinkers, activists, and non-governmental organizations.

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OPINION

Sustainability of equality: a paradox for democracy

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There are too many people in the world: we all know it, but there are perverse incentives preventing us from doing anything about it. Democratic ideals, resource mismanagement, human adaptability and scientific advances, all play a role in deciding whether equality of resource consumption within our world population is sustainable in the present age. There are a couple of axioms that need to be accepted: (1) the planet has finite inhabitable space and resources, and (2) the human population cannot continue to expand indefinitely. The global human population is currently 7.6 billion (Cohen, 2017; World Population Clock, 2018). The maximum sustainable global human population has been conservatively estimated to be 10 billion (United Nations, 2001 p.31), and is expected to exceed this between 2050 and 2100 (United Nations, 2017a). Any population expansion clearly has implications for standards of living and quality of life, but with continued growth even the minimum survival needs of everyone living on our planet will soon outstrip its capacity to provide. It follows that we must actively control population or face disaster (Higgs, 2017). However, this requires political intervention without allowing the adoption of a eugenics agenda. We argue that democracy, through the welfare state, can lead to a greater degree of economic

and social equality. This economic and social inequality has a tendency, through rising incomes, higher levels of education, and the greater emancipation of women, to reduce fertility rates. However, we also argue that in terms of achieving an environmentally sustainable population that, due to a number of individual and political interests, liberal democracy appears unlikely to develop policies to safeguard population sustainability on a global scale.

The inability to sustain the environment is a consequence of human dominance and mismanagement of the resources available. Human overpopulation is the root cause of all environmental sustainability problems. For example, if there were no humans there would be no environmental pollution or resource problems. We know with logical certainty that natural population controls will eventually be catastrophic, unless there is intervention to ensure otherwise. Think of Easter Island on a global scale (Brandt and Merico, 2015). Modern advances in medicine, democratic pressure for improved public health and welfare measures, along with increases in incomes have to some extent circumvented natural controls of lifespan. Despite this, increasing competition for finite resources must still ultimately lead to substantial global death tolls through famine, disease, and war. The only alternative to letting nature take its course and controlling population through death, is to prevent further increases in competition by reducing birth rates. Thus, the provision of a high quality of life for the world's current population through the mutual sharing of global resources is expounded and promulgated.

It appears somewhat paradoxical that in many cultures as the quality of life increases the birth rate decreases. This is due in part to less reliance on one's own children for care and security in old age, coupled with opportunities to pursue personal ambition. However, since current levels of resource consumption are unsustainable, providing the quality of life which most in the Global North take for granted for the whole of the world's current population is obviously not possible. Even if resource consumption is reduced to sustainable levels, more equitable sharing of resources in the absence of adequate family planning and a reduction of global population, cannot achieve both high standards of human welfare and environmental sustainability. Clearly, we need to reach a global agreement to restrict conception; ideally through education about family planning, encouraged by incentives that are proportionate to the environmental costs. We will have to do this eventually unless pollution leads to widespread infertility (Joffe, 2003; Lebine

et al., 2017). Better that we start now to give time to develop, agree and refine a worldwide approach before it is too late. The political appetite to control the size of populations has publically declined, despite increased promotion of other environmental safeguards (e.g. against global warming, United Nations 2017b; and oceanic plastic, Ocean Cleanup, 2018). There is insufficient appreciation that while environmental problems are the result of human behavior, population is a multiplying factor. Thus, at levels of consumption compatible with human welfare there are too many people for a finite space and the associated natural resources. One person disposing of waste in a thousand acres is an ecological opportunity by opening niches to increase biodiversity (Shea and Chesson, 2002; Chase and Leibold, 2003). Whereas, a thousand people carefully using resources and responsibly disposing of waste in one acre is a disaster for the natural environment. To think that we might manage to somehow pull off some technological trick in the future so that billions of people could all have an equally good quality of life while preserving pristine environments and retaining species diversity is a logical absurdity.

Managing population growth will reduce competition for resources and improve environmental conditions, and thus facilitate sustainable levels of global health, affluence and well-being. While there is a clear imperative to reduce the global population load on the earth's resources, there are numerous ways this might be achieved without draconian coercion (Coole, 2018). However, waiting to see if passive methods will check overpopulation is a high stakes gamble. If these methods are likely to be insufficient then coercion must be considered. An escalating scale of rewards is preferable to sanctions and in turn compulsion; and decreasing fecundity (the number of offspring) is preferable to decreasing fertility (the ability to have offspring) as a means to control procreation. Coercion can only be achieved through politicians agreeing new laws (Maxton & Randers, 2016), which will lead to new welfare and healthcare policies targeting demographic goals. This would need to have a dramatic impact on the working practice of some medical specialties, for example general practice, psychiatry, obstetrics and gynecology, and especially the subspecialty of reproductive endocrinology and infertility. It is clear that any attempt to actively control family size would directly challenge the core ethical tenet of personal autonomy, and also conflict with some religious beliefs and cultural norms. Coercion runs against the current trend of increasing individual rights over collective responsibility, but with individual rights come responsibilities to society (Mill, 1859). How can reproductive freedom be

permitted if uncontrolled reproduction increases the global resource debit, increases misery, and ultimately leads to the destruction of society? To prevent a global social calamity there does need to be a fundamental shift in our expectations of self-determination, and a move towards selflessness and altruism for the sake of humanity. Uncontrolled reproduction disadvantages everyone, but there is insufficient incentive for individual restraint unless everyone is regulated (Hardin, 1968). Therefore, it is necessary to apply sanctions to prevent harm to others.

The ideal is to find a combination of non-coercive measures that would reduce fecundity below the level required to maintain the current population; thus reducing human numbers to a level that can be sustained, with a high quality of life, by the planet. However, the situation is bad enough to require coercion (Sen, 1996); if we wait for panic then there will have been too much suffering and irreversible damage to society and the environment. While coercion towards single child families (Conly, 2016) seems an excessive approach to achieve a sustainable population, ruling out directly coercive policies as advocated by Coole (2018) does not seem 'politically sensible', because indirect coercive measures are counter to democratic self-interest and thus unlikely to succeed. The challenge is to bring about a stable lower global population through an escalating combination of soft and hard coercive measures (Cripps, 2015), without victimising the vulnerable. It would be counterproductive if: (1) Having multiple children is disproportionately more expensive for parents, as those children will then be disadvantaged; and (2) The only prospect to fulfill your own ambitions is through your children, as procreation is surely encouraged. Clearly, population control is predicated on establishing equal life chances for everyone, through the fair distribution of resources and opportunities. Our global society needs to change radically, with each living individual valued as equivalent.

Unfortunately, there are considerable obstacles restricting our ability to control our own population. For example, China's one child policy (1979-2015) (Roche, 2017) failed partly because boys were (and still are) more valued than girls (Fong, 2015). The implication is that the policy would have worked if there were complete equality. It is also true that equally valuing those with disability, and older people, would bring a positive perspective to the different types of support required by all subgroups of the population. While liberal democracy is arguably the most powerful method to ensure equality (both political and of social and economic

opportunity), it may also unintentionally be a powerful force against population control. In the developed world, family size has become defined as an entirely private and self-regarding matter and politicians meddle in such things at their peril. Moreover, the issue of how to pay for an aging population can lead for a call for higher levels of fertility or increased migration. Indeed, South Korea has introduced incentives to increase the country's birth rate (Kwang-tae, 2017). This short-termism, motivated by the short duration of most political offices, may unwittingly be increasingly compromising our long-term quality of life and survival prospects. Ergo, liberal democracy as we currently practice it is not conducive to environmental sustainability.

In theory, equality is a prerequisite for an effective population control policy, and democracy promotes equality, but while personal autonomy regarding choice of family size remains an unquestioned basic right, liberal democracy is antithetical to population control. Why is there inaction? Populations feel powerless as individuals and have no forum to unite. Decision makers are motivated by typical voting cycles of only a few years. Those people who possess the most do not want to see their living standards decrease. Lifestyle practices are often geared towards immediacy rather than being forward looking. Environmental damage due to inaction is more likely to adversely impact future generations rather than the current generation. Clearly most politicians and wealthy individuals have conflicted interests and are probably complacent about the sustainability of the planet's human population or too cowardly to admit the enormity of the problem. With our future existence at stake, the international community should be earnestly discussing these obstacles and debating potential solutions. For example, should we be drafting a model theoretical policy that challenges the longstanding international human right (United Nations, 1966) to determine one's own family? No doubt, this would be extremely difficult and unpopular, but less difficult and unpopular than what will happen if we do nothing. If we do not find a way to agree to control the human population peacefully then we risk having no future for humanity at all.

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BOOK REVIEW

Empty planet: the shock of global population decline
Darell Bricker and John Ibbitson
London: Robinson 2019. £14.99 (GBP). 288pp. ISBN 978-1-47214-296-2.

David Samways – Editor

Unless written by academics or leading figures in their field, books aimed squarely at the popular market are usually not considered for academic review. However, *Empty Planet* by Darell Bricker and John Ibbitson certainly warrants critical examination as it articulates many of the discourses of population disavowal (Coole, 2013). In particular, Bricker and Ibbitson's use of demographic transition theory to further a sanguine view of population growth, especially in relation to environmental impact, is notable.

Demographic transition theory (DTT) will be familiar to the majority of readers of this review, but it is worth giving a brief summary. According to classical DTT, prior to economic development (Stage 1) a country's demographic structure will be characterised by high, and roughly equal, mortality and fertility rates leading to largely stable populations. As economic development takes place, improvements in the food supply, sanitation, etc. produce DTT's second stage of rapid population growth as mortality rates fall while fertility rates remain unchanged. DTT's third stage is characterised by a fall in fertility rates due to factors including: urbanisation and the decline of subsistence agriculture; increases in wages; increases in the general level of education, and in particular the education of women; increasing social and economic participation of women; the use of contraception, and so on. During this stage population continues to grow due to demographic momentum due to its age structure. However, stage 3 eventually gives way to Stage 4: as the demographic structure shifts, births once again equal deaths, and population stabilises – albeit a higher level.

Bricker and Ibbitson's take on DTT places an emphasis on the role of urbanisation leading to greater levels of female education. They argue that due to the unrecognised accelerating pace of urbanisation, the UN's projection of continuing global population growth peaking at 11 billion by the end of the century is a massive overestimate. While Bricker and Ibbitson are right to point out that there is debate and discussion concerning the accuracy of UN's population projections, they fail to adequately explore this issue or the reasons why the UN has consistently revised the figures in an upward direction. Their argument is inadequately supported and researched, with the authors preferring to draw on interviews, newspaper reports and a Youtube TedX talk rather than conduct a review of the demographic literature. The figure at which Bricker and Ibbitson believe population is likely to peak is unstated, but figures of between 8 and 9 billion by mid century are mentioned.

The book's title, *Empty Planet: The Shock of Global Population Decline* is obviously deliberately sensationalist and provocative. Yet it's worth pointing out that even the most optimistic sources drawn upon by Bricker and Ibbitson forecast that global population will not cease growing until the middle of this century at the earliest. While only indirectly citing their research, Bricker and Ibbitson's thesis has clearly been influenced by the work of the World Population Programme at International Institute for Applied Systems Analysis (IIASA) who have produced perhaps the most well respected alternative to the UN projections. Working in collaboration with the Wittgenstein Centre for Demography and Global Human Capital (WCDGHC) the IIASA's 2014 population projections differ from the UN's in that they model the effect of education on fertility rates. While indeed lower than the UN's figures, the IIASA/WCDGHC medium projection still gives a peak of 9.4 billion in 2070 (Lutz et al., 2014). However, more importantly for the titular claim of *Empty Planet*, research from contributors to the IIASA/WCDGHC project showed that at a world average total fertility rate (TFR) of just 1.5, somewhat below the current European average of 1.58, it would take around 200 years for the population to fall back to around 3 billion (Basten et al., 2013). A population of 3 billion was last seen in the 1960s and is believed by many to be the level compatible with ecological sustainability (see Daily et al. 1994). Neither of these population projections is suggestive of a very much emptier planet any time soon!

The most problematic aspect of Bricker and Ibbitson's use of DTT is their tendency to present the outcome of transition, driven by a logic of convergent modernisation toward a cultural and demographic homogeneity, as autonomous and inevitable. Indeed, Bricker and Ibbitson lament this inevitable loss of cultural diversity. DTT is frequently mobilised as a critique by those sceptical about population growth as a problem, the argument being that once the transition is completed growth will cease (Coole, 2013). However, while Bricker and Ibbitson are clearly aligned with such a position, they go further in arguing that a fifth stage of transition, where fertility rates fall below replacement levels and population declines, is also an inevitable outcome of the same forces. Indeed, such trends have been observed in most of the developed world (Myrskylä, et al., 2009).

However, as Coole (2018) has noted, the question for those concerned with population growth has never pivoted around whether or not the rate of growth is declining (or even becoming negative), but whether the pace of decline is fast enough to keep us within ecological boundaries. It is Bricker and Ibbitson's apparent environmental ignorance that is most problematic here. Notwithstanding the fact that little mention of the environment is made before page 227, they seem unaware that humanity has already breached sustainable ecological boundaries (McBain et al. 2017). Moreover, they fail to acknowledge that, without a change from business-as-usual economics coupled with a reduction of total resource consumption along with a shift from north to south in their distribution, irreversible ecological damage could result (Hickel, 2018). Like other forms of population disavowal, Bricker and Ibbitson's faith in the autonomous forces of DTT to bring about population reduction risks contributing to a climate of complacency and inaction that may find its way into the policies of governments and NGOs. As Bricker and Ibbitson themselves acknowledge, in many parts of the world it has been active government policy that has achieved huge and rapid reductions in fertility. Iran, Bangladesh, South Korea and China have all successfully reduced fertility in pursuit of improved welfare. However, changes in government policy and the priorities of NGOs have already been shown as a cause of stalling fertility decline (see Sinding, 2009; Kebede et al. 2019). Reducing population as part of tackling ecological overshoot requires more than a reliance on the supposedly autonomous logic of demographic transition. If we fail to address this challenge the only kind of empty planet we will experience is one empty of ever-greater numbers of species crushed beneath the juggernaut of the Anthropocene.

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