



# Family Planning and Environmental Sustainability: Assessing the Science



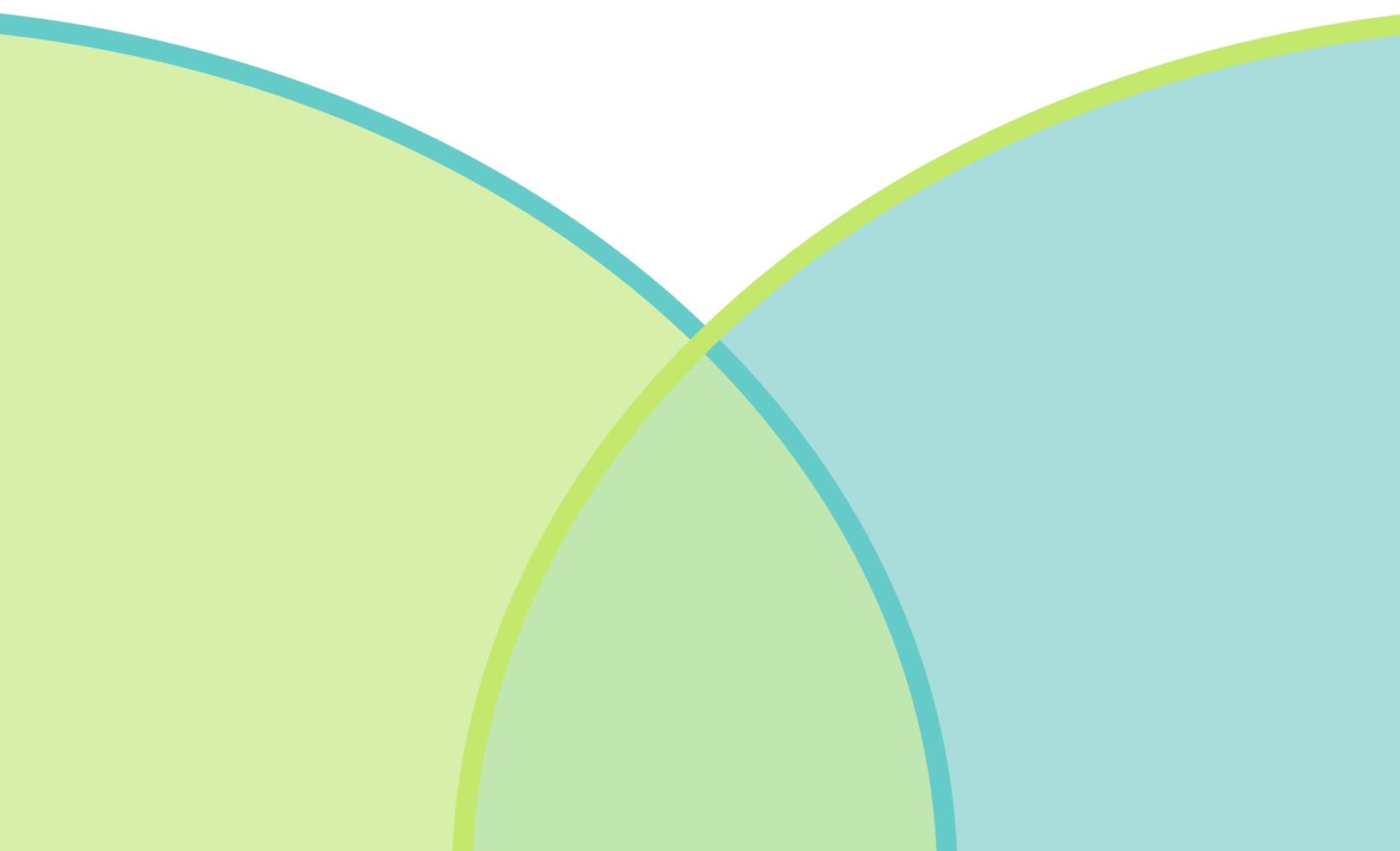


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# Family Planning and Environmental Sustainability: Assessing the Science





The Summary, Findings, and Annotations sections of this report were written by Robert Engelman, with input from members of the Family Planning and Environmental Sustainability Assessment (FPESA) project team, its assessment network, and others. Authors of the Perspective articles are indicated on each one. All text was edited by Lisa Mastny. All opinions expressed are those of the authors and are not intended to represent the views of the Worldwatch Institute, its Board of Directors, or its funders.

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# Note to Readers

The FPESA project sought to assess recent peer-reviewed scientific research related to family planning and the environment as objectively as possible. Any assessment of the qualities, strengths, and weaknesses of written work requires some degree of subjective judgment. We applied numerical scores and other quantification methodologies from group assessments provided by project staff, consultants, and network assessors associated with the project. While working where possible with these data and endeavoring to reflect the diverse viewpoints that we assembled, project director Robert Engelman made the final judgments on which articles to include in the annotated bibliography and wrote the annotations. He takes final responsibility for the selections of papers and findings and for any opinions expressed in the main text and annotations. Opinions expressed in this report are those of the authors and should not be taken to represent the views or positions of the Worldwatch Institute or its funders.

FPESA project staff will endeavor to correct any errors brought to our attention in the electronic version of this report, which will be posted on the project website, [fpesa.net](http://fpesa.net). (Current plans include integrating this website with that of the Worldwatch Institute, <http://www.worldwatch.org>, in late 2016 or 2017.) We encourage readers to email [fpesa@worldwatch.org](mailto:fpesa@worldwatch.org) with any errors they identify and any other comments on the report. We hope to continue this work and to publish updates and later reports. Our plans include a comprehensive online database of papers annotated and described in this report along with others relevant to the hypothesis that family planning supports environmental sustainability.





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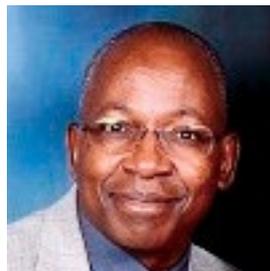
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# Summary

The [Family Planning and Environmental Sustainability Assessment](#) (FPESA), a project of the Worldwatch Institute, surveys recently published peer-reviewed health and environmental research to address two questions:

- 1) Does evidence support the claim that the practice of voluntary family planning promotes environmental benefits and helps lead to an environmentally sustainable world that meets human needs?
- 2) Is this connection of interest to researchers and others of both sexes and from developing as well as developed countries around the world?

What follows is the project's first comprehensive report on its findings to date.

From mid-2014 through early 2016, the project evaluated 939 papers published in peer-reviewed scientific journals from 2005 to the present, selected through a variety of search methods for relevance to the primary hypothesis that the use of family planning contributes to environmental sustainability. Grounding its work in an understanding that the use of contraception is a matter of human rights and individual choice, the project engaged a diversity of international researchers and field practitioners in a collaborative assessment of some of this literature. The diversity of both the assessment network and of the authors of relevant papers tested our secondary hypothesis, that interest in the linkage between family planning and the environment is widespread. The review reveals how complex the study of this cross-sectoral topic is, pointing to both specific areas of strength and major gaps in data and research.

## Key Findings

Peer-reviewed scientific research published since 2005 has rarely considered directly the hypothesis that family planning benefits environmental sustainability. Not surprisingly, given this relative lack of attention, no scientific consensus is apparent in the literature. We cannot confirm the hypothesis. The preponderance of evidence from the papers reviewed nonetheless supports it, with little refutation. Overall, the literature sustains the following statements:

In addition to improving health outcomes for women and their children, **access to and use of family planning—specifically effective modern contraception—reduces fertility by preventing unintended pregnancies and timing wanted ones according to partners' intentions, slowing population growth.** This statement is not contested in the literature examined.

**The overwhelming majority of researchers who explore relationships between population growth and environmental degradation or resource scarcity either find empirically or assert that the former is an influential factor in the latter,** although often interacting in complex ways with other factors. This finding fits well with recent survey work on scientists' views and some official scientific statements on the influence of population growth on the environment. A handful of papers argue that the role of population is exaggerated or insignificant. Two papers demonstrate cases in which lower fertility under certain circumstances encourages higher per capita consumption, weakening any environmental benefits of family planning.





**A sizable minority of authors mentions family planning in relation to the population-environment connection, often calling for improvements in access or services as one way to slow environmental degradation or increases in resource scarcity.** This perspective is widely shared geographically, with African authors more likely than those of any other continent to call for improved family planning services.

Some papers contribute evidence that **family planning improves the likelihood of beneficial environmental outcomes regardless of its impact on fertility and population trends.** The linkages in this case are multiple and complex, relating to life options for women that managing the timing of pregnancy may open up. A greater range of opportunities on which to spend their time and energy may then enable women so inclined to contribute more than would otherwise be possible to environmental sustainability and societal resilience. Separately, some literature documents ways in which women tend to be more concerned about the environment and to take action to protect it.

**Little literature undermines our primary hypothesis.** Although, as mentioned above, two papers found correlations between smaller families and higher per capita consumption, one of these calculates that resultant slowing of population growth more than compensated for this effect, given the topic examined (household fuelwood consumption). One paper suggests that population growth contributes to improved soil management in Indonesia, although not to forest or fisheries management or the conservation of biodiversity in that country. One paper finds “little association” between rapid population growth and climate change emissions, due to low per capita emissions in high-fertility countries. No papers hypothesize or conclude that family planning is harmful to the environment.



## Methodology

Project team members closely read abstracts of the 939 articles and read or skimmed complete texts where easily available. Ranking all of these based on their likely relevance to our hypothesis, we selected 112 for closer review due to certain relevance. An additional 302 were noted for probable relevance and may be closely reviewed in the future. For 13 of the articles of certain relevance that the team found especially interesting and promising early in the process, we enlisted the help of the network of research collaborators recruited for the purpose. These are

women and men from developing as well as developed countries who joined us in assessing the articles’ rigor and relevance to a conceptual framework developed to illustrate our hypothesis in simple terms. Fifteen members of the network contributed to these collaborative assessments. An annotated bibliography following the Findings section of the report includes annotations

and assessments of 50 papers, including all 13 of the collaboratively assessed articles and others that either are described in the text or were otherwise selected for high importance to our hypotheses. Others will be posted on the FPESA website.

Important shared values grounded our collective exploration of the science, especially the conviction that population policy must be based on women’s right to choose whether and when to have children and that women and men should have equal rights and equal opportunities in every sphere of life. A few of the papers that we reviewed applied such terms such as “overpopulation” or “population control.” We nonetheless found that our values grounding in voluntary, rights-based family planning did not require us to reject any research that we encountered.

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*From mid-2014 through early 2016, the project evaluated 939 papers published in peer-reviewed scientific journals from 2005 to the present.*

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### SUMMARY

#### Additional Findings

No scientific sub-discipline actively explores the connections between population growth and environmental change, let alone the influence of family planning on the environment. Leading demographic and environmental researchers whom we interviewed associated this absence with the complexity of the connections, their association with disparate scientific specialties, and acute sensitivities related to population and contraception. (A few felt that the connection between population growth and environmental change may be too obvious to merit research interest.) Empirical explorations of possible connections between the use of family planning and the environment do not appear to attract researchers. At the least, they do not attract sufficient funding or potential for career advancement to become a legitimate sub-topic within demography, public health, or the environmental sciences.

Surprising and valuable findings nonetheless emerge from our review. We feel that we have confirmed our secondary hypothesis: interest in the linkages that we are exploring exists among both genders and in all parts of the world. Researchers from all continents were willing to join our collaborative assessment network. At least 133 women are among the 495 authors of the papers that we ranked as most relevant to our hypothesis. Although no definitive count was possible, we believe that the proportion of authors based in or with roots in developing countries is similar. Africans were the primary authors of nine out of 22 of those top-ranked papers that specifically called for better access to family planning in order to ameliorate environmental problems.

Among other findings that emerged from our work:

- Comparisons of the influence of population growth and climate change on water scarcity, land degradation, and food insecurity find, overwhelmingly, that population growth has the larger impact overall.
- Several papers involving case studies in Africa, and written by African authors, find a high correlation

between household size—presumably in large part a proxy for fertility—and food insecurity.

- Two papers attempt to quantify the “legacy effect” of population growth on the environment—the likelihood that any birth leads to subsequent births in later generations, with associated environmental impacts long into the future. Both conclude that this effect can increase dramatically the long-term environmental impacts of current births.
- The effect of population growth on the environment sometimes can be illustrated by exploring situations where population growth has slowed significantly (one paper finds this hopeful for future food security) or is absent altogether (a paper finds that wildlife is returning to land around the failed Chernobyl reactor in Ukraine).

Overall, despite the lack of a scientific sub-discipline or research initiative linking these topics—family planning, women’s empowerment, population change, and environmental sustainability—the literature reveals a richness of ideas and a diversity of geographic origins. Among the 414 papers ranked as certainly or probably relevant to the primary FPESA hypothesis, there is a wide array of findings and views that can support family planning education and advocacy. There are some findings as well that caution against overconfidence that the connections between family planning, population growth, and environmental change are certain or obvious.

The evidence, while falling short of a confirmation of our hypothesis, is strong. Especially given the importance of this potential linkage in our time, the literature deserves more attention than it has received, and the remaining research gap deserves to be closed.

We intend to continue our work in the FPESA project. Its findings so far illuminate considerable evidence supporting, and almost none refuting, the statement that expanding access to and use of family planning can help bring about an environmentally sustainable world that meets human needs.







# Findings

Imagine a profusion of scientific evidence, documented in peer-reviewed journals, that demonstrates that voluntary family planning contributes to a sustainable environment—one that can support humanity and nature’s well-being indefinitely. In an era of human-caused climate change and rising environmental risk, wouldn’t such evidence strengthen the case for safe, effective contraception, available to any sexually active person wanting to avoid unwanted pregnancy?

## The Search for an Evidence Base

This is the question behind the [Family Planning and Environmental Sustainability Assessment](#) (FPESA, *fuh-PAY-suh*) at the [Worldwatch Institute](#).<sup>2</sup> Funded by the [Universal Access Project](#) of the United Nations Foundation, the [Turner Foundation](#), and the [Wallace Global Fund](#), the project aims to identify and assess the evidence that access to and use of family planning improves environmental outcomes. We do this by 1) assembling an international team of consultants and researchers to work with project staff, and 2) exploring databases of peer-reviewed scientific journals for papers published from 2005 to the present that shed light on the primary hypothesis that family planning promotes environmental sustainability. A secondary hypothesis, demonstrable through the diversity of the project network and the authorship of relevant papers, is that interest in the linkage of family planning and the environment is

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*“We know from science that nothing in the universe exists as an isolated or independent entity.”*

— Margaret J. Wheatley,  
management consultant and writer.<sup>1</sup>

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shared worldwide and among both sexes.

Sensitivity and controversy surround the use of environmental arguments to promote family planning. These hamper organizational alliances and strategies that potentially could advance both access to reproductive

health services and the prospects for environmental sustainability. A review of recent scientific evidence related to these linkages arose as an idea that might encourage alliances between environmental and reproductive health organizations. Such a review might also ease fears that environmental arguments for family planning promote coercive population “control.”

A firmer scientific foundation for the connection might yield a freer discussion about it, with resulting public and policy benefits. Such a review would be stronger if conducted collaboratively, without predetermined conclusions, by diverse researchers of both sexes and from countries at different levels of development. The values shared by the project team and the assessment network necessitated a foundation for the work in sexual and reproductive health and rights and the importance of individual choice in the timing and frequency of childbearing.

## What Is Family Planning?

The project places family planning in the broader context of reproductive health, the well-being of





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individuals in their sexuality and its expression, as well as their choices on reproduction safely put into effect. We see [family planning](#) as a range of behaviors allowing women and couples to avoid unintended pregnancy and to make and put into effect decisions on whether and when to have children.<sup>3</sup> These behaviors include not just the use of contraception, but also education and counseling on how to time or avoid pregnancy, treatment for involuntary infertility, and voluntary abstinence for the purpose of avoiding pregnancy.

Our primary focus is improving access to family planning services, ideally in the context of comprehensive reproductive health care. We interpret *access* broadly to mean the removal of all barriers to the free use of family planning. These may include physical barriers such as distance to sources of contraception or inadequate services, methods, or counseling when one arrives there. The barriers also may be social, such as religious restrictions or other prohibitive social norms, pressure from partners and others, or misinformation about side effects. Although we do not deal directly with strategies for increasing the demand for family planning, we see such strategies as compatible with our hypothesis so long as the means respect human rights and individual reproductive intention.

The right of parents to choose the timing and spacing of children is well established in international

agreements going back to the United Nations' 1968 International Conference on Human Rights in Tehran, Iran.<sup>4</sup> The FPESA project is not investigating the basis for that right or the well-established evidence that family planning contributes to maternal and child health. (For an overview, see [Amy O. Tsui et al.](#), 2010.<sup>5</sup>) The subject of study is the impact that access to and use of family planning may have on the environment globally and in all countries, whatever their level of development or income. This could be through either a demographic pathway (more use of family planning reducing fertility and slowing population growth) or one connecting the empowerment of women to greater engagement in environmentally friendly behavior and action.

### What Is Environmental Sustainability?

We define environmental sustainability, in the words of the 1987 World Commission on Environment and Development report, *Our Common Future*, as actions to assure that human activity “meet[s] the needs of the present without compromising the ability of future generations to meet their own needs.”<sup>6</sup> In focusing on meeting human needs, the concept includes social justice and equality of rights and opportunity as well as the ongoing integrity of the biophysical environment that supports life. We interpret the environment broadly to include such issues as food security—which requires sustainably fertile soils, fresh

## We define:

### Family Planning

as a range of behaviors allowing women and couples to make and put into effect decisions on whether and when to have children.

### Environmental Stability

as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

### Access

as the removal of all barriers to the free use of family planning.





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water, and a supportive climate—and such human health issues as infectious disease. (Nearly one in four deaths worldwide result from environmental causes, according to a [report](#) by the World Health Organization.<sup>7</sup>)

The Worldwatch Institute assembled a small group of staff, consultants, and eventually a network of researchers around the world to conduct the work. Robert Engelman, Worldwatch Senior Fellow and former President, who directs the project and is the main author of this report, is on the record with his own view that family planning is environmentally beneficial and worthy of support in part for that reason. A former science journalist who has co-authored peer-reviewed scientific papers, he and the project team of researchers, consultants, and communications specialists are committed to presenting fairly and as objectively as possible the evidence that the FPESA project uncovers. This report presents key findings to date.

### The Peer Review Standard

Basing our work on peer-reviewed scientific papers published over the past decade in academic journals allowed us to narrow our search to those research studies and papers that we could consider recent, published in roughly the last 12 years. (The original study period was a decade, beginning in 2005, but as the project continued, we considered publication through early 2016.) This period was comparable to those chosen by other researchers that we encountered who examined literature that they considered recent. Although academic books often are peer-reviewed, we lacked the capacity to confirm peer review in each case and so did not include books or book chapters in our review.

Why peer-reviewed research? The process of scientific peer review is designed to provide a system of checks on published research by exposing ideas, methodologies, findings, and conclusions to outside scrutiny. The reading public can expect journals to select peers to review submitted manuscripts based on their knowledge of the subject at hand, their lack of any role or stake in the research itself, and their presumed lack of bias. In the real world, however, the process is far from perfect.

Peer reviewers may know the authors of the manuscripts that they are reading or have their own strong views on the subject of the research. Despite peer review, journals occasionally “retract”—that is, disavow support for—a previously published paper due to critical errors or other deficiencies discovered after publication.

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*Peer-reviewed publication . . . remains the highest standard available for evaluating whether research has merit and can be prioritized for informing public opinion, advocacy, and policymaking.*

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Peer-reviewed publication nonetheless remains the highest standard available for evaluating whether research has merit and can be prioritized for informing public opinion, advocacy, and policymaking. There are many reports on critical global issues by governmental and intergovernmental agencies, blue-ribbon commissions, and think tanks, including the Worldwatch Institute. The FPESA project may, at a later date, assess some of the best of this “gray literature” for evidence related to our hypotheses.

With the proliferation of publicly available scientific information in recent decades, the news media—and the social media that leverages its messages—increasingly limit their coverage of scientific advances to findings published or about to be published in peer-reviewed journals. A week rarely passes without one such study making headlines and riding a wave of likes, favorites, and retweets. Our focus on peer-reviewed papers allows us to delineate a well-defined and sufficiently narrow field for a scholarly study, while favoring results that are most likely to prove robust, usable, and influential over the long term.





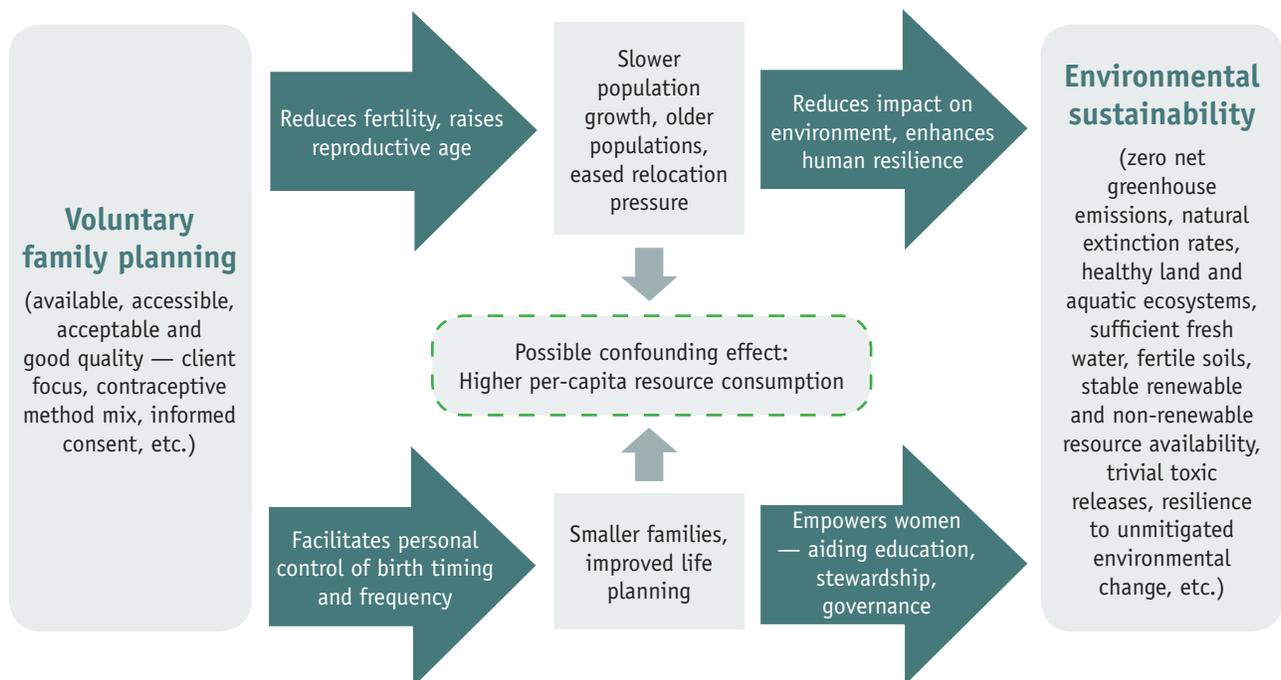
**Methodology:**  
**What We Did**

By one estimate, 24,000 academic journals worldwide publish 1.3 million papers each year.<sup>8</sup> A 2015 [study](#) by Elsevier, a leading journal publisher, and SciDev.Net, an online science news site, found that the volume of papers related to “sustainability science” was growing by more than 7 percent a year, with an output of 75,602 papers in 2013.<sup>9</sup> There was no possibility of reviewing so vast a library of literature. We began our process by developing a conceptual framework designed to capture, in simple terms, the two pathways by which we hypothesized that family planning might prove beneficial to the environment. (See Figure 1.)

The resulting framework, refined after a period of external peer review, illustrates two key points:

- 1) As indicated by the direction of arrows, the FPESA project is looking for ways that the use of family planning influences environmental sustainability, more than the reverse effect. Exceptions include a few papers that we selected because they shed light on the possibility of feedback effects that themselves might highlight or undermine added environmental value of access to family planning. Undesirable environmental change, for example, might prompt reductions in desired fertility and hence raise family planning demand, which, if met, could mitigate further environmental change.
- 2) We are looking for these potential connections not just through fertility and hence demographic change, but through non-demographic pathways. These chiefly involve family planning’s potential contribution to empowerment and improved

**Figure 1. FPESA Conceptual Framework: How Family Planning Might Benefit Environmental Sustainability**





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options for autonomy and social agency among women. We are not asking how environmental degradation might disproportionately put women at risk and how the use of family planning might contribute to reductions in that risk, questions that have attracted some literature. Rather, we are asking how the use of family planning might improve the prospects for achieving environmental sustainability through its impacts on women's lives.

Nestled centrally in the diagram is a square with a dotted perimeter to symbolize its potentially undermining relationship to the rest of the hypothesis. This is the possibility that family planning indirectly boosts per capita consumption, presumably through lowering fertility and thus boosting affluence or acquisitiveness. If operative, this effect could counteract the sustainability that might otherwise be induced by slower population growth.

### A Network for Collaborative Assessment

Simultaneously with our search for relevant scientific literature, we worked to build a network of research-assessment collaborators. We invited some individual authors that we encountered in our early scan of research. And we placed a notice in the listserv of the [Population-Environment Research Network](#), based at Columbia University and read by thousands of researchers around the world. Ultimately, 28 researchers and others working in fields related to our work accepted our invitation, 15 of whom went on to help in assessing research. See “Authors, Project Team, and Research Assessors” on page vi.)

Project staff and consultants began by gathering a few papers that were identified previously through earlier work, and then went on to interview experts for their ideas, to peruse relevant reports for citations, and to explore web-based and library databases. In 2014, we engaged Joe Bish of the [Population Media Center](#), which monitors news from around the world about population and reproductive health, to screen for journal papers meeting our criteria.

We eventually developed a more systematic process for identifying peer-reviewed scientific papers for evaluation and assessment. Working with doctoral candidate Sam Sellers at the University of North Carolina at Chapel Hill, we developed a set of search terms designed to bring to the foreground scientific papers worthy of further evaluation. Our hope was to identify papers that mimicked our conceptual framework in comparing topics related, directly or indirectly, both to family planning and to environmental sustainability.

We then applied these search terms to the [Web of Science](#) database, which claims access to 90 million scientific papers published around the world.<sup>10</sup> After realizing that there could be interactions in the central area of our conceptual framework that would not be captured by terms included in the framework's two vertical rectangles framing family planning and sustainability, we returned to Web of Science with somewhat different sets of search terms. (See Table 1.) These were designed to bring forward papers that explore environmentally or demographically related conflict or the empowerment of women.

The conceptual framework strongly guided our literature selection process. We asked ourselves and the network of assessors to relate each paper that we read to the flow chart in an effort to see if it supported or undermined any of the various relationships depicted. The selection of papers for annotation, and the annotations themselves, reflect this discipline, often referring to specific connections depicted in the conceptual framework. Although many contemporary researchers interested in population and the environment prefer to focus at local and even household scales, we consider the connection at all scales—including the impact that population dynamics in one country might have remotely on environmental problems in others. Some researchers who study these linkages appear to see the question of population growth's impact on the environment as among the least interesting threads to explore. One group of authors, for example, wrote that their “[studies](#) have sought to go beyond the attribution of environmental degradation to high fertility and





**Table 1. Web of Science Search Terms**

We compiled a list of search terms designed to link together family planning and sustainability, constructing a search that required articles to contain a topic term relating to family planning or its possible consequences (such as changes in fertility rates or greater gender equity) and a topic term relating to conservation or sustainability. Web of Science defines a topic term as a word or phrase appearing in an article’s title, in its abstract, or among the keywords denoted by article authors.

We generated an initial list of search terms and then tested various combinations in the Web of Science database. We tried adding and deleting certain terms to see whether they changed the number of relevant results that we received. On this basis, we deleted a number of terms, as some greatly increased the number of results we received, resulting in an excess of articles that were not relevant for our purposes. Additionally, we eliminated terms that had little or no impact on our results.

The terms listed at right were tested but omitted after generating a unmanageable volume of mostly irrelevant results (12,700 total):

The final result, after some further eliminations for irrelevance, yielded approximately 500 papers. Approximately 200 were later added through comparable searches of Web of Science focusing on civil conflict related to environment or population, and on women’s empowerment. These were added to more than 200 articles found through interviews, news and social media articles, and literature searches made through Google Scholar and Library of Congress databases.

Omitted Terms
fertility
gender
energy
adapt*
mitigation
child marriage
demograph*
child brides
gender-based violence
women’s status
women’s agency
women’s autonomy
pollution

Family Planning Terms	Sustainability Terms
reproductive health	natural resource
sexual health	carrying capacity
reproductive rights	resilien*
sexual rights	climate change
family planning	global warming
gender equ*	carbon emissions
contracept*	water scarcity
birth control	food *security
population control	famine
total fertility rate	biodiversity
TFR	ecosystem
population growth	sustainable development
growing population	consumption
population pressure	environment* sustainabil*
population dynamics	soil fertility
girls education	anthropogen*
empower*	fossil fuel
decreas* family size	renewable
low* family size	non-renewable
small* family size	resource scarcity
demographic transition	resource depletion
intended pregnancy	environmental degradation
desired fertility	
population pressure	
population stab*	
stab* population	
fertility intent*	
fertility desir*	

**Note:** An asterisk (\*) denotes the use of a “wild-card term,” meaning that the search included terms with different sets of letters in place of the asterisk. For example, a search for the term “empower\*” would include results that contain the words “empower” or “empowers” or “empowerment.” “TFR” is an acronym for “total fertility rate,” a demographic term quantifying the average lifetime number of live births per woman in a population at any given time.





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associated population increase.”<sup>11</sup> By contrast, we were particularly interested in assessing such attributions, as changing trends in fertility and demographic growth are among the more likely effects of the use of family planning. We did not rule out assessment of papers relating to such population dynamics as age structure and distribution, including migration and urbanization. But we found only a handful of such papers that we could associate with family planning through one or more of the pathways in our conceptual framework.

**The Assessment Survey**

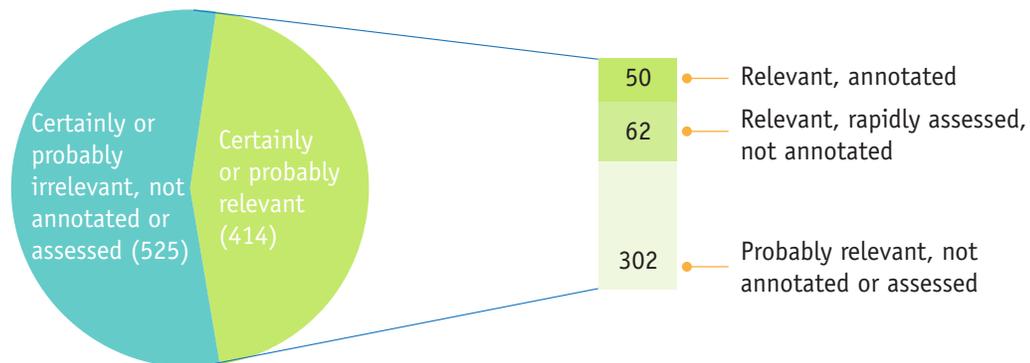
We developed a survey for collaborating assessors to fill out for each paper assessment. (See Table 2 on page 12.) The collaborative assessments themselves were originally voluntary. In late 2014, we began offering a modest honorarium of \$100 for each completed assessment. For budgetary reasons, the project has since returned to a voluntary system for collaborative assessments. The collaborative evaluations received from the FPESA network were designed to contribute significantly to the overall assessment process. Due to limitations on time available and on the project’s human and financial resources, however, only 13 of the most promising papers we identified were collaboratively evaluated by the network. We hope to expand the network and to continue to work with it in future assessments following the publication of this report.

The literature searches and our previous list of identified papers produced a total of 939 papers published in 2005 or later that qualified for preliminary evaluation. The qualifying process involved at least two readers of each paper’s abstract, who then assigned a score based on the assessment of the abstract’s promise of relevance to the primary FPESA hypothesis (family planning’s benefit to environmental sustainability). No specific scoring instructions were made on the question of support for the secondary hypothesis (diverse researcher interest in the overall linkage). Members of the project team were encouraged to look especially closely at those papers published in developing-country journals and/or written by women or researchers who likely worked in or had close connections in developing countries.

Readers ranked each of the papers numerically, based on their relevance to the FPESA conceptual framework, evaluating their perceived strength on the basis of comprehensibility, reproducibility, and a range of related qualities. These rankings became an important basis for sending some papers out for collaborative assessment and for annotating many more in this report.

Out of the field of 939 papers total, 112 were top-ranked (based on a ranking of 5 on a 1-to-5 scale of relevance to our conceptual framework), 50 of which we annotate in this report. An additional 302, ranked 4, were judged likely to contribute something of value

**939 Papers Reviewed:  
How They Break Down by Relevance, Annotation, and Assessment**





**Table 2. Form for a Collaborative Article Assessment**

*This section to be filled out by FPESA staff (sample provided below):*

**Title of article:** Integrated management of coastal resources and human health yields added value: a comparative study in Palawan (Philippines)

**URL:** <http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=7944204&fileId=S0376892910000779>

**Author:** Leona D'Agnes et al.

**Year published:** 2010

**Journal name and related information** (volume, number, pages, online code number if applicable): Environmental Conservation, November 2010, vol. 37, no. 4, pp. 398-409

**Digital object identifier:** DOI: 10.1017/S0376892910000779

*This section to be filled out by FPESA network collaborators:*

Questions 1 through 7 may be answered simply by highlighting or boldfacing one of the three options. Optional comments may be added below each question. It is not necessary to respond to all questions. When complete to your satisfaction, please email as an attached document to Yeneneh Terefe at [yterefe@worldwatch.org](mailto:yterefe@worldwatch.org).

Annotator's Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. Is the methodology sound? Yes No Uncertain
2. Are the data and evidence presented understandable and believable? Yes No Uncertain
3. Do the analysis and conclusions follow logically from the evidence presented?  
Yes No Uncertain
4. Are the research, analysis and conclusions reasonably free from obvious ideology, bias or pre-conceived opinions?  
Yes No Uncertain
5. Could this research be reproduced? That is, could it be repeated in this or another form to generate findings that would either support or undermine its conclusions?  
Yes No Uncertain
6. Does this report help answer the key question under consideration in the FPESA project: whether better access to, and more use of, voluntary family planning is likely to support environmental sustainability? (For FPESA's conceptual framework, a work in progress designed to illustrate aspects of this complex linkage, [click here](#).)  
Yes No Uncertain
7. Strength of article (highlight response):  
Very good Good Neutral Weak Very weak
8. Are there particular articles cited in this article's references that you believe FPESA staff should obtain to consider for possible assessment? These should be peer-reviewed and published in 2005 or later. However, citations of earlier and/or non-peer-reviewed articles may still be of interest for the project.
9. Annotation. IMPORTANT: This is a commentary of at least 250 words expressing your judgment of the paper's hypothesis or message, its potential relevance to the linkage of family planning and environmental sustainability, and its robustness and potential impact as a piece of research. Include any caveats or weaknesses you see.





to our hypothesis. Another 225, ranked 3, were seen as of uncertain value, with a possibility that each would prove at least somewhat helpful if examined in greater detail than we were able to do in the current round of analysis. Papers ranked lower than 3—a total of 299—were judged to be of unlikely relevance or certain irrelevance. We hope to explore more fully many of the papers ranked 4 and 3 in the future, while also potentially identifying existing qualified literature that we missed in our search as well as new work published in mid-2016 or later.

### Looking for Empirical Evidence

In our assessment, we have particularly sought out papers that are quantitative and based on empirical evidence and calculation. In some cases, however, we have selected papers for annotation that are qualitative or dependent on an accumulation of other research to make their points. We seek literature that is available to anyone interested, so we necessarily exclude papers that are not readily accessible online at least in abstract form and ideally in full. (Unfortunately, this requirement introduces an unwelcome hindrance, as it disqualifies some otherwise qualifying papers published in developing countries that are not available in any form online.) We prefer papers that are easy for non-specialists to understand, as the project is designed to be useful to the public, the media, advocates, and policymakers. With few exceptions, we have excluded papers based on highly technical methodologies, requiring highly specialized knowledge, or focused on the research process rather than on outcomes.

Honoring an essential scientific value, we have sought out and paid particular attention to papers that may undermine our primary hypothesis and conceptual framework. Given our emphasis on recent research, papers published during the project work period may have gained more attention than older ones. Excluding

papers published before 2005 may have eliminated important findings from earlier years that have not been revisited since.

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*We have particularly sought out papers that are quantitative and based on empirical evidence and calculation.*

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In two important areas, we lacked the capability for satisfactory assessment. We aimed to assure ourselves that all journals from which we drew papers required peer review for original research articles. Although many journals state this explicitly, not all do, and it was not possible to guarantee that all journals that we used do require peer review. We rejected commentaries, letters

to the editor, and similar articles, even if published in peer-reviewed journals, based on editors' statements that these articles may not have been subjected to peer review. But we cannot guarantee that we caught all such examples, or that we did not mistakenly reject some peer-reviewed research.

Secondly, given the broad range of specialized knowledge and training represented in the diverse body of literature that we reviewed, we could not adequately evaluate the methodologies employed in each paper. We tended to favor those papers where methodologies, as well as findings and conclusions, were accessible to a range of readers. But in most cases, we relied on the peer review process to weed out faulty methodologies and assumed, possibly not always accurately, that relevant and compelling findings were made legitimately.

Although we have no illusions that our search captured all or even most recent papers relevant to our primary hypothesis, we are confident that our selection represents a substantial and informative sample of the research related to our hypothesis. Selection preferences and biases, intended or not, may have influenced the project's findings to date. The small size of our team, the large body of research with which we have been working, and the complexities of the interface of human and biophysical interactions





preclude a rigorously quantitative approach to the assessment project.

Our goal has been accuracy and fairness in both the identification and assessment of the body of literature related to our primary hypothesis. Among our project team and network of assessors, there were sometimes diverse opinions on the conclusions that evidence could support. The conclusions stated in this report are based on the fullest review of the articles surveyed and take into account all expressed viewpoints of the team and network. They should not be taken to represent the views of all authors, team members, and network assessors. We welcome scrutiny and outside judgments as we hone our own methods for conducting our assessment.

### What We Found

Dozens of peer-reviewed papers published since 2005, many of them described in this report, support the causal links in our conceptual framework. The preponderance of evidence from the 112 papers that we identified as most relevant to our primary hypothesis supports this hypothesis, with little refutation. Yet only a handful of papers among all we examined directly explore the question of whether family planning is good for the environment.

The body of scientific research connecting the conceptual framework's two pillars is too small and indirect to convince neutral observers, let alone skeptics, that investments in family planning will pay off directly in benefits to the environment. We find the hypothesis to be supported, but unconfirmed. This statement could change as a result of future findings. It is also possible that a deeper, more comprehensive examination of literature across a longer time period would conclude differently. In the meantime, there is much to learn from the most relevant evidence.

We are confident that our secondary hypothesis—that the linkage between family planning and environmental sustainability draws the interest of diverse researchers around the world—is confirmed, as described

below. Widespread interest is all the more reason to accelerate and expand research on this linkage.

Based on our assessment, we can say that peer-reviewed scientific research published from 2005 through early 2016 generally supports the following three core conclusions related to our primary hypothesis:

- **Access to and use of family planning—specifically effective modern contraception—reduces fertility and facilitates delayed and more widely spaced childbirths, slowing population growth.** In particular, contraception dampens the frequency of unintended pregnancies, nearly 40 percent of which end in unplanned births. About 40 percent of all pregnancies worldwide (85 million out of 213 million total in 2012) are unintended, resulting in more than 32 million unplanned births. (Data from [Gilda Sedgh et al.](#), 2014, see annotation on page 62. For comparison, the world's population grows by roughly 80 million people each year.<sup>12</sup>) A study of U.S. pregnancies by [Lawrence B. Finer and Mia R. Zolna](#), 2016 (see annotation on page 60), concludes that increases in contraceptive use from 2008 to 2011 reduced unintended pregnancies from 51 percent of all pregnancies to 45 percent.<sup>13</sup> The rate of unintended pregnancies resulting in unplanned births dropped in parallel, from 27 per 1,000 women of reproductive age in 2008 to 22 per 1,000 in 2011.
- **Slowing population growth tends to lessen the risk of dangerous environmental changes and to enhance the potential for societal resilience to climate change, water scarcity, food insecurity, the loss of biological diversity, and related threats.**
- **By reducing unintended pregnancy and facilitating personal choices on the number and timing of births, family planning expands opportunities available to women and girls.** This enables them to contribute more actively to environmental activities and to societal resilience.





The weight of evidence suggests that women are somewhat more likely than men to take or support actions that promote environmental sustainability.

These core conclusions of the FPESA project are based on the balance of evidence that we reviewed in our literature screening, review, and assessments. Although we identified no single peer-reviewed scientific paper that directly explores our primary hypothesis, [Brian O'Neill et al.](#), 2010 (annotation on page 74),<sup>14</sup> and [Derek D. Headey and T.S. Jayne](#), 2014 (annotation on page 86)<sup>15</sup> came close. Both approached the standard in offering evidence both for family planning's slowing of population growth and for the environmental impact of that growth.

Dozens of papers produced findings that, examined cumulatively, could encourage open-minded readers to lean toward accepting our primary hypothesis. Since the use of family planning demonstrably contributes to slower population growth, convincing evidence that slowing population growth will slow environmental decline would effectively confirm the hypothesis in two steps. We identified numerous papers whose conclusions supported the second step (slower population growth contributes to environmental sustainability) and few papers refuting it. Without stronger and more consistent empirical evidence and a stronger scientific consensus on this connection, however, we could not conclude that the hypothesis is confirmed.

We nonetheless found a diverse and rich body of literature that often crossed disciplines, sometimes mixed empirical data with researcher opinion, and, in many cases, supported at least key portions of the two pathways in our [conceptual diagram](#). We counted 414 papers, out of the total 939 examined, with likely or certain relevance to our hypothesis. Based on that, we conclude that the level of research interest in questions associated with our assessment is significant. On average, roughly four peer-reviewed papers were published each month during the time period of more than 11 years that we explored that



were of probable or definite interest to the family planning-environment linkage.

Within the context of our three core conclusions, the following findings are among the most notable that emerged from the literature we surveyed:

► **Finding:**

**Use of family planning reduces fertility below what it otherwise would be.**

The point may seem obvious to some, and abundant literature prior to 2005 supports the statement. Although not a common theme of more recent research, several papers we reviewed, beyond those mentioned above, show that increased use of family planning is clearly an important factor in reducing fertility and hence slowing population growth. This connection supports a key pathway in our conceptual framework denoting that family planning promotes fertility decline, which then slows population growth. (See, for example, [John B. Casterline and Laila O. El-Zeini](#), 2014, annotation on page 59;<sup>16</sup> [David L. Carr](#), 2007, annotation on page 97;<sup>17</sup> and [Lynn M. Van Lith et al.](#), 2013, annotation on page 63.<sup>18</sup>) Other factors often interact, especially educational attainment at least part-way through secondary school. (See, for example, [Mark L. Wahlqvist et al.](#), 2013, annotation on page 90;<sup>19</sup> and [Leiwen Jiang and Karen Hardee](#), 2014.<sup>20</sup>)





► **Finding:**

**Much of the literature demonstrates or asserts a causal population connection to environmental risk or degradation.**

Among the 112 articles that we found most certainly relevant to our primary hypothesis (a score of 5), 72 either present findings supporting the statement that population growth contributes to environmental problems or, in a few cases, simply assert the connection. The proportion of evidence-free assertions appears to be similar or possibly somewhat higher in the lower-ranked categories of papers.

A frequent formulation, with perhaps several dozen examples in our database, is for abstracts to open with a statement that projected population growth will cause or contribute to a deterioration of a specific environmental variable—freshwater supplies or forested land, for example. The papers then go on to consider potential solutions to this problem unrelated to demographic change, with no further mention of population growth. (See, for example, [James R. Oakleaf et al., 2015](#);<sup>21</sup> [Nikhil Lele and P.K. Joshi, 2008](#);<sup>22</sup> and [Nidal Hadadin et al., 2010](#).<sup>23</sup>)

These authors’ assumption that their readers need no evidence for such assertions gains support from 2014 [survey findings](#) by the Pew Research Center and the American Association for the Advancement of Science. According to the organizations’ report, 82 percent of the association’s member scientists (3,748 surveyed) expressed concern that “growing world population will strain natural resources.” A smaller but still-majority 59 percent of the U.S. public (2,002 surveyed) agreed.<sup>24</sup> (See Figure 2.)

Scientists’ support for such convictions was demonstrated in 1993 by a [joint statement](#) of 58 national academies of science that “Humanity’s ability to deal successfully with its social, economic and environmental problems will require the achievement of zero population growth within the lifetimes of our children.”<sup>25</sup> A [joint statement](#) published the year earlier from the Royal Society of London and the U.S. National Academy of Sciences

similarly called attention to the urgency of addressing population growth, along with consumption.

The earlier statement went further than the later one, connecting the issue to voluntary family planning in language that remains apt today:

Unlike many other steps that could be taken to reduce the rate of environmental changes, reductions in rates of population growth can be accomplished through voluntary measures. Surveys in the developing world repeatedly reveal large amounts of unwanted childbearing. By providing people with the means to control their own fertility, family planning programmes have major possibilities to reduce rates of population growth and hence to arrest environmental degradation.<sup>26</sup>

For good measure, the statement authors added a point supported by the diversity of papers that we reviewed:

Also, unlike many other potential interventions that are typically specific to a particular problem, a reduction in the rate of population growth would affect many dimensions of environmental change. Its importance is easily underestimated if attention is focused on one problem at a time.<sup>27</sup>

**Figure 2. Resources and Population Growth**

% of each group saying the growing world population will or will not be a major problem because...



Survey of U.S. adults August 15-25, 2014. Q28. AAAS scientists survey Sept. 11 — Oct. 13, 2014. Q24. Those saying don't know or giving no response are not shown.

*Illustration from Pew Research Center, Public and Scientists’ Views on Science and Society (Washington, DC: 29 January 2015). Used by permission.*





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If one wanted a consensus statement from scientists connecting family planning to environmental sustainability, these statements might qualify. They are more than two decades old, however, and it is not clear that the same institutions would join forces to make such statements today. More recent concerns among some scientists about the impact of population growth have been expressed in relation to particular ecosystems. One of the papers in our database, [Joan A. Kleyvas and C. Mark Eakin](#), 2007, surveyed 286 researchers specializing or interested in coral reefs. Most of those surveyed rated the direct effects of human population growth more highly than climate change or any other factor as a threat to the survival of the reefs.<sup>28</sup>

These findings raise a paradoxical question, however: Are scientists basing their views on the environmental impacts of population on empirical evidence, or on untested assumptions or even bias? The publication process itself may introduce “biases for significant and expected results,” in the words of [Camilo Mora and Peter F. Sale](#), 2011, in their paper on the relative value of protected areas for biodiversity conservation (see annotation on page 82).<sup>29</sup> We found no dependable way to test for such a bias in the research that we evaluated.

**► Finding:**  
**A diversity of authors call for increasing access to and use of family planning to resolve specific environmental problems.**

More than 40 percent of these authors among our top-ranked papers are African (see “Perspective: African Researchers on the Linkage,” page 46), but those from other regions make this connection and recommendation as well—generally without offering specific evidence for the benefits of family planning. As noted earlier, two papers that offer evidence are O’Neill et al., 2010, and Headey and Jayne, 2014. An author of Colombian origin now working in the United States

led a large group of international authors [identifying](#) improvement in family planning as one strategy for the maintenance of biological diversity. (See Mora and Sale, 2011;<sup>30</sup> [Camilo Mora et al.](#), 2011, annotation on page 83;<sup>31</sup> and “Perspective: Convince Them to Say It,” page 39.) [Julian A. Lampietti et al.](#), 2011 (annotation on page 89), called for family planning to help ameliorate growing food insecurity in Arab countries.<sup>32</sup>

**► Finding:**  
**Although the literature does not demonstrate directly that increased use of family planning contributes to environmental sustainability through women’s empowerment, some papers offer evidence that, cumulatively, can support that statement.**

Greater gender equality and participation of women in governance and civil society can lead to positive environmental outcomes, several papers indicate. Identification of empirical evidence that the use of family planning facilitates or encourages gender equity and women’s participation would thus effectively confirm

our primary hypothesis through this pathway, via two steps: In the first step, family planning empowers women. In the second, women apply this empowerment to positive environmental outcomes.

Eleven of our 112 top-ranked papers document evidence for the value of gender equity and women’s empowerment in environmental outcomes. (Achieving these is [Goal 5](#) in the United Nations’ Sustainable Development Goals.<sup>33</sup>) Several more papers appeared to do so in our second-ranked group of 302 articles, although we have not made a thorough count of the findings in this group. (See “Perspective: Are Women More Environmental” on page 36.)

Several top-ranked papers identify correlations between women’s participation in civic affairs and positive environmental outcomes. (See, for example,

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*More than 40 percent of these authors among our top-ranked papers are African.*

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[Bina Agarwal](#), 2009, annotation on page 64;<sup>34</sup> [John M. Shandra et al.](#), 2008<sup>35</sup> [Kari Norgaard and Richard York](#), 2005, annotation on page 68;<sup>36</sup> and [Colleen Nugent and John M. Shandra](#), 2009.<sup>37</sup>)

Although the link to family planning is absent in these papers, their findings support our primary hypothesis and conceptual framework. The proposition that planning the timing of pregnancy facilitates women's participation in social activities beyond parenting is not tested in our database of papers, possibly due in part to perceptions of its obviousness. This forces us to draw this specific connection based on logic rather than empirical evidence.

► **Finding:**

**Population growth is often found to be more influential a factor than climate change in current or projected environmental problems.**

There is agreement among those authors who attempt to quantify the forces driving freshwater scarcity that population growth and its accompanying rising demand is a larger and more certain cause than is climate change and accompanying reductions in water supply. (See, for example, [Yongbo Liu and Yaning Chen](#), 2010, annotation on page 79;<sup>38</sup> [W. Buytaert and B. De Bièvre](#), 2012, annotation on page 77;<sup>39</sup> [Richard C. Carter and Alison Parker](#), 2009, annotation on page 78;<sup>40</sup> and [Emmanuel Obuobie et al.](#), 2012, annotation on page 80.<sup>41</sup>) Some authors simply identified both factors as important, without comparing them quantifiably.

This finding is less surprising than it may seem, given considerable uncertainties about whether and how much climate change has already affected the environment and natural resources or will in the future. The evidence for demand growth from recent and projected population growth, by contrast, is more robust. (Government policy and increases in per capita water withdrawals or other resource consumption, of course, influence demand growth as well. We did not find efforts to disaggregate these

factors in the literature comparing climate change and demographic impacts.)

The idea that population growth may more powerfully direct environmental change affecting human well-being than does climate change goes against widespread perceptions about the relative importance of these two drivers. The likelihood that population growth also influences climate change and adaptation to it complicates this relationship. Nonetheless, when researchers document that increases in precipitation are occurring even as per capita water supplies are declining, as Liu and Chen do, it is clear that demand-driven increases in water withdrawals related to population growth are directly causing shortages.

► **Finding:**

**Food security is undermined by high fertility.**

Three of the articles in which African authors connect family planning, population growth, and the environment found strong correlations between household size and food insecurity in the areas of Africa that they studied. (See [Paul S. Amaza et al.](#), 2008;<sup>42</sup> [Mary O. Agada and Edwin M. Igbokwe](#), 2014, annotation on page 88;<sup>43</sup> and [Mesfin Welderufael](#), 2014, annotation on page 91.<sup>44</sup>) All three articles





called for improved family planning to address food insecurity. This conclusion by African authors could be useful in informing efforts at the U.S. Agency for International Development and elsewhere to integrate family planning with food security initiatives.<sup>45</sup>

► **Finding:**

**There is no sub-specialty of demography or environmental science that routinely examines linkages between family planning and the environment.**

With a few exceptions, there appears to be little conversation or sense of community among the researchers who do test the waters of this linkage. Cross-citations of the literature in our database were relatively uncommon. Letters to journal editors commenting on published literature were quite rare. (For an exception, see [Corey J.A. Bradshaw and Barry W. Brook](#), 2014, annotation on page 105.<sup>46</sup>)

This finding fits well with our conversations with experts who have experience studying the linkage. Some experts whom we interviewed suggested that the lack of a stronger body of data and evidence in our database of articles could be associated with a sense among many researchers that the truth of our hypothesis is too obvious to be worth exploring. (See “Perspective: Experts Reflect on the Research,” page 54.) How could wider use of family planning fail to reduce fertility beyond what it otherwise would be, all else equal? And how could lower fertility fail to slow population growth and, through this, reduce human pressure on the environment? We found that these conclusions did seem obvious to many paper authors, based on their stating them as unexplored underlying assumptions to their research.

Other experts that we interviewed drew attention to the sensitivity of both contraception and population—a sensitivity that, for various reasons, seems heightened when either or both are connected to the environment. The United Nations, for example, “ignored population growth in framing the SDGs

[Sustainable Development Goals], which should be a point of public concern,” a group of scholars from India, Japan, the United Kingdom, and the United States [wrote](#) in 2015 in the journal *Science*.<sup>47</sup> These linkages may be risky topics of study and research for those who are ambitious about academic career advancement. For the same reasons, those who fund environmental research may shy away. (See [Martha Campbell](#), 2007;<sup>48</sup> [Diana Coole](#), 2013;<sup>49</sup> and “Perspective: Convince Them to Say It” on page 39.)

► **Finding:**

**No papers directly refute the hypothesis that family planning contributes to environmental sustainability, although a small number of papers undermine it somewhat.**

In our top-ranked group of papers, we identified two papers that present modest caveats to the hypothesis that family planning is environmentally beneficial. (See [Kyle W. Knight and Eugene A. Rosa](#), 2011, annotation on page 92,<sup>50</sup> and [Ronald Lee and Andrew Mason](#), 2009, annotation on page 93.<sup>51</sup>) These papers provided quantitative evidence that lower fertility may boost per capita consumption of specific natural resources, offsetting some environmental benefit resulting from smaller population size. Knight and Rosa noted, however, that in the case they studied—household fuelwood use in developing countries—slower population growth resulting from fertility decline still more than compensated for increases in per capita consumption.

[David Henley](#), 2007 argues that population growth may enhance soil management among smallholder farmers in Indonesia, although not forest and fisheries management or the conservation of nature.<sup>52</sup> One paper argues that slowing population growth would do little to reduce greenhouse gas emissions ([David Satterthwaite](#), 2009, annotation on page 76), based on calculations showing much lower per capita emissions among national populations with high fertility rates.<sup>53</sup> We did not identify any research suggesting that significant environmental risks may result from population





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decline or aging. No paper even asked whether family planning itself might be in any way environmentally harmful, let alone concluded that this was the case. On balance, empirical findings and expressions of scientific opinion support environmental benefits for family planning.

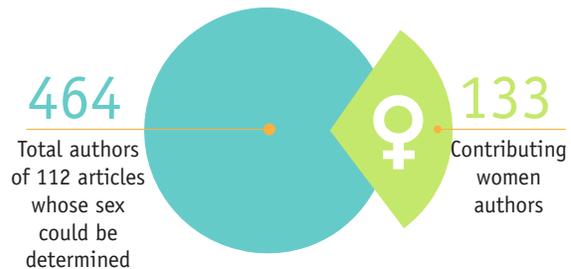
► **Finding:**

**The national and gender diversity evident among authors of papers and the members of our international assessment network confirm our secondary hypothesis, that research interest in linkages between family planning and environmental sustainability is diverse and widespread among both genders and in both developing and developed countries.**

We used authors' names and their university affiliation listed on their papers to determine their sex and regional origin (to the extent possible), supplementing this with our personal knowledge or Internet searches. The roster of hundreds of authors writing on the topics that we explored included more men than women, but many of the latter nonetheless. Of 464 authors of our 112 top-ranked articles whose sex could be determined, 133 were female. (See Figure 3 below.) Although we could not always identify the country or regional origins of authors, based on names and online searches, it is likely that from one-quarter to one-third of the authors in our full database of 939 papers have origins in or close connections to developing countries.

The secondary hypothesis gains support as well from the fact that we assembled a collaborative assessment network from Latin America, Africa, and Asia, as well as North America and Europe. Interestingly, authors in our database of papers from developing countries—especially those in Africa, including women authors—frequently were among those who asserted a strong role for the influence of population growth on climate change, food security, ecosystem health, the integrity of forests, and similar environmental or natural resource issues. African authors were more likely than those from other regions to call for improved availability of

**Figure 3:  
Authorship of Highest-ranked Papers:  
Women and Men**



family planning services. (See “Perspective: African Researchers on the Linkage,” page 46.)

One paper ([Theresa H. Hoke et al.](#), 2015, annotation on page 102) reported a survey of volunteer workers in the Green Belt Movement (GBM) of Kenya. GBM is a nongovernmental organization (NGO) founded by the late Nobel Peace Prize laureate Wangari Maathai that works on both environmental conservation and community development.<sup>54</sup> The authors noted:

When asked what family planning has in common with tree planting and GBM’s other core activities, all Green Volunteers were able to articulate at least one way in which their new responsibilities were consistent with the GBM mission; the most common response was that slower population growth reduces consumption of natural resources and environmental degradation. All 42 Green Volunteers indicated their interest in continuing their EHP [environment, health and population] activities; 35 spontaneously mentioned a desire to continue educating on family planning in particular.<sup>55</sup>

Although the question deserves more exploration than the FPESA project was able to achieve, our results indicate that the linkages that the project is exploring are of widespread interest among audiences in all regions of the world, among researchers and within NGO communities. We did not conduct a





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survey, and the community of collaborators and paper authors was hardly representative of the diversity of opinions that exists. Nonetheless, based on our experience conducting the assessment, we can say that objection to discussion of family planning’s potential contributions to environmental sustainability among women or in developing countries generally should not be assumed unless demonstrated in specific instances.

► **Finding:**

**The predominant evidence suggests that environmental degradation may encourage lower fertility or increased unmet need for family planning.**

Five papers examined the influence of environmental change on fertility and hence couples’ interest in using contraception. (See [Steven Arnocky et al.](#), 2012, annotation on page 95;<sup>56</sup> [Dirgha J. Ghimire and Paul Mohai](#), 2005, annotation on page 98;<sup>57</sup> [Karina M. Shreffler and F. Nii-Amoo Dodoo](#), 2009, annotation on page 99;<sup>58</sup> [Ann E. Biddlecom et al.](#), 2005, annotation on page 96;<sup>59</sup> [David L. Carr](#), 2008, annotation on page 97;<sup>60</sup> and [Derek D. Headey and T.S. Jayne](#), 2014, annotation on page 86.<sup>61</sup>) This linkage conceivably could shed light on our hypothesis by testing a possible causal relationship that could lead to a negative (in this case, constructive) fertility feedback loop: the high fertility that may contribute to environmental degradation would be discouraged by the degradation itself. Of the five papers, four found evidence for such a feedback loop, while one (Biddlecom et al.) found a positive feedback loop—that is, environmental degradation encouraging higher fertility. (The article “Perspective: Research Challenges and Opportunities,” see page 42, cites a second example of this relationship, by [Sarah R. Brauner-Otto](#).)

**Observations**

In some cases, we encountered isolated points or observations that hardly qualify as findings. Typically, these

were based more on logic, a line of reasoning by authors, than on empirical evidence. A few of these points deserve mention, and perhaps future exploration:

- Because of the nature of population change and momentum, slowing population growth can produce reductions in environmental stresses that last for generations. Sometimes called the “legacy effect,” this phenomenon is tied directly to reproduction itself. Each birth leads to a significant likelihood that the individual born will also reproduce (perhaps with multiple births), and so on,

unless or until a specific genetic line dies out. (See [Paul A. Murtaugh and Michael G. Schlx](#), 2009, annotation on page 73;<sup>62</sup> and [Usman Khan and Jim A. Nicell](#), 2014, annotation on page 61.<sup>63</sup>) However, it remains for now an unreliably quantifiable effect, depending on assumptions made today about reproductive rates and other conditions in a future that may be unimaginably distant.

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*The linkages that the project is exploring are of widespread interest among audiences in all regions of the world, among researchers and within NGO communities.*

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- One characteristic of population growth that sets it apart from other forces that may influence environmental change is the range of problems, risks, and topics it may influence. Perhaps its only competitor in this regard is bad policy, but this is more often cited for failing to resolve environmental problems than for causing their emergence. Population growth, by contrast, is most often characterized as a force behind that emergence. (See, for example, [Khalid Zaman et al.](#), 2012, annotation on page 94.<sup>64</sup>)
- The slowing of population growth or the absence of population were cited, in two cases, to illustrate negatively that these population dynamics affect the environment. The first case is a reduction in conversion of forests to agricultural land attributed at least in part to slowdowns in population growth rates. (See [Jesse H. Ausubel et al.](#), 2013, annotation





on page 88.<sup>65</sup>) The second is the return of wildlife to areas where, for various reasons, humans are now excluded, such as the land around the failed Chernobyl reactor in Ukraine. (See [T.G. Deryabina et al.](#), 2015.<sup>66</sup>)

And one more comment worth making on the FPESA literature review:

A half dozen or so among the hundreds of papers in our database used the terms “overpopulation” or “population control.” These terms are potentially troubling in implying, to some ears, that governments should coerce or incentivize family planning as an instrument of demographic control to reduce population size. Such terms can, nonetheless, mean different things to different authors, especially across borders and cultures, and we felt no need to disqualify these papers from our database. Nowhere in the research that we have examined are there authors or findings that undermine the human rights framework for addressing the linkage of family planning to environmental sustainability. Any linkages documented appear to be based in, or at least compatible with, achieving the freely chosen reproductive intentions of individuals and couples.

Perhaps paradoxically, given the inability to confirm our primary hypothesis, we found that much of the literature that we reviewed was rich, compelling, and generated by researchers diverse in specialty and geography. Forty-four percent of the 939 papers that our literature search identified definitely or probably shed light on pathways by which family planning might benefit the environment. The 50 most relevant of these are the basis of our annotations in that section of this report, and more will be presented on the FPESA [website](#).

**The evidence, while falling short of a confirmation of our hypothesis, is strong. Especially given the importance of this potential linkage in our time, the literature deserves more attention than it has received, and the remaining research gap deserves to be closed.**

The [Perspectives](#) and [Annotations](#) sections of this report present further and more-detailed findings. The FPESA process has offered a rich exploration of a large and varied body of literature by authors from most regions of the world—except for Latin America and the Caribbean, which are poorly represented in our sample. (See “Perspective: Research in Latin America and the Caribbean,” page 51, which presents some Spanish-language findings.)

There is in this literature a reasonable depth of conceptualization, investigation, and analysis on connections between family planning, population change, improvement in gender relations, and prospects for environmental sustainability.

Numerous papers yield important findings for policymakers and for advocates of the empowerment of women and the universal access to voluntary family planning services. The research tools are undoubtedly available to test the proposition that there are important environmental benefits to be expected from wider use of family planning worldwide.

### Where We Go from Here

Some experts whom we interviewed suggested that many researchers would like to explore linkages among family planning, population change, women’s empowerment and the environment— but there is little interest or support from those who might fund their work. Such research, we were told, also tends to be difficult to shepherd through peer review to publication in journals.

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*Nowhere in the research that we have examined are there authors or findings that undermine the human rights framework for addressing the linkage of family planning to environmental sustainability.*

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Since the 1970s, limited funding has been available for on-the-ground programs linking community-based efforts in both family planning and natural resource conservation.<sup>67</sup> Now called Population, Health, and Environment (PHE), this concept has generated its own literature. (See, for example, [Rachel Winnik Yavinsky et al., 2015](#).<sup>68</sup>) In theory, this small but burgeoning practice of integrating access to family planning with natural resource conservation should offer fertile ground for evidence that the linkage works in the real world. In practice, however, only a small proportion of the modest volume of reporting on PHE has been peer-reviewed and published in journals. (See “Perspective: Experts Reflect on Research,” page 54, and “Perspective: Family Planning and the Environment in Communities,” page 33.)

Most of the papers on PHE that we examined were narratives rather than empirical work based on indicators and data related to environmental outcomes of the operational linkage. One paper made an effort to compare integrated services with comparable ones focused on only natural resource conservation and only family planning and found better outcomes for the integrated services. (See [Leona D’Agnes et al., 2010](#), annotation on page 100.<sup>69</sup>) A considerable body of evidence on the effectiveness of PHE projects exists in non-peer reviewed or “gray literature.”

### Understanding Complex, Large-Scale Processes

Research gaps are often encountered when researchers attempt to understand how human behavior interacts with physical and biological phenomena. Scholars must cross disciplines, deal with complexity, and often make qualitative judgments in making the attempt. One quotation, from the authors of a 2008 [paper](#) (not part of our assessment) on a comparable environmental linkage—the ecological drivers of emerging diseases—could easily apply to our own:

Despite awareness that disease emergence may be related to ecological change, few studies have rigorously analyzed the underlying environmental drivers of the dynamics of disease emergence. This may be due to the fact that ecological change and disease emergence are often mediated through complex and large-scale processes that are not amenable to traditional reductionist approaches to causal inference.<sup>70</sup>

A similar conclusion may help explain the scarcity of research that we have found on the linkage between family planning and environmental sustainability, supplemented by sensitivity to discussion of family planning and population in relation to the environment. (See “Perspective: Convince Them to Say It,” page 39. The relative lack of research interest in non-demographic connections between family





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planning and the environment is harder to explain. Such research may be unfairly tainted by assumptions that the demographic pathway is the only one that could connect the two concepts.)

What may be needed is a certain amount of passion, well-controlled, for the importance of studying these connections, combined with the creativity to design innovative investigations and the discipline and rigor to carry them off. And, of course, funding is essential, yet hard to find in the area that we are studying. We hope that work like our own may raise the profile of the family planning-environment linkage in both the research and the funding communities.

The FPESA project endeavors to supplement knowledge on a linkage whose evidence base has been more inferential and anecdotal than rooted in hard science. We highlight selected findings by a diverse set of authors that shed light on a variety of links germane to the hypothesis that family planning contributes to environmental sustainability. We generalize on what we have read with what are, admittedly, qualitative conclusions. We organize what we find to be the strongest and most relevant assessed papers by broad topic, such as family planning, climate change, and water availability. We feel that we have developed an assessment methodology that could be used over time, with more human and financial resources, to conduct a more thorough and extensive assessment of scientific research on this or any similarly complex scientific topic. In later work, we hope to call attention to and suggest how to address specific research gaps. In broad-brush strokes, this report suggests the

scientific community has largely failed to explore empirically how family planning might benefit the environment, yet so far we have not proposed specific ideas for how researchers could accomplish this objective. That, too, is among the tasks that we would like to take on in future work, engaging with researchers interested in the linkage.

### **A Deeper Discussion, With Stronger Science**

With this report and in our ongoing work, we hope to place family planning on a more scientific footing in relation to women's status, population dynamics, and its influence on environmental sustainability and sustainable development. We seek to encourage and support research advances and family planning advocacy that is based more rigorously on scientific evidence. That evidence may never become absolutely conclusive, but through science the picture tends to become clearer with time. As Margaret J. Wheatley notes in the quotation above, science helps us understand connections, because nothing exists in isolation. We hope, through this work, to build and diversify the community of experts interested in a better understanding of the influence of voluntary family planning on the prospects for achieving environmental sustainability. And we hope to stimulate a broader and deeper discussion about the importance of family planning in today's world.

For today, we believe that our work and this report illuminate considerable evidence supporting—and very little refuting—the statement that expanding access to and use of family planning can help bring about an environmentally sustainable world that meets human needs.





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#### Endnotes

- 1 Margaret J. Wheatley, *Turning to One Another: Simple Conversations to Restore Hope in the Future* (San Francisco: Berrett-Koehler Publishers, Inc., 2002), p. 89.
- 2 FPESA website, [fpesa.net](http://fpesa.net). Twitter: @FPESANet; Worldwatch Institute website, [www.worldwatch.org](http://www.worldwatch.org). Twitter: @Worldwatch.
- 3 World Health Organization (WHO), "Family Planning/Contraception," Fact Sheet No. 351 (Geneva: May 2015), [www.who.int/mediacentre/factsheets/fs351/en/](http://www.who.int/mediacentre/factsheets/fs351/en/).
- 4 United Nations, *Final Act of the International Conference on Human Rights* (New York: 1968), [legal.un.org/avl/pdf/ha/fatchr/Final\\_Act\\_of\\_TehranConf.pdf](http://legal.un.org/avl/pdf/ha/fatchr/Final_Act_of_TehranConf.pdf).
- 5 Amy O. Tsui et al., "Family Planning and the Burden of Unintended Pregnancies," *Epidemiologic Review*, vol. 32, no. 1 (2010), pp. 152–74, <https://doi.org/10.1093/epirev/mxq012>.
- 6 World Commission on Environment and Development, *Our Common Future* (London: Oxford University Press, 1987), [www.un-documents.net/our-common-future.pdf](http://www.un-documents.net/our-common-future.pdf).
- 7 Annette Prüss-Üstün et al., *Preventing Disease Through Healthy Environments: A Global Assessment of the Burden of Disease from Environmental Risks* (Geneva: WHO, 2016), [apps.who.int/iris/bitstream/10665/204585/1/9789241565196\\_eng.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/204585/1/9789241565196_eng.pdf?ua=1).
- 8 Ben Goldacre, *I Think You'll Find It's a Bit More Complicated Than That* (London: Fourth Estate, 2014), statement verified at [www.amazon.com/reader/0007462484/ref=rdr\\_sb\\_hist\\_1&state=01111](http://www.amazon.com/reader/0007462484/ref=rdr_sb_hist_1&state=01111).
- 9 Elsevier Research Intelligence Analytical Services, *Sustainability Science in a Global Landscape* (Amsterdam: Elsevier and SciDev.Net, 2015), [https://www.elsevier.com/\\_data/assets/pdf\\_file/0018/119061/SustainabilityScienceReport-Web.pdf](https://www.elsevier.com/_data/assets/pdf_file/0018/119061/SustainabilityScienceReport-Web.pdf).
- 10 Web of Science, "Discover Web of Science: Content," [wokinfo.com/citationconnection](http://wokinfo.com/citationconnection).
- 11 Alex de Sherbinin et al., "Rural Household Demographics, Livelihoods and the Environment," *Global Environmental Change*, vol. 18, no. 1 (February 2008), pp. 38–53, <https://doi.org/10.1016/j.gloenvcha.2007.05.005>.
- 12 Gilda Sedgh et al., "Intended and Unintended Pregnancies Worldwide in 2012 and Recent Trends," *Studies in Family Planning*, vol. 45, no. 3 (September 2014), pp. 301–14, <https://doi.org/10.1111/j.1728-4465.2014.00393.x>.
- 13 Lawrence B. Finer and Mia R. Zolna, "Declines in Unintended Pregnancy in the United States, 2008–2011," *New England Journal of Medicine*, vol. 374 (3 March 2016), pp. 843–52, <https://doi.org/10.1056/NEJMsa1506575>.
- 14 Brian O'Neill et al., "Global Demographic Trends and Future Carbon Emissions," *Proceedings of the National Academy of Sciences*, vol. 107, no. 41 (12 October 2010), pp. 17521–26, <https://doi.org/10.1073/pnas.1004581107>.
- 15 Derek D. Headey and T.S. Jayne, "Adaptation to Land Constraints: Is Africa Different?" *Food Policy*, vol. 48 (October 2014), pp. 18–33, <https://doi.org/10.1016/j.foodpol.2014.05.005>.
- 16 John B. Casterline and Laila O. El-Zeini, "Unmet Need and Fertility Decline: A Comparative on Prospects in Sub-Saharan Africa," *Studies in Family Planning*, vol. 45, no. 2 (June 2014), pp. 227–45, <https://doi.org/10.1111/j.1728-4465.2014.00386.x>.
- 17 David L. Carr, "Resources Management and Fertility in Mexico's Sian Ka'an Biosphere Reserve: Campos, Cash, and Contraception in the Lobster-fishing Village of Punta Allen," *Population and Environment*, vol. 29, no. 29 (November 2007), pp. 83–101, <https://doi.org/10.1007/s11111-008-0062-0>.
- 18 Lynn M. Van Lith et al., "Women's Growing Desire to Limit Births in Sub-Saharan Africa: Meeting the Challenge," *Global Health: Science and Practice*, vol. 1, no. 1 (1 March 2013), pp. 97–107, <https://doi.org/10.9745/GHSP-D-12-00036>.
- 19 Mark L. Wahlqvist et al., "Rethinking the Food Security Debate in Asia: Some Missing Ecological and Health Dimensions and Solutions," *Food Security*, vol. 4, no. 4 (December 2012), pp. 657–70, <https://doi.org/10.1007/s12571-012-0211-2>.
- 20 Leiwin Jiang and Karen Hardee, "Women's Education, Family Planning, or Both? Application of Multistate Demographic Projections in India," *International Journal of Population Research*, vol. 2014 (2014), <https://doi.org/10.1155/2014/940509>.
- 21 James R. Oakleaf et al., "A World at Risk: Aggregating Development Trends to Forecast Global Habitat Conversion," *PLoS ONE*, vol. 10, no. 10 (7 October 2015), <https://doi.org/10.1371/journal.pone.0138334>.
- 22 Nikhil Lele and P.K. Joshi, "Analyzing Deforestation Rates, Spatial Forest Cover Changes and Identifying Critical Areas of Forest Cover Changes in North-East India During 1972–1999," *Environmental Monitoring and Assessment*, vol. 156, no. 1–4 (September 2009), p. 159, <https://doi.org/10.1007/s10661-008-0472-6>.
- 23 Nidal Hadadin et al., "Water Shortage in Jordan—Sustainable Solutions," *Desalination*, vol. 250, no. 1 (1 January 2010), pp. 197–202, <https://doi.org/10.1016/j.desal.2009.01.026>.
- 24 Pew Research Center, *Public and Scientists' Views on Science and Society* (Washington, DC: 29 January 2015), [www.pewinternet.org/files/2015/01/PI\\_ScienceandSociety\\_Report\\_012915.pdf](http://www.pewinternet.org/files/2015/01/PI_ScienceandSociety_Report_012915.pdf). Figure 2 from idem.





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- 25 “Science Summit’ on World Population: A Joint Statement by 58 of the World’s Scientific Academies,” *Population and Development Review*, vol. 20, no. 1 (1994), pp. 233–38, <https://doi.org/10.2307/2137653>.
- 26 Royal Society of London and U.S. National Academy of Sciences, “The Royal Society and the National Academy of Sciences on Population Growth and Sustainability,” *Population and Development Review*, vol. 18, no. 2 (June 1992), pp. 375–78, <https://doi.org/10.2307/1973696>.
- 27 Ibid.
- 28 Joan A. Kleypas and C. Mark Eakin, “Scientists’ Perceptions of Threats to Coral Reefs: Results of a Survey of Coral Reef Researchers,” *Bulletin of Marine Science*, vol. 80, no. 2 (2007), pp. 419–36, [www.isse.ucar.edu/staff/kleypas/docs/PUBS/Kleypas\\_eakin\\_bms\\_2007.pdf](http://www.isse.ucar.edu/staff/kleypas/docs/PUBS/Kleypas_eakin_bms_2007.pdf).
- 29 Camilo Mora and Peter F. Sale, “Ongoing Global Biodiversity Loss and the Need to Move Beyond Protected Areas: A Review of the Technical and Practical Shortcomings of Protected Areas on Land and Sea,” *Marine Ecology Progress Series*, vol. 434 (28 July 2011), pp. 251–66, <https://doi.org/10.3354/meps09214>.
- 30 Ibid.
- 31 Camilo Mora et al., “Global Human Footprint on the Linkage Between Biodiversity and Ecosystem Functioning in Reef Fishes,” *PLoS Biology*, vol. 9, no. 4 (5 April 2011), p. e1000606, <https://doi.org/10.1371/journal.pbio.1000606>.
- 32 Julian A. Lampietti et al., “A Strategic Framework for Improving Food Security in Arab Countries,” *Food Security*, vol. 3, suppl. 1 (February 2011), pp. 7–11, <https://doi.org/10.1007/s12571-010-0102-3>.
- 33 United Nations Sustainable Development Knowledge Platform, “SDGs: Goal 5,” [sustainabledevelopment.un.org/sdg5](http://sustainabledevelopment.un.org/sdg5).
- 34 Bina Agarwal, “Gender and Forest Conservation: The Impact of Women’s Participation in Community Forest Governance,” *Ecological Economics*, vol. 68, no. 11 (15 September 2009), pp. 2785–99, <https://doi.org/10.1016/j.ecolecon.2009.04.025>.
- 35 John M. Shandra et al., “Women, Non-governmental Organizations, and Deforestation: A Cross-National Study,” *Population and Environment*, vol. 30, no. 1 (12 November 2008), pp. 48–72, <https://doi.org/10.1007/s11111-008-0073-x>.
- 36 Kari Norgaard and Richard York, “Gender Equality and State Environmentalism,” *Gender & Society*, vol. 19, no. 4 (August 2005), pp. 506–22, <https://doi.org/10.1177/0891243204273612>.
- 37 Colleen Nugent and John M. Shandra, “State Environmental Protection Efforts, Women’s Status, and World Polity,” *Organization & Environment*, vol. 22, no. 2 (2009), pp. 208–29, <https://doi.org/10.1177/1086026609338166>.
- 38 Yongbo Liu and Yaning Chen, “Impact of Population Growth and Land-Use Change on Water Resources and Ecosystems of the Arid Tarim River Basin in Western China,” *International Journal of Sustainable Development & World Ecology*, vol. 13, no. 4 (2006), pp. 295–305, <https://doi.org/10.1080/13504500609469681>.
- 39 W. Buytaert and B. De Bièvre, “Water for Cities: The Impacts of Climate Change and Demographic Growth in the Tropical Andes,” *Water Resources Research*, vol. 48, no. 8 (August 2012), pp. 1–13, <https://doi.org/10.1029/2011WR011755>.
- 40 Richard C. Carter and Alison Parker, “Climate Change, Population Trends and Groundwater in Africa,” *Hydrological Science Journal*, vol. 54, no. 4 (2009), pp. 676–89, <https://doi.org/10.1623/hysj.54.4.676>.
- 41 Emmanuel Obuobie et al., “Assessment of Vulnerability of River Basins in Ghana to Water Stress Conditions Under Climate Change,” *Journal of Water and Climate Change*, vol. 3, no. 4 (December 2012), pp. 276–86, <https://doi.org/10.2166/wcc.2012.030.2012>.
- 42 Paul S. Amaza et al., “Measurement and Determinants of Food Insecurity in Northeast Nigeria: Some Empirical Policy Guidelines,” *Journal of Food, Agriculture & Environment*, vol. 6, no. 2 (2008), pp. 92–96, [world-food.net/download/journals/2008-issue\\_2/f16.pdf](http://world-food.net/download/journals/2008-issue_2/f16.pdf).
- 43 Mary O. Agada and Edwin M. Igbokwe, “Food Security and Coping Strategies Among Ethnic Groups in North Central Nigeria,” *Developing Country Studies*, vol. 4, no. 8 (2014), pp. 31–44, [iiste.org/Journals/index.php/DACS/article/view/12196/12549](http://iiste.org/Journals/index.php/DACS/article/view/12196/12549).
- 44 Mesfin Welderufael, “Determinants of Households Vulnerability to Food Insecurity in Ethiopia: Econometric Analysis of Rural and Urban Households,” *Journal of Economics and Sustainable Development*, vol. 5, no. 24 (2014), pp. 70–79, [iiste.org/journals/index.php/jeds/article/view/17506/17926](http://iiste.org/journals/index.php/jeds/article/view/17506/17926).
- 45 See, for example, Reena Borwankar and Shelly Amieva, *Desk Review of Programs Integrating Family Planning with Food Security and Nutrition* (Washington, DC: FANTA III and U.S. Agency for International Development, 2015), [www.fantaproject.org/sites/default/files/resources/FANTA-PRH-FamilyPlanning-Nutrition-May2015\\_0.pdf](http://www.fantaproject.org/sites/default/files/resources/FANTA-PRH-FamilyPlanning-Nutrition-May2015_0.pdf).
- 46 Corey J.A. Bradshaw and Barry W. Brook, “Human Population Reduction Is Not a Quick Fix for Environmental Problems,” *Proceedings of the National Academy of Sciences*, vol. 111, no. 46 (18 November 2014), pp. 16610–15, <https://doi.org/10.1073/pnas.1410465111>.





## Family Planning and Environmental Sustainability: Assessing the Science

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- 47 P. Dasgupta et al., “How to Measure Sustainable Progress,” *Science*, vol. 350, no. 6262 (13 November 2015), p. 748, <https://doi.org/10.1126/science.350.6262.74>.
- 48 Martha Campbell, “Why the Silence on Population,” *Population and Environment*, vol. 28, no. 4 (2007), pp. 237–46, <https://doi.org/10.1007/s11111-007-0054-5>.
- 49 Diana Coole, “Too Many Bodies? The Return and Disavowal of the Population Question,” *Environmental Politics*, vol. 22, no. 2 (2013), pp. 195–215, <https://doi.org/10.1080/09644016.2012.730268>.
- 50 Kyle W. Knight and Eugene A. Rosa, “Household Dynamics and Fuelwood Consumption in Developing Countries: A Cross-national Analysis,” *Population and Environment*, vol. 33, no. 4 (June 2012), pp. 365–78, <https://doi.org/10.1007/s11111-011-0151-3>.
- 51 Ronald Lee and Andrew Mason, “Fertility, Human Capital, and Economic Growth Over the Demographic Transition,” *European Journal of Population*, vol. 26, no. 2 (19 June 2010), pp. 159–82, <https://doi.org/10.1007/s10680-009-9186-x>.
- 52 David Henley, “Natural Resource Management: Historical Lessons from Indonesia,” *Human Ecology*, vol. 36, no. 2 (April 2008), pp. 273–90, <https://doi.org/10.1007/s10745-007-9137-2>.
- 53 David Satterthwaite, “The Implications of Population Growth and Urbanization for Climate Change,” *Environment & Urbanization*, vol. 21, no. 2 (October 2009), pp. 545–67, <https://doi.org/10.1177/0956247809344361>.
- 54 Theresa H. Hoke et al., “Integrating Family Planning Promotion Into the Work of Environmental Volunteers: A Population, Health and Environment Initiative in Kenya,” *International Perspectives on Sexual and Reproductive Health*, vol. 41, no. 1 (March 2015), pp. 43–50, [www.guttmacher.org/pubs/journals/4104315.html](http://www.guttmacher.org/pubs/journals/4104315.html).
- 55 Ibid.
- 56 Steven Arnocky et al., “Environmental Concerns and Fertility Intentions Among Canadian University Students,” *Population and Environment*, vol. 34, no. 2 (December 2012), pp. 279–92, <https://doi.org/10.1007/s11111-011-0164-y>.
- 57 Dirgha J. Ghimire and Paul Mohai, “Environmentalism and Contraceptive Use: How People in Less Developed Settings Approach Environmental Issues,” *Population and Environment*, vol. 27, no. 1 (September 2005), pp. 29–61, <https://doi.org/10.1007/s11111-005-0012-z>.
- 58 Karina M. Shreffler and F. Nii-Amoo Doodoo, “The Role of Intergenerational Transfers, Land, and Education in Fertility Transition in Rural Kenya: The Case of Nyeri District,” *Population and Environment*, vol. 30, no. 3 (January 2009), pp. 75–92, <https://doi.org/10.1007/s11111-009-0077-1>.
- 59 Ann E. Biddlecom et al., “Environmental Effects on Family Size Preferences and Subsequent Reproductive Behavior in Nepal,” *Population and Environment*, vol. 26, no. 3 (January 2005), pp. 583–621, <https://doi.org/10.1007/s11111-005-1874-9>.
- 60 Carr, op. cit. note 17.
- 61 Headey and Jayne, op. cit. note 15.
- 62 Paul A. Murtaugh and Michael G. Schlax, “Reproduction and the Carbon Legacies of Individuals,” *Global Environmental Change*, vol. 19, no. 1 (February 2009), pp. 14–20, <https://doi.org/10.1016/j.gloenvcha.2008.10.007>.
- 63 Usman Khan and Jim A. Nicell, “Contraceptive Options and Their Associated Estrogenic Environmental Loads: Relationships and Trade-Offs,” *PLoS ONE*, vol. 9, no. 3 (March 2014), p. e92630, <https://doi.org/10.1371/journal.pone.0092630>.
- 64 Khalid Zaman et al., “Determinants of Electricity Consumption Function in Pakistan: Old Wine in a New Bottle,” *Energy Policy*, vol. 50 (November 2012), pp. 623–34, <https://doi.org/10.1016/j.enpol.2012.08.003>.
- 65 Jesse H. Ausubel et al., “Peak Farmland and the Prospect for Land Sparing,” *Population and Development Review*, vol. 38, suppl. s1 (February 2013), pp. 221–42, <https://doi.org/10.1111/j.1728-4457.2013.00561.x>.
- 66 T.G. Deryabina et al., “Long-term Census Data Reveal Abundant Wildlife Populations at Chernobyl,” *Current Biology*, vol. 25 (5 October 2015), pp. R811–26, <https://doi.org/10.1016/j.cub.2015.08.017>.
- 67 Robert Engelman, *Plan & Conserve: A Source Book on Linking Population and Environmental Services in Communities* (Washington, DC: Population Action International, 1998).
- 68 Rachel Winnik Yavinsky et al., *The Impact of Population, Health, and Environment Projects: A Synthesis of the Evidence* (Washington, DC: Population Council, June 2015), [evidenceproject.popcouncil.org/wp-content/uploads/2015/06/PHE-Synthesis-Report1.pdf](http://evidenceproject.popcouncil.org/wp-content/uploads/2015/06/PHE-Synthesis-Report1.pdf).
- 69 Leona D’Agnes et al., “Integrated Management of Coastal Resources and Human Health Yields Added Value: A Comparative Study in Palawan (Philippines),” *Environmental Conservation*, vol. 37, no. 4 (December 2010), pp. 398–409, <https://doi.org/10.1017/S0376892910000779>.
- 70 Raina K. Plowright et al., “Causal Inference in Disease Ecology: Investigating Ecological Drivers of Disease Emergence,” *Frontiers in Ecology and the Environment*, vol. 6, no. 8 (October 2008), pp. 420–29, <https://doi.org/10.1890/070086>.







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# Shared Values

Robert Engelman

The work of the Family Planning and Environmental Sustainability Assessment (FPESA) project is consistent with the consensus of those in the field of [sexual and reproductive health and rights](#) and related fields that the use of family planning must always be based on the fundamental human right of all individuals and couples to decide for themselves the timing and spacing of pregnancy. Even if some of the scientific evidence that we assess suggests an urgency to slow the growth of population to ease pressure on natural resources and the environment (and some does), this principle is paramount. So is the principle that the importance, value, dignity, and rights of girls and women should be equal everywhere to those of boys and men, and that politics, economics, law, and culture should reflect and support this equality.

There certainly have been times when these principles have been undermined or shunted aside—sometimes in the interest of boosting population growth, sometimes to slow it down. China tries to control its population even today by [restricting childbearing](#).<sup>1</sup> The population field has to live with its history—and with at least one misguided policy in the present. But we at FPESA believe that the mindset of demographic control is passing and is unlikely to return given growing respect worldwide for human rights and individual choice.

Perpetual vigilance against such a return of the control mentality is essential. But absent evidence that such a threat exists, the FPESA project has seen no reason to shy away from evidence that population growth threatens environmental sustainability. At the same time, we hypothesize that there also are [non-demographic pathways through which family planning](#) contributes to sustainability, and we explore these as well.<sup>2</sup>

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*The FPESA project has seen no reason to shy away from evidence that population growth threatens environmental sustainability.*

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In part to demonstrate the global acceptance of the rights basis of family planning and its consistency with evaluation of scientific evidence on the population-environment linkage, we have gathered an international network

of 17 researchers and leaders of nongovernmental organizations to help us conduct the FPESA project. The group is nearly evenly divided by sex, with a slight majority in or from developing countries in all three major regions (Latin America, Africa, and Asia). If we or any of the authors whose papers we examine ever appear to veer from our stated values in this work, we can count on FPESA network members to raise a question or concern.

The fact that such concerns have been minor, almost non-existent, reflects an encouraging bit of scientific information. In the 939 papers published since 2005 that we have examined so far, we have not identified





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*In the 939 papers published since 2005 that we have examined so far, we have not identified one that argued for a weakening of the rights basis of family planning.*

one that argued for a weakening of the rights basis of family planning. True, a few authors use terms such as “overpopulation” or “population control” that earn

winces from some of us who work in this field. But in each case that we have encountered such terms, it has seemed clear that they reflect more of a lack of familiarity with common word usage in this field and not a conviction that coercion or anything resembling it has a place in family-planning or population policy. In the annotation section of this report are descriptions, quotations and our assessments of some of the more relevant, interesting, or compelling pieces of scientific research that the FPESA project has identified over the last two years. Some of this research makes no mention of family planning, women’s rights, education, or anything else directly pertaining to the values described above. None of it, we are confident, is inconsistent with these values, the exercise of sexual and reproductive rights, or the importance of women and girls standing in equality with men and boys everywhere.

1 Melissa Chan, “China Makes New 2-Child Policy Official,” *Time*, 27 December 2015, [time.com/4161746/china-two-child-policy/](http://time.com/4161746/china-two-child-policy/).  
2 Family Planning and Environmental Sustainability Assessment, “Our Approach,” [fpesa.net/our-work/our-approach/](http://fpesa.net/our-work/our-approach/).





## » PERSPECTIVE

# The Challenge of Showing Causation

Sam Sellers

As the FPESA project illustrates, an abundance of peer-reviewed scientific literature addresses various potential connections between family planning, demographic change, and environmental sustainability. Although the project does not attempt to show how the research has evolved or grown in recent decades, both evolution and growth have no doubt occurred. Nonetheless, something vital is still missing from this research: it is unable to establish whether family planning has a causal effect on sustainability. (See [Alex de Sherbinin et al.](#), 2008, for a useful overview of some of the theoretical underpinnings linking family planning and sustainability in rural livelihoods and the degree to which these are supported by empirical evidence.<sup>1</sup>)

Researchers in this field are exploring open and dynamic systems, with multiple processes influencing both family planning and sustainability. Among the characteristics that complicate the search for causality in relation to family planning are scale, time, non-linearity, the multiple forces influencing population change (rates of births, deaths, immigration, and emigration), as well as special challenges in evaluating programs that integrate family planning with other services.

Researchers are challenged by the difficulty of separating the impacts of environmental changes at different scales, some of which are more affected than others by family planning. This question has suffused much of the literature that the FPESA project has evaluated. Consider the case of East African coral reef habitats that are vulnerable to the effects of small-scale overfishing, as well as to global climate change.

Researchers have made efforts to determine the impact of different stressors on these systems. (See, for example, [Emily S. Darling et al.](#), 2010.<sup>2</sup>) However, a good understanding of the impact of family planning on these factors requires measuring a system before and after an intervention.

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*Researchers are challenged by the difficulty of separating the impacts of environmental changes at different scales, some of which are more affected than others by family planning.*

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For example, the marine conservation group [Blue Ventures](#) is monitoring changes in reef habitat as part of its integrated population, health, and environment (PHE) program in Madagascar, which aims to improve access to family planning services for local populations. A project that combines a PHE intervention with research seeking to determine the impact of particular drivers on an ecosystem's condition is theoretically possible, but it is logistically complex and time-consuming, which may be largely why such research is uncommon.

Time is important because demographic change usually occurs slowly, and the environmental impacts of family planning may be felt decades after it is used.





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In the intervening period between the use of family planning and the change in resource conditions due to population growth, other changes, such as in harvesting practices, may occur. To determine the impact of family planning on resource quality, as opposed to the impact of changes in other factors such as resource use, researchers may need to make assumptions about the nature of these other changes, such as their rate of change or whether they take place evenly across the study area. This adds greater uncertainty to the findings.

Many natural systems are characterized by nonlinear dynamics that sometimes exhibit what are called threshold effects or tipping points. In such systems, resource quality may be stable for some time until a small change produces a dramatic decline. Effects can vary between similar systems in different locations. Predicting tipping points can be very challenging. If population growth strains a particular resource system, researchers often encounter difficulties quantifying this pressure if its impact on the resource is modified by aspects of the resource itself, such as the resource's initial condition or sensitivity to change.

Population growth results from a combination of natural increase (births minus deaths) and net immigration. While the former is strongly influenced by rates of contraceptive use, family planning less directly influences migration flows, which are largely subject

to a host of socioeconomic and political factors. If researchers hypothesize that population growth places pressure on natural resources, the composition of this growth must be determined in order to understand the effects potentially attributable to family planning.

Some researchers have used longitudinal surveys (long-term studies involving frequent collections of data) of households to determine the composition of demographic change over time, which can then be compared against land cover change to understand the impact of demographics on the environment. Such longitudinal surveys, however, require considerable time and funding.

Some recent work on family planning and sustainability concerns PHE projects that seek to integrate reproductive and other health services with conservation and environmental sustainability. Many of the implementing organizations have evaluated their own work to help improve their operations. These evaluations, however, are typically not intended for peer review and publication as scientific literature to advance understanding of PHE interactions or synergies. While the FPESA project summarized some peer-reviewed literature on PHE, none is scientifically rigorous enough to justify strong conclusions about the impact of the concept. Strengthening the science behind PHE is among the research gaps that the project has identified.

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- 1 Alex de Sherbinin et al., "Rural Household Demographics, Livelihoods and the Environment," *Global Environmental Change*, vol. 18, no. 1 (February 2008), pp. 38–53, <https://doi.org/10.1016/j.gloenvcha.2007.05.005>.
  - 2 Emily S. Darling, Timothy R. McClanahan, and Isabelle M. Côté, "Combined Effects of Two Stressors on Kenyan Coral Reefs Are Additive or Antagonistic, Not Synergistic," *Conservation Letters*, vol. 3, no. 2 (April 2010), pp. 122–30, <https://doi.org/10.1111/j.1755-263X.2009.00089.x>.





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# Family Planning and the Environment in Communities

Gladys Kalema-Zikusoka

Although they are too rarely the topic of peer-reviewed research, community-based projects in some developing countries are bringing family planning and environmental sustainability together at the level of people’s lives. Called PHE projects—for “population, health, and environment”—these initiatives integrate environmental and natural resource conservation with family planning and reproductive health. They endeavor to tap ground-level synergies by diversifying livelihoods, engaging women in natural resource management, and strengthening community engagement in sustainable development while also contributing to climate change mitigation and adaptation.

In my experience directing [Conservation Through Public Health](#) (CTPH), a nongovernmental organization (NGO) that manages such projects, many have shown that it is possible to build social resilience in the face of rapid environmental change—and perhaps even to help prevent some of that change. CTPH is a 12-year-old nonprofit registered in the United States and in Uganda that has been implementing PHE initiatives for eight years, starting with a focus on preventing disease transmission in areas where people, their livestock, and gorillas and other wildlife interface.

We added a family planning component to our work in 2007. CTPH works with the Ugandan Ministry

of Health, which set up a structure of Village Health Teams (VHTs), or groups of community volunteers trained to conduct public health outreach at the household level. (In Kenya and other countries, these individuals typically are called community health workers.) By adding a conservation component to the teams’ work, we renamed them Village Health and Conservation Teams (VHCTs).

The activities that VHCTs promote in communities include peer counseling of couples on reproductive health and family planning service delivery, including injectable Depo-Provera, a popular contraceptive in the region. Activities also include the promotion of hygiene and sanitation; counseling on infectious disease prevention and control as well as on nutrition and sustainable agriculture; and education on the conservation of gorillas and the forests in which they live.

The VHCTs have brought about measurable behavior change in our projects, including an increase (from 20 percent to 60 percent) in the number of users of modern family planning methods, an increase (from 11 percent to 60 percent) in the use of hand-washing facilities, and reduced disease incidences and conflicts between people and gorillas. These trends are

*Called PHE projects—for “population, health, and environment”—these initiatives integrate environmental and natural resource conservation with family planning and reproductive health.*





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monitored and evaluated through monthly data collection. Launched with the support of the U.S. Agency for International Development’s [Office of Population and Reproductive Health](#), the VHCT model is now sustained in part through group livestock income-generating projects within each parish. These were introduced in the first year of the PHE project.

A few years after initiating VHCTs, the concept of Village Savings and Loan Associations—community-managed and -owned microfinance groups—took shape, and these associations now help support our work. The health and conservation models that we have developed at Bwindi Impenetrable National Park, in southwestern Uganda, are being scaled up at Virunga National Park in the Democratic Republic of the Congo and at Mount Elgon National Park in Uganda and Kenya. Some support for this comes from the [Global Development Network](#), a network of research and policy institutes associated with the World Bank.

### Scaling Up Interventions: Health Easier Than Conservation

One project partner, [ExpandNet](#), studies the science of scaling up health interventions and has developed a nine-step approach, with the philosophy of “beginning with the end in mind.” One of the steps is to engage government and community planners. This was applied successfully in a project called the [Health of People and the Environment in Lake Victoria Basin](#) (HoPE-LVB). The project also adopted the VHCT model in communities in the freshwater ecosystem of Lake Victoria.

We have found that health interventions are often relatively simple and easy to scale up in most places.

Conservation interventions, by contrast, tend to be more complex and tailored toward site-specific demands. Bridging both sectors, PHE activities fall somewhere in between in both ease and complexity. PHE often can apply an asset from one of the two sectors in the other—as, for example, the VHCTs apply health innovations to ongoing work on conservation.

Adding livelihood-diversification initiatives—such as group livestock (cows and goats) enterprises, in the case of CTPH—to the integrated conservation and health model provides modest income to VHCT members, reducing their dependence on the forest for their basic needs. Offering livelihood-related activities also allows the teams to expand their presence and time with community members where CTPH operates. In Madagascar, Blue Ventures has diversified livelihoods by encouraging communities to farm seaweed and sea cucumbers. This allows stocks of endangered octopus to regenerate, while promoting community-based family planning, which improves both food security and conservation.

PHE projects typically engage health workers for education and service delivery in conservation as well as in reproductive health. Organizations such as [FHI 360](#) and the [Green Belt Movement](#) tested the concept of using environment workers to promote integrated health and conservation. The success of this innovation was attributed to the fact that the tree-planting volunteers delivering PHE messages had already gained the trust of the community through successful work on natural resource conservation.

Conservation and public health workers alike capitalize on each other’s community networks and allegiances to promote PHE. Conservation organizations can expand family planning services to remote locations

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*PHE projects typically engage health workers for education and service delivery in conservation as well as in reproductive health.*

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where they work that often have scarce health services. Similarly, health organizations can implement PHE where conservation organizations have already built trust with the community. This has been the case with the HoPE-LVB project implemented by both health and conservation organizations in Uganda and Kenya. The same is true of projects in Madagascar and Nepal.

### Health Services Support Conservation

In Tanzania, surveys demonstrated that communities gained more support for conservation not only through education, but also because health services were brought closer to them, an outcome that PHE projects aim to achieve. Certain interventions are seen as demonstrating core principles of PHE, such as the promotion of energy-efficient cook stoves in projects in Nepal. This intervention combines in a single device benefits to personal health (less pollution risk to respiratory systems) and environmental sustainability (reduced use of wood and other biomass to cook meals). VHCTs are promoting the stoves in Bwindi Impenetrable National Park, an important home to critically endangered mountain gorillas, and to households in Lake Victoria Basin.

To date, there have been very few studies that quantitatively demonstrate the cost-effectiveness of PHE. In the Philippines, at least, operational research suggested greater impacts on both fertility and the sustainability of fisheries from integrated conservation and health activities, as opposed to those with activities in just one of the two sectors. Other ways of measuring the value added by PHE need to be developed that are less costly and that allow for examination and analysis of data retrospectively.

Documentation of the evidence that PHE results in benefits for both health and the environment is particularly important for engaging policymakers and governments. Historically, PHE projects have been developed by NGOs in Madagascar, Tanzania, Uganda, Nepal, the Philippines, India, and other countries. In East Africa, however, advocacy efforts by PHE working groups and/or networks have led to an exciting new development: a multinational government agency, the [East African Community](#), has developed a five-year strategic PHE plan for all five partner states (Burundi, Kenya, Rwanda, Tanzania, and Uganda).

This is a significant policy development that offers greater hope than ever for institutional sustainability. The advocacy role that NGOs have played in East Africa is now evolving from showcasing tested pilot projects to developing sustainable PHE interventions that the government can scale up. Similar developments are offering hope for both scaling up and improving the sustainability of PHE work in Nepal.

NGOs in both East Africa and southern Asia will continue to catalyze cross-sectoral responses for complex development issues such as the linkage of family planning, environmental sustainability, and development. And, we can hope, more researchers will demonstrate the evidence that this approach to development is both cost-effective and catalytic in improving lives and sustaining health and well-being.





# Are Women More Environmental?

Robert Engelman

“Sisters are doin’ it for themselves,” sang Aretha Franklin and The Eurythmics’ Annie Lennox in a [1985 hit song](#), “standin’ on their own two feet and ringin’ on their own bells.”<sup>1</sup>

Three decades on, is it fair to ask whether sisters also are doing it for the earth? Or, put differently, could the empowerment of women and girls contribute to environmental sustainability—that is, to a world that meets human and nature’s needs in perpetuity? Not that any such justification should be needed for women and girls’ well-being. Equal rights and opportunities are their own reward, only fair, and worth striving for no matter what.

And there’s no way that saving the environment should be seen as women’s work or a special obligation for females. It’s human work and it obligates us all.

Yet a practical question arises: Might those of both sexes who care about sustainability be more likely to advocate for gender equality and an end to sexual violence if research demonstrated that a world of secure and powerful women would be better off environmentally?

Based on our review of the recent literature, we can say that hard evidence is spotty at best. Considerable sociological research does find more altruism among women than among men, suggesting a greater likelihood that more women active in society could imbue it with such values. When women achieve

from 20 percent to 30 percent representation in an organization, for example, they begin to be heard and to alter the way the organization operates. (For details on that research, see the book [Broad Influence: How Women Are Changing the Way America Works](#).<sup>2</sup>)

Not many researchers, however, seem to take on the question of how women and men compare in their attitudes and actions on the environment. Or perhaps those who do don’t succeed at publishing in peer-reviewed journals—at least not in the past decade. A few of the articles we reviewed cited evidence published prior to our 2005-to-present study period that women tend to be more concerned than

men about the environment and are more likely to take action to protect it.

Even in the recent research we reviewed, the project team and assessment network have uncovered a few suggestive findings. They steer toward a hopeful conclusion, presuming that gender equality grows and women’s rights take hold around the world. Sisters may indeed be doing it for the earth—at least somewhat more than their brothers. Here are 11 of the most compelling papers we’ve found, with hyperlinks to the abstracts and in some cases to full papers to go beyond the short summaries offered below:

- Countries in which women are closer to men in status, rights, and opportunities have lower per

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*Sisters may indeed be doing it for the earth—at least somewhat more than their brothers.*

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capita emissions of heat-trapping carbon dioxide when other factors are controlled for (i.e., their effect was adjusted so that they would not distort the calculations), [Christina Ergas and Richard York](#), 2012, found.<sup>3</sup>

- Forest-management groups in India and Nepal that had higher proportions of women on their executive committees more effectively conserved community forests, [Bina Agarwal](#), 2009, found.<sup>4</sup>
- Along similar lines, [John M. Shandra et al.](#), 2008, found that higher ratios of women’s nongovernmental organizations to countries’ populations correlated with lower rates of deforestation, other factors controlled.<sup>5</sup>

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*Increasing women’s political status in particular through representation in national government has a positive effect on state environmental protection efforts.*

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- Countries with higher proportions of women in their national legislative bodies are more likely to approve environmental agreements, [Kari Norgaard and Richard York](#) found in a 2005 study.<sup>6</sup>
- In a 2009 study, [Colleen Nugent and John M. Shandra](#) similarly found “strong support for the idea that increasing women’s political status in particular through representation in national government has a positive effect on state environmental protection efforts.”<sup>7</sup>
- In the United States, a study of eight years of Gallup polling data concluded that women are more concerned than men about climate change. Not only that, but “women exhibit more scientifically accurate climate change knowledge than do men”—although they also “tend to underestimate their climate change knowledge more than do men.” ([Aaron M. McCright](#), 2011.)<sup>8</sup>

- In Bangladesh, a small survey of indigenous women and men in a village near a national park found higher environmental awareness among women than men ([Shah Md. Atiqul Haq](#), 2013).<sup>9</sup>

- In the coal country of the U.S. Appalachian mountains, women tend to lead and fill environmental justice organizations, [Shannon Elizabeth Bell and Yvonne A. Braun](#) reported in 2010.<sup>10</sup> In focus group interviews, these women articulated a sense of place and motherhood that led them to their activism, while men interviewed tended to identify more with the coal industry and eschewed similar roles.

- The idea that their experience as mothers prompts some women to care more than men do for the environment gets some pushback, however. [Michelle E. Carreon and Valentine M. Moghadam](#) argued in a 2015 paper that this “maternalist” argument may serve “partriarchal. . . purposes with implications for gender justice.”<sup>11</sup>
- A 2014 paper by [Angela Franz-Balsen](#) argued against stereotyping women’s interest in the environment and called for more attention to gender issues generally to help shift social norms toward sustainability by integrating both women and men’s attitudes.<sup>12</sup>
- In an encouraging sign of continuing interest in the environmental outcomes of empowered women, Craig Leisher and 10 other researchers launched in 2015 an [open-access “systematic review protocol”](#) that somewhat resembles the FPESA project in its structure.<sup>13</sup> The researchers are embarking on an effort to “produce a systematic map of the evidence”





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that the gender composition of forest and fishery management groups affects conservation outcomes. No results are available yet, but our project will watch for the outcome of theirs.

Clearly, the recent literature on the connection between empowered women and environmental sustainability is not large in scope and magnitude. Yet what we have found in recently published journals and seen cited from earlier decades suggests that women tend to have more concern about environmental problems than men do. Under some circumstances, such as participation in government, they are more likely to act on this greater interest.

For the FPESA hypothesis, this is significant. If family planning opens up opportunities for women to participate more actively in their communities, in government, and in civil society, one might expect a greater demand—and maybe more activity—from them for policies and actions that protect the environment. More research and harder evidence is needed for anything like certainty. What we have found nonetheless supports the benefit of family planning for environmental sustainability, based simply on what happens when women “stand on their own two feet and ring their own bells.”

- 1 “Eurythmics – Sisters Are Doin’ It for Themselves,” YouTube, 24 October 2009, [www.youtube.com/watch?v=drGx7JkFSp4](http://www.youtube.com/watch?v=drGx7JkFSp4).
- 2 Jay Newton-Small, *Broad Influence: How Women Are Changing the Way America Works* (New York: Time Books, 2016).
- 3 Christina Ergas and Richard York, “Women’s Status and Carbon Dioxide Emissions: A Quantitative Cross-national Analysis,” *Social Science Research*, vol. 41, no. 4 (July 2012), pp. 965–76, <https://doi.org/10.1016/j.ssresearch.2012.03.008>; see also annotation on p. 66 of this report.
- 4 Bina Agarwal, “Gender and Forest Conservation: The Impact of Women’s Participation in Community Forest Governance,” *Ecological Economics*, vol. 68, no. 11 (15 September 2009), pp. 2785–99, <https://doi.org/10.1016/j.ecolecon.2009.04.025>; see also annotation on p. 64 of this report.
- 5 John M. Shandra et al., “Women, Non-governmental Organizations, and Deforestation: A Cross-National Study,” *Population and Environment*, vol. 30, no. 1 (12 November 2008), pp. 48–72, <https://doi.org/10.1007/s11111-008-0073-x>.
- 6 Kari Norgaard and Richard York, “Gender Equality and State Environmentalism,” *Gender & Society*, vol. 19, no. 4 (August 2005), pp. 506–22, <https://doi.org/10.1177/0891243204273612>; see also annotation on p. 68 of this report.
- 7 Colleen Nugent and John M. Shandra, “State Environmental Protection Efforts, Women’s Status, and World Polity,” *Organization & Environment*, vol. 22, no. 2 (2009), pp. 208–29, <https://doi.org/10.1177/1086026609338166>.
- 8 Aaron M. McCright, “The Effects of Gender on Climate Change Knowledge and Concern in the American Public,” *Population and Environment*, vol. 32, no. 1 (September 2010), pp. 66–87, <https://doi.org/10.1007/s11111-010-0113-1>; see also annotation on p. 68 of this report.
- 9 Shah Md. Atiqul Haq, “Nexus Between Perception, Environment and Fertility: A Study on Indigenous People in Bangladesh,” *Sustainable Development*, vol. 21, no. 6 (8 March 2011), pp. 372–84, <https://doi.org/10.1002/sd.515>; see also annotation on p. 67 of this report.
- 10 Shannon E. Bell and Yvonne A. Braun, “Coal, Identity, and the Gendering of Environmental Justice Activism in Central Appalachia,” *Gender & Society*, vol. 24, no. 6 (December 2010), pp. 794–813, <https://doi.org/10.1177/0891243210387277>; see also annotation on p. 65 of this report.
- 11 Michelle E. Carreon and Valentine M. Moghadam, “‘Resistance Is Fertile’: Revisiting Maternalist Frames Across Cases of Women’s Mobilization,” *Women’s Studies International Forum*, vol. 51 (July–August 2015), pp. 19–30, <https://doi.org/10.1016/j.wsif.2015.04.002>.
- 12 Angela Franz-Balsen, “Gender and (Un)Sustainability—Can Communication Solve a Conflict of Norms?” *Sustainability*, vol. 6, no. 4 (2014), pp. 1973–91, <https://doi.org/10.3390/su6041973>.
- 13 Craig Leisher, “Does the Gender Composition of Forest and Fishery Management Groups Affect Resource Governance and Conservation Outcomes: A Systematic Map Protocol,” *Environmental Evidence*, vol. 4, no. 13 (2015), <https://doi.org/10.1186/s13750-015-0039-2>.





## >> PERSPECTIVE

# “Convince Them to Say It”

Kenneth R. Weiss

As a young and promising marine [biologist, Camilo Mora led a team of 55 scientists assessing](#) the rapid decline of fish on the world’s coral reefs. It was a global enterprise with broad implications. Hundreds of millions of people rely on reef fish for their primary source of animal protein. Healthy reefs protect coastal communities from devastating storms and provide a multitude of livelihoods, including jobs in the fast-growing tourism industry.

To figure out why so many reef fish are in trouble, Mora plugged all of the possible factors into a massive data-driven analysis. One reason stood out from all the rest: the density of nearby human population. The more people who live close to the reef, the steeper the plunge in the abundance and diversity of fish. And those countries with coral reefs are all on the fast track to doubling their populations in this century.

What happened next gave Mora an insight into why population has become a taboo topic—often avoided, if not intentionally ignored—in peer-reviewed literature, scientific conferences, and academic discussions.

Mora drafted a conclusion suggesting improvements for reef management to confront overfishing, coastal development, and pollution “as well as long-term strategies (improvements in education, empowerment of women, family planning, poverty alleviation, etc.) to curb the growth of coastal human populations.” Then he sent the draft to his colleagues for feedback.

One of the other authors objected, suggesting that the paper instead should recommend setting aside larger proportions of these reefs as marine protected areas. Then another chimed in, supporting an alternate conclusion. So did others. There was widespread discomfort around the topic of population pressures. The revolt of his scientific colleagues took Mora by surprise.

How could they ignore the most striking evidence from the data? Mora asked. Wasn’t his proposed recommendation the most logical, the most obvious conclusion?

### Not Suggesting Anything Crazy

Mora soon learned about an overriding fear among scientists of straying from their narrow scientific field—especially if it meant drifting into the fraught issue of a rapidly growing human population.

“All of them were arguing that it was too hot of a topic, as a concluding remark of the paper. It was not our place or responsibility to suggest it as one of the solutions. They didn’t want to deal with the controversy,” Mora recounted. “I was saying, ‘I’m sorry, I’m not suggesting anything crazy. Let’s start investing in human development to reduce the growth rate of population.’”

In the end, Mora won the debate on purely scientific grounds, and his conclusion was [published](#) as he had written it.<sup>1</sup> It probably helped that Mora made his case with a heavy Spanish accent, revealing roots in





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Colombia before moving to Canada to pursue a PhD. It gave his co-authors political cover.

The experience drove Mora to write [another article](#) showing how population has been downplayed or trivialized in other research into preserving biodiversity and improving human welfare.<sup>2</sup> He ignored warnings of colleagues who urged him not to publish it and who suggested that he was too junior of a scientist to weather the potential stormy backlash.

Mora’s story is far from unique.

[Ndola Prata](#), a public health professor at the University of California at Berkeley, removed her name in protest from an article after her collaborators stripped out a key point that she wrote connecting the need for contraception to population growth, an unsustainable ecological footprint, as well as persistent problems with maternal and child health.

Prata chalked up this and similar experiences to Western guilt: the fear among academics and researchers from wealthy industrialized nations to blunder into a socially or culturally sensitive issue confronting the world’s poor countries. The academic taboo, she said, results in inconvenient or uncomfortable words left out of articles and public lectures.

### Everything But the Crowd

Prata speaks about sex, human reproduction, and contraception in a candid, matter-of-fact way, befitting a female physician from Angola who has spent decades working on reproductive health issues. In late

2014, Prata was asked to join other university experts at a [symposium](#) to talk about global health action on a “crowded Earth.”

Prata was amazed how researchers waltzed around the “crowded” part, focusing on everything else: water, sanitation, disease, hunger, and even the need for genetically modified crops to boost food production. “Nobody brought up family planning,” Prata said. “When I had the microphone, I said that one way we could help alleviate these problems is to focus on rapid population growth.”

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*Mora soon learned about an overriding fear among scientists of straying from their narrow scientific field—especially if it meant drifting into the fraught issue of a rapidly growing human population.*

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Initially, her comments brought apprehensive looks among other panelists. Then, a member of the audience asked the speakers: If they had \$100 million to make progress on public and environmental health problems, where would they put their money for maximum benefit? “I said family planning would be the best use of the money,” Prata recalled. “And everyone on the panel agreed.”

Prata wishes she would see more “guilt-free researchers” help bridge the population-environment research divide, given that roughly four out of five U.S. scientists recognize that population growth strains natural resources, according to a [2015 survey of members of the American Association for the Advancement of Science](#).<sup>3</sup> “I don’t need to convince them that population is a factor. They know. I need to convince them to say it.”

Even if researchers are willing to address it, their message can get obscured, distorted, or lost among audience members with strong views on touchy topics.





## PERSPECTIVE >> “Convince Them to Say It”

### The Unintended-Pregnancy Factor

Usman Khan, while pursuing a PhD in civil engineering at McGill University in Montreal, Canada, decided to assess the rate of release of estrogens and other human hormones into surface waters in the United States, after having been flushed with urine and feces into sewage systems and ultimately into adjacent rivers and estuaries. The trend has been implicated in the feminization of male fish, with a consequent impact on their ability to reproduce. Some scientists have focused on excess hormones excreted by women using birth control pills, prompting some European lawmakers to consider regulating hormonal birth control as an environmental pollutant.

Working with his doctoral advisor, Dean of Engineering Jim A. Nicell, Kahn took a more comprehensive look at estrogens in effluent in the United States. “There was a knowledge gap that all contraception options have an estrogen load. We wanted to fill that gap.” So they meticulously quantified the load of estrogens from oral contraceptives released into the environment, but also the estrogens that women produce naturally and how they excrete them at far higher levels during pregnancy.

Factoring in the fact that roughly half of U.S. pregnancies are unintended, the researchers ran scenarios with various forms of birth control and failure rates. They determined in an [article](#) published in early 2014 that the collective use of contraception in the United States averts 8.8 million unintended pregnancies a year and

avoids the release of tons of additional estrogens by pregnant women into U.S. waters.<sup>4</sup> Moreover, if American women’s need for contraception were met, it would further benefit the environment by reducing estrogens by about another 13 percent.

Before publication, Khan presented his initial findings at a green chemistry meeting, packed with mostly women scientists. “There was a palatable increase in tension when he stood up,” Nicell said, recalling the event. “There was a sense: here’s a Pakistani male engineer about to make a pronouncement on women’s contraception.”

Nicell was well aware of the sensitivity of the subject, but he was amazed at how trained academics reacted. “The door was slammed shut before [Khan] even started talking,” he said. The audience seemed to miss the results that oral contraception has a net environmental benefit. What they seemed to hear was, Nicell said, “How dare you engineers, focused on the environment, tell me what I can or cannot put in my body. What they didn’t hear was that any attempt to ban the pill would have a negative effect on the environment.”

All these scientists are among the brave ones, willing to pursue key scientific questions and present the evidence that answers them, even when the results bump up against political sensitivities or invite criticism. Prata seems to speak for all of them when she said: “We are scientists. If we don’t do it, who will?”

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- 1 Camilo Mora et al., “Global Human Footprint on the Linkage Between Biodiversity and Ecosystem Functioning in Reef Fishes,” *PLoS Biology*, vol. 9, no. 4 (2011), p. e1000606, <https://doi.org/10.1371/journal.pbio.1000606>.
  - 2 Camilo Mora, “Revisiting the Environmental and Socioeconomic Effects of Population Growth: A Fundamental but Fading Issue in Modern Scientific, Public, and Political Circles,” *Ecology and Society*, vol. 19, no. 1 (2014), article 38, <https://doi.org/10.5751/ES-06320-190138>.
  - 3 Lee Rainie and Cary Funk, “Chapter 3: Attitudes and Beliefs on Science and Technology Topics,” in *Public and Scientists’ Views on Science and Society* (Washington, DC: Pew Research Center, 29 January 2015), [www.pewinternet.org/files/2015/01/PI\\_ScienceandSociety\\_Report\\_012915.pdf](http://www.pewinternet.org/files/2015/01/PI_ScienceandSociety_Report_012915.pdf).
  - 4 Usman Khan and Jim A. Nicell, “Contraceptive Options and Their Associated Estrogenic Environmental Loads: Relationships and Trade-Offs,” *PLoS ONE*, vol. 9, no. 3 (March 2014), p. e92630, <https://doi.org/10.1371/journal.pone.0092630>; see also annotation on p. 61 of this report.





# Research Challenges and Opportunities

Lori M. Hunter

The FPESA project has undertaken an important and challenging agenda, one with tremendous implications for the well-being of human populations and the planet. The project’s finding that there is little scholarship directly linking family planning to environmental sustainability is certainly correct. Having engaged in population research for over 20 years and been editor-in-chief of the journal *Population and Environment* since 2007, I believe that the lack of such research is related to key challenges faced by scholars who are potentially interested in the family planning-environment link. These include:

guides academic research, this is one reason that the population-environment connection is under-studied.

*Innovative approaches to research design can allow for the exploration of alternative futures under different family planning and population scenarios.*

- *Disconnects between researchers, practitioners, and funding agencies* that constrain collaboration. Practitioners require timely evidence of programmatic impacts, yet academic research can take years to appear in peer-reviewed scientific journals. Funding for basic social science research also is increasingly difficult to obtain and, if received, often requires many rounds of proposal submissions.

- *Research design challenges*, such as: 1) the need to develop long-term studies allowing for potential environmental impacts to be measurable, and 2) identifying comparison groups to contrast environmental change in households and communities that are with and without access to family planning.
- *Complexity and intervening factors* that challenge researchers’ ability to isolate the effects of family planning on environmental conditions, since environmental change arises from myriad socioeconomic and environmental processes.
- *Demographic theory* that historically has not integrated environmental factors; because theory

Even so, creativity can help overcome some of these challenges.

## Innovations in Research Design

Innovative approaches to research design can allow for the exploration of alternative futures under different family planning and population scenarios, without requiring long-term studies. Two examples, from China and the United States, illustrate this approach.

The Wolong Nature Preserve in southwestern China’s Sichuan Province is home to 4,500 people while also providing critical habitat for the endangered giant panda. To simulate future habitat loss under a variety of family planning scenarios, researchers from Michigan State University used “agent-based





## PERSPECTIVE >> Research Challenges and Opportunities

modeling.” They first linked population and household dynamics to land use and then estimated the amount of habitat change projected under different family planning scenarios.

The [researchers found](#) that family planning—and related factors such as fertility rate, birth spacing, and upper reproductive age—have almost immediate impacts on human population size. Although overall fertility changes shape habitat loss only in the longer term (40 years), increasing the maternal age at marriage would produce positive habitat impacts in only 10 years.<sup>1</sup>

In a [second example](#), Oregon State University researchers used mathematical modeling of the contribution of population to climate change by estimating the extra carbon dioxide (CO<sub>2</sub>) emissions caused by childbearing—an individual’s “carbon legacy” as related to fertility choices.<sup>2</sup> When considering descendants across two generations, under current conditions in the United States, they found that each child adds over 9,000 metric tons of CO<sub>2</sub> emissions for an average individual. This suggests that a reduction of one child would bring dramatically more emission savings than reducing driving miles (147 tons saved), replacing single-paned windows (121 tons saved), and replacing light bulbs (36 tons saved).

Other innovations in research design include embedding “comparative potential” within family planning interventions. For example, based on data from a quasi-experimental design in the rural Philippines, [Leona D’Agnes and colleagues](#) determined in 2010 that programs that integrated reproductive health and environmental conservation yielded greater socio-environmental outcomes than programs that offered either in isolation.<sup>3</sup> By

collecting pre- and post-project data in communities with different types of interventions, statistical models could be used to estimate the utility of linking family planning and conservation efforts. The integrated programs yielded greater reductions in the average number of children born.

With regard to challenges posed by *complexity and intervening factors*, innovations such as those outlined above help to focus analytical attention on the environmental implications of family planning and changes in fertility.

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*The FPESA project has piloted the intriguing approach of disaggregating the association between fertility and the environment into its constituent parts.*

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### Integrating the Environment Into Demographic Theory

In addition, the FPESA project has piloted the intriguing approach of disaggregating the association between fertility and the environment into its constituent parts. On one side of FPESA’s [conceptual framework](#), we find the negative impact of high levels of human population on envi-

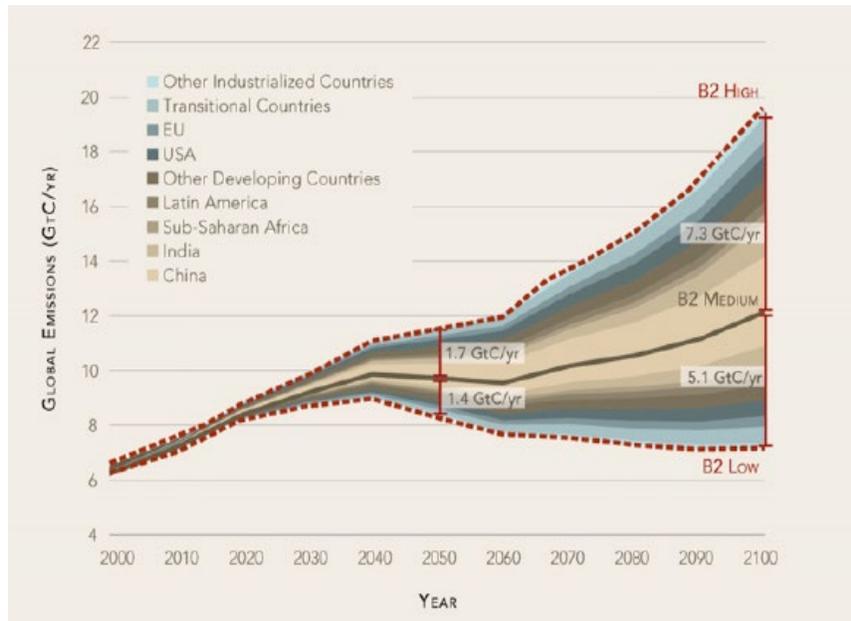
ronmental sustainability—a statement that few would disagree with today. This association is demonstrated in Figure 1 as the association between future population and emission projections.<sup>4</sup>

But FPESA’s approach also considers the importance of focusing on research that examines the connection between family planning and population growth. This body of work is vast and includes insights related to women’s unmet need for contraception, factors influencing contraceptive uptake, and impacts of improvements in (or absence of) reproductive health offerings. Documenting what is known about this connection should help activists, practitioners, and policymakers better make the connection between family planning, population growth, and, ultimately, environmental sustainability.





## PERSPECTIVE» Research Challenges and Opportunities



**Figure 4.**

Differences in Annual Carbon Dioxide Emissions, Based on Low, Medium, and High Projections of World Population Growth, 2000–2100, Globally (Dashed and Center Lines) and by Region (Shaded Areas)

Source: O'Neill et al., 2010.

Bringing these pieces together by summarizing research reflecting the constituent parts should help inform the demographic theories that guide fertility and other demographic research. Ultimately, the expansion of demographic theories to better integrate environmental concerns will go a long way toward motivating, and improving, scholarship on population and the environment.

### Addressing Disconnects

On the topic of disconnects between researchers and practitioners, improved pathways of collaboration can create win-win scenarios. For example, practitioners such as those implementing “population, health, and environment” (PHE) interventions may have, or can collect, quantitative data that could fuel creative research and collaboration with experts in simulation modeling, for example. Such collaborations could benefit researchers in university settings who need to publish peer-reviewed science in order to advance professionally, as well as practitioners who gain from an improved evidence-base from which to develop future programs. Creative funding initiatives

bringing together these communities could yield results that advance understanding of these complex connections, thereby contributing to science as well as program and policy development.

### Considering How the Environment Shapes Demographics

On a broader note, it is useful to consider current research in the context of the reciprocal nature of the association between population dynamics and environmental conditions. As opposed to linking population processes to environmental change, many demographers have been engaged in the reciprocal question of how environmental conditions shape demographic processes. For example, many recent studies have shed light on how local environments shape migration decision making: in some cases, environmental disasters and/or natural resource scarcity can increase movement away from an area, but, in other cases, such movement is constrained.





## PERSPECTIVE» Research Challenges and Opportunities

Related to fertility, a handful of studies have examined the association between local environmental factors and fertility decision making. In Nepal, [Sarah R. Brauner-Otto](#) found in 2013 that women in settings in which plant density and diversity are both low are more likely to have large families.<sup>5</sup> In rural Kenya, land scarcity may have played an important role in the country’s dramatic fertility decline since the late 1970s, according to [one 2009 paper](#). Land tenure rules have resulted in smaller and smaller plots because inheritance must be provided to sons—a trend that has necessitated smaller family sizes.<sup>6</sup>

The increasing number of studies examining environment-population connections suggests that demographers are not, as a whole, uninterested in environmental questions. Yet the challenges related to theory, research design, data, and funding are very real and ultimately result in the reality that population-environment connections receive less research attention than socioeconomic and other determinants and implications of population dynamics.

### Moving Forward

To move research forward, starting conversations between researchers and practitioners might yield innovative data-sharing arrangements. To jumpstart these conversations, existing research networks, such as professional associations, could create small grant opportunities or sessions at conferences. Likewise, practitioner networks could reach out to relevant academic professional associations to identify opportunities for research collaboration. Larger-scale foundations and national granting agencies could offer targeted funding opportunities to bridge research and practice in population-environment connections, including those between fertility, family planning, and environmental context.

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*The expansion of demographic theories to better integrate environmental concerns will go a long way toward motivating, and improving, scholarship on population and the environment.*

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In all, bridging the gaps between researchers, practitioners, and funders would go a long way toward developing innovative, win-win collaborations among those who are interested in the important connections between family planning and environmental sustainability.

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1 Li An and Jianguo Liu, “Long-term Effects of Family Planning and Other Determinants of Fertility on Population and the Environment,” *Population and Environment*, vol. 31, no. 6 (July 2010), pp. 427–59, <https://doi.org/10.1007/s11111-010-0111-3>.  
2 Paul A. Murtaugh and Michael G. Schlax, “Reproduction and the Carbon Legacies of Individuals,” *Global Environmental Change*, vol. 19, no. 1 (February 2009), pp. 14–20, <https://doi.org/10.1016/j.gloenvcha.2008.10.007>; see also annotation on p. 73 of this report.  
3 Leona D’Agnes et al., “Integrated Management of Coastal Resources and Human Health Yields Added Value: A Comparative Study in Palawan (Philippines),” *Environmental Conservation*, vol. 37, no. 4 (December 2010), pp. 398–409, <https://doi.org/10.1017/S0376892910000779>; see also annotation on p. 100 of this report.  
4 Figure 1 from Brian C. O’Neill et al., “Global Demographic Trends and Future Carbon Emissions,” *Proceedings of the National Academies of Science*, vol. 107, no. 41 (12 October 2010), p. 17524, <https://doi.org/10.1073/pnas.1004581107>; see also annotation on p. 74 of this report.  
5 Sarah R. Brauner-Otto, “Environmental Quality and Fertility: The Effects of Plant Density, Species Richness, and Plant Diversity on Fertility Limitation,” *Population and Environment*, vol. 36, no. 1 (10 November 2013), pp. 1–31, <https://doi.org/10.1007/s11111-013-0199-3>.  
6 Karina M. Shreffler and F. Nii-Amoo Doodoo, “The Role of Intergenerational Transfers, Land, and Education in Fertility Transition in Rural Kenya: The Case of Nyeri District,” *Population and Environment*, vol. 30, no. 3 (January 2009), pp. 75–92, <https://doi.org/10.1007/s11111-009-0077-1>; see also annotation on p. 99 of this report.





# African Researchers on the Linkage

Robert Engelman

*A version of this article was presented as a paper at the 7th African Population Conference of the Union for African Population Studies in Johannesburg, South Africa, on December 1, 2015.*

African researchers are well-represented among the articles that the FPESA project team found relevant to the linkage between family planning and environmental sustainability. They also are the most likely from any region to bring up the need to improve access to and use of voluntary family planning in order to slow rates of population growth that are demonstrated to be environmentally deleterious. African authors thus are more likely than those from other continents to follow the full demographic pathway of the FPESA conceptual framework from family planning to environmental sustainability. As with almost all other researchers, however, these authors provide empirical evidence only for selected linkages in the pathway.

Out of 22 top-ranked papers calling for family planning to address environmental concerns, 9 (41 percent) had complete, majority, or at least one-half African authorship. (We gave top ranking, for greatest relevant to the project's primary hypothesis that family planning supports environmental

sustainability, to a total of 112 out of 939 papers that we reviewed or fully assessed.) African authors were well-represented among 72 top-ranked papers asserting or demonstrating connections between population growth and environmental problems, with 15 papers (21 percent) total. We based African authorship on identification with African institutions

in papers, on our personal knowledge of an author's African background, or on Internet searches establishing birth and/or educational training in Africa.

We did not conduct as full or careful of an author count by continent among the 302 papers ranked "4," for "likely helpful" to the primary FPESA hypothesis that family planning contributes to environmental sustainability. But we believe that the high proportion of African authorship pertains to these papers as well.

We do not speculate as to why African authors might be somewhat more likely than those from other regions to test or assert the population-environment connection. But their strong presence in our selection of relevant or probably relevant papers helps to confirm our secondary hypothesis, that the linkage of family planning to environmental sustainability is of considerable interest among a diversity of researchers around the world. It may be that African researchers can be models for those on other continents interested

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*Out of 22 top-ranked papers calling for family planning to address environmental concerns, 9 (41 percent) had complete, majority, or at least one-half African authorship.*

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## PERSPECTIVE >> African Researchers on the Linkage



in exploring the family planning-environment connection.

Here are brief summaries of some of the most compelling African-authored papers we have found:

- Household size—presumably a proxy for, or at least closely related to, fertility—was the first among several determinants of food insecurity in the area studied by [Paul S. Amaza et al.](#), 2008.<sup>1</sup> Calling particular attention to this influence, the authors wrote that the Nigerian “government should give adequate priority and attention to policy measures directed towards the provision of better family planning.”
- Another paper about Nigerian food insecurity by [Mary O. Agada and Edwin M. Igbokwe](#), 2014, found household size to have twice the predictive power for food insecurity as farm income, total annual income, or the scale of home-based production.<sup>2</sup> Agada and Igbokwe also called for improvements in family planning. [Mesfin Welderufael](#), 2014, concluded similarly and made the same policy recommendation.<sup>3</sup>
- In a paper in the journal *Nature*, South African scholar [Graeme S. Cumming et al.](#), 2014, conceptualize interacting influences of population growth and densification with urbanization and technological change.<sup>4</sup> The authors argue that the collective impact of these forces both magnifies the scale and alters the nature of human-ecological relationships. Feedbacks between natural and social systems are thereby weakened, dangerously undermining the prospects for sustainable resource use and ecological stability.
- Global population growth contributes to greenhouse gas emissions, and Nigerian population growth contributes to deforestation, which can undermine resilience to climate change impacts, [Sajini Faith Iwejingi](#), 2013, concludes.<sup>5</sup> While acknowledging that her work is descriptive rather than quantitative, she carefully examines the global and Nigerian forces that contribute to emissions and that undermine climate change adaptation and resilience. Among her recommendations are delayed first births and greater use of family planning to reduce fertility.





## PERSPECTIVE >> African Researchers on the Linkage

- Combining population data and survey results, Ethiopian authors [Teshahun Fentahun and Temesgen Gashaw](#), 2014, found correlations between population growth and declining size of landholdings, increasing migration to sloping and other marginal farmland, and deforestation.<sup>6</sup> They concluded that demographic forces played an important role in land-use change and land degradation. They did not quantify the magnitude of this role, however, or demonstrate how they derived a causative effect from the correlations that they found. This article, too, included a recommendation of improvement in family planning access and service delivery as one strategy for delinking population and land degradation.
- Some articles with African authorship treated aspects of the FPESA hypothesis that are unrelated to demographic change. [Karen Austrian and Eunice Muthengi](#), 2014, mention family planning only in passing, as one of several interventions that can build social assets and overall health.<sup>7</sup> Such interventions were found to be more valuable than economic assets alone in reducing vulnerability to unwanted touching and other forms of sexual harassment of girls. How might this relate to the FPESA hypothesis? Simply by adding to the evidence base that family planning can contribute to girls' and women's self-confidence, autonomy, and life options—thereby conceivably facilitating more engagement in society and in environmental stewardship and conservation.

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- 1 Paul S. Amaza et al., "Measurement and Determinants of Food Insecurity in Northeast Nigeria: Some Empirical Policy Guidelines," *Journal of Food, Agriculture & Environment*, vol. 6, no. 2 (2008), pp. 92–96, [world-food.net/download/journals/2008-issue\\_2/f16.pdf](http://world-food.net/download/journals/2008-issue_2/f16.pdf).
  - 2 Mary O. Agada and Edwin M. Igbokwe, "Food Security and Coping Strategies Among Ethnic Groups in North Central Nigeria," *Developing Country Studies*, vol. 4, no. 8 (2014), pp. 31–44, [iiste.org/Journals/index.php/DCS/article/view/12196/12549](http://iiste.org/Journals/index.php/DCS/article/view/12196/12549); see also annotation on p. 88 of this report.
  - 3 Mesfin Welderufael, "Determinants of Households Vulnerability to Food Insecurity in Ethiopia: Econometric Analysis of Rural and Urban Households," *Journal of Economics and Sustainable Development*, vol. 5, no. 24 (2014), pp. 70–79, [iiste.org/Journals/index.php/JEDS/article/view/17506/17926](http://iiste.org/Journals/index.php/JEDS/article/view/17506/17926); see also annotation on p. 91 of this report.
  - 4 Graeme S. Cumming et al., "Implications of Agricultural Transitions and Urbanization for Ecosystem Services," *Nature*, vol. 515, no. 7525 (6 November 2014), pp. 50–57, <https://doi.org/10.1038/nature13945>; see also annotation on p. 106 of this report.
  - 5 Sajini F. Iwejingi, "Demographic Change and Climate Change: The Nigerian Experience," *Journal of Environment and Earth Science*, vol. 3, no. 1 (2013), pp. 80–85, <http://www.iiste.org/Journals/index.php/JEES/article/view/4009/4063>; see also annotation on p. 71 of this report.
  - 6 Teshahun Fentahun and Temesgen Gashaw, "Population Growth and Land Resources Degradation in Bantneka Watershed, Southern Ethiopia," *Journal of Biology, Agriculture and Healthcare*, vol. 4, no. 14 (2014), pp. 13–16, [iiste.org/Journals/index.php/JBAH/article/view/14198/14506](http://iiste.org/Journals/index.php/JBAH/article/view/14198/14506); see also annotation on p. 85 of this report.
  - 7 Karen Austrian and Eunice Muthengi, "Can Economic Assets Increase Girls' Risk of Sexual Harassment? Evaluation Results from a Social, Health and Economic Asset-building Intervention for Vulnerable Adolescent Girls in Uganda," *Children and Youth Services Review*, vol. 47, part 2 (December 2014), pp. 168–75, <https://doi.org/10.1016/j.childyouth.2014.08.012>.





# Church, Conservation, and Family Planning

Robert Engelman and Yeneneh Girma Terefe

With its relatively rapid population growth and high vulnerability to climate change, the East African country of Ethiopia has drawn interest from around the world in the interaction of family planning and environmental sustainability. The interest is domestic as well: in a move that some might see as surprising, the Ethiopian government has convinced the country’s conservative Orthodox Christian Church not to actively oppose the government’s family planning program, which focuses on reproductive health, natural resource conservation, and social resilience in the face of ongoing climate change.

The widening interest in such connections in Africa’s second most-populous country is reflected in more than two-dozen peer-reviewed Ethiopian case studies and other research articles related to reproductive health, population, and the environment. The papers address such issues as food security, land use, climate change, contraceptive use, and gender relations, often considering connections among these topics. Land use offers a particularly interesting topic of study, given not just the country’s environmental and demographic change, but a longstanding history of the Orthodox Church in the preservation of sacred groves and forest conservation generally. [Haileab Zegeye et al.](#), 2014, in a study of a lake district in south-central Ethiopia that is listed in the FPESA database, found that the Church “has played a vital role in environment and

development issues” in the region, urging residents to spare the lives of trees whenever possible.<sup>1</sup>

Ethiopia has been successful so far in promoting family planning with the help (or at least acquiescence) of the Orthodox Church, which in a “gentleman’s agreement” has opted no longer to stress its opposition to contraception given the aggressive government program in favor of it.<sup>2</sup> The country also is home to one of the world’s best-documented population, health, and environment (PHE) programs. But the government has never really taken advantage of the Church’s interest in forests to integrate family planning with

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*By working closely with Church officials on conservation and family planning, Ethiopia could seize an important opportunity to further strengthen its PHE programs.*

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conservation. By working closely with Church officials on conservation and family planning, Ethiopia could seize an important opportunity to further strengthen its PHE programs.

In the 4th century A.D., King Ezana established Christianity as the official state religion of the then-Aksum Empire, covering present-day Ethiopia and surrounding regions.<sup>3</sup> Still today, the Orthodox Church claims the allegiance of two out of five Ethiopians, followed distantly in popularity by Islam, newer Protestant Christian denominations, and a handful of indigenous religions. Possibly reflecting at least in part the Church’s decision not to oppose





## PERSPECTIVE» Church, Conservation, and Family Planning

family planning, average fertility in Ethiopia declined from an estimated 4.8 children per woman in 2010 to 4.1 children in 2013.<sup>4</sup>

Why fertility is falling and how that decline relates to the work of the government and the Church are questions that deserve more research. In Ethiopian tradition, children are considered a blessing from God, and large families are desired. But attitudes are changing in urban areas, where educated young women desire a small family size.<sup>5</sup> Tradition and modernization are on a collision course, especially in urban centers like Addis Ababa, the capital city.

Even though the Ethiopian government encourages religious leaders to help it promote family planning, it has allowed the Church to continue recommending abstinence as the preferred behavior for avoiding unintended pregnancy. However, Ethiopia's population is growing at 2.9 percent annually, and research suggests that there is rising public awareness of and concern about this relatively high growth rate. Focus-group research also suggests that many Ethiopians believe that the country is already feeling the effects of climate change—particularly drought, with resulting reductions in food production.

One of the government's objectives is to modernize agricultural practices through irrigation and mechanization, while also reducing greenhouse gas emissions and deforestation. Given the country's rapidly growing population, however, this is not an easy undertaking.

The rise in the number of farmers and herders has resulted in farmland expansion and livestock overgrazing, two of the leading causes of deforestation in the country. Between 1990 and 2010, Ethiopia's forest cover declined from 13 percent to 11 percent.<sup>6</sup>

Through education and its art and liturgy, the Orthodox Church has encouraged the preservation of ancient forests throughout Ethiopia, with many of those that remain surrounding individual church buildings and monasteries.<sup>42</sup> Within the Church's strong monastic tradition, hermits and monks use forested areas for seclusion and meditation. Yet the expansion in agricultural land has gradually changed the landscape, including around northern Ethiopia's Abune Guba monastery, where 40 years ago the forest spanned 100 hectares. Despite significant deforestation across Ethiopia's landscape, the Church has discouraged much of the loss of trees around monasteries. In 2011, a reported 23 hectares of forest remained at Abune Guba, according to a Church development commission.<sup>7</sup>

The Church's commitment to conservation may offer additional opportunity for partnerships to link family planning, climate change action, and conservation. Given Ethiopia's need to prepare for climate change, the importance of family planning, and growing public awareness about the country's rapid population growth, engaging the Orthodox Church could be especially effective in encouraging healthier and more environmentally-minded behavior throughout the country.

- 1 Haileab Zegeye et al., "Socio-Economic Factors Affecting Conservation and Sustainable Utilization of the Vegetation Resources on the Islands of Lake Ziway, South-Central Ethiopia," *Earth & Environmental Sciences*, November 2014, pp. 864–75, <https://doi.org/10.4236/nr.2014.514074>.
- 2 Allyn Gaestel and Allison Shelley, "Ethiopians Seeking Birth Control: Caught Between Church and State," National Public Radio, 30 December 2014, [www.npr.org/sections/goatsandsoda/2014/12/30/301425396/ethiopians-seeking-birth-control-caught-between-church-and-state](http://www.npr.org/sections/goatsandsoda/2014/12/30/301425396/ethiopians-seeking-birth-control-caught-between-church-and-state).
- 3 Valery Votrin, "The Orthodoxy and Sustainable Development: A Potential for Broader Involvement of the Orthodox Churches in Ethiopia and Russia," *Environment, Development and Sustainability*, vol. 7, no. 1 (2005), pp. 9–21, <https://doi.org/10.1007/s10668-003-5053-9>.
- 4 Central Statistical Agency, *Ethiopia Mini Demographic and Health Survey 2014* (Addis Ababa: July 2014).
- 5 Kimberly Rovin, Karen Hardee, and Aklilu Kidanu, "Linking Population, Fertility, and Family Planning with Adaptation to Climate Change: Perspectives from Ethiopia," *African Journal of Reproductive Health*, vol. 17, no. 3 (September 2013), pp. 10–11, <http://www.bioline.org.br/pdf?rh13035>.
- 6 Solomon Gebreyohannis Gebrehiwot et al., "Forest Cover Change Over Four Decades in the Blue Nile Basin, Ethiopia: Comparison of Three Watersheds," *Regional Environmental Change*, vol. 14 (February 2014), pp. 253–66, <https://doi.org/10.1007/s10113-013-0483-x>.
- 7 Ethiopian Orthodox Church Development and Inter-Church Aid Commission, *Ten Years Revised Project Proposal, Submitted to Alliance of Religions and Conservation* (Addis Ababa: 2012).
- 8 Ibid.





» PERSPECTIVE

# Research in Latin America and the Caribbean

Javiera Fanta

The population of Latin America and the Caribbean has nearly quadrupled since the mid-20th century, from 169 million in 1950 to 634 million in 2015, according to the [United Nations Population Division](#).<sup>1</sup>

A key factor behind this sharp growth was the substantial decline in infant mortality, which was not balanced by comparable declines in fertility. This led to a rise in the number of live births and, over time, to an [increase in the number of women of childbearing age](#).<sup>2</sup> Demographers project that the region will be home to some 780 million people in 2050.

Although the region has experienced a rapid decline in total fertility—from nearly 6 children per woman in the 1950s to 2.2 children today—fertility among adolescent girls is well above the global average. During 2010–15, for girls and women aged 15–19, the birth rate was 66.5 per 1,000 at the regional level, compared to a worldwide average of 46.2 per 1,000. Adolescent fertility is especially high (above 80 births per 1,000) in the Dominican Republic, French Guiana, Guatemala, Guyana, Haiti, Nicaragua, and Venezuela. The region also has the world’s highest level of unwanted pregnancy, according to researchers with the [Guttmacher Institute](#).<sup>3</sup> In 2012, 56 percent of total pregnancies in women aged 15 to 44 (comprising unplanned births, induced abortions, and miscarriages) were unintended, ranging from 40 percent in Central America to 62 percent in South America and 64 percent in the Caribbean.

Governments in Latin America and the Caribbean have invested substantially in policies geared toward improving family planning. Yet the data on unintended pregnancy demonstrate that certain populations still face substantial obstacles to avoiding or delaying pregnancy. This is worrisome given that efforts to reduce the unmet need for contraception—especially to limit births, in contrast to merely delaying wanted pregnancies—have been a major force in bringing down fertility rates. As researchers [John B. Casterline and Laila O. El-Zeini](#), 2014, observed, as the demand for family planning in the region was increasingly met between 1975 and 2014, unwanted fertility declined by an annual average of 150 births per 1,000 women who were married or in non-marital unions.<sup>4</sup>

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*Demographers project that the region will be home to some 780 million people in 2050.*

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## Links Between Family Planning, Population, and the Environment

Literature review by the FPESA project team turned up only limited empirical studies on the relationship between family planning (i.e., population dynamics) and environmental effects in Latin America and the Caribbean. Although population dynamics are likely as important to the environment in this region as they are in others (see, for example, the [Montevideo Consensus on Population and Development](#)), most research on this topic appears to be based on exploratory case studies and remains inconclusive.<sup>5</sup>





## PERSPECTIVE» Research in Latin America and the Caribbean



Within the regional literature, Mexico and Central America have received special attention, as this area has a high concentration of tropical forest zones that are threatened by increasing deforestation. A 2008 study by [David L. Carr et al.](#) examined the influence of demographic and household variables on deforestation in Guatemala's Sierra de Lacandón National Park, a core conservation zone of the country's Maya Biosphere Reserve.<sup>6</sup> The study surveyed a random sample of 241 households in the park's agricultural borderlands and considered adjacent areas of deforestation. The number of farmers in the agricultural borderlands—mostly the product of in-migration—correlated closely with the conversion of primary forest into farm and grazing land.

Another 2008 study by [Carr](#), in Mexico's Sian Ka'an Biosphere Reserve, assessed the relationship between marine resource management and the use of contraception among married couples in the lobster fishing village of Punta Allen, using a qualitative approach.<sup>7</sup> Results showed that the village's observed low fertility

levels were due to the universal use of modern contraception among couples, based on the intention of villagers to favor smaller family sizes. Carr concluded that the need to protect the lobster population, the village's main economic resource, was a key factor behind the desire to limit childbearing. The villagers perceived population growth to be a threat to the economic security of Punta Allen and its inhabitants.

A 2006 study by [Sergio Franco Maass et al.](#) analyzed the land cover change in Mexico's Nevado de Toluca National Park between 1972 and 2000.<sup>8</sup> The park is one of the most important natural areas of the country, as it provides 30 percent of the water used in the populous Toluca Valley and 14 percent of water used in the valley that is home to Mexico City. Although the authors did not specifically analyze the impact of demographic change in the park, they noted that a tripling in the number of villages during the last two decades of the 20th century was highly influential in the loss of more than 8,000 hectares of forest and natural vegetation during the study period.





## PERSPECTIVE» Research in Latin America and the Caribbean

In a 2002 study, [Luis Rosero-Bixby et al.](#) analyzed the relationship between population growth and forest conservation in Costa Rica's Osa Peninsula, using logistic regression and multivariate analysis in their methodology.<sup>9</sup> Nearly a third of the country's tree species are located in this area, including half of Costa Rica's endangered species. The authors analyzed deforestation, reforestation, and forest fragmentation between 1980 and 1995, using geographically referenced censuses and information on land use derived from satellite and aerial imaging. During the study period, 16 percent of the forest in the peninsula was harvested and 3 percent was fragmented. The researchers found that the probability of deforestation was zero in unpopulated areas but rose to as high as 65 percent as the number of farmers in an area increased. Each 1 percent increase in the number of households boosted

the risk of deforestation 0.6 percent and the risk of fragmentation 1 percent, whereas reforestation decreased 0.4 percent.

Such conclusions by Latin American scholars (all written in Spanish, except for Carr's Mexico study) hint that if the FPESA project were expanded to include Spanish-language literature, the project's overall findings might be reflected in Latin America and the Caribbean as well. The literature on population's impact in the region is at best suggestive, but it is more likely than not to support the likelihood of demographic components of environmental change. Research on more-direct connections between family planning and environmental sustainability in the region likely would be harder to identify, as is the case with the project's English-language scientific literature.

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- 1 United Nations Population Division, *2015 Revision of World Population Prospects* (New York: 2015), data available at [esa.un.org/unpd/wpp/](http://esa.un.org/unpd/wpp/).
  - 2 Juan Chackiel, *La Dinámica Demográfica en América Latina* (Santiago, Chile: Centro Latinoamericano y Caribeño de Demografía, May 2004), available in Spanish at [repositorio.cepal.org/bitstream/handle/11362/7190/S045328\\_es.pdf?sequence=1](http://repositorio.cepal.org/bitstream/handle/11362/7190/S045328_es.pdf?sequence=1).
  - 3 Gilda Sedgh et al., "Intended and Unintended Pregnancies Worldwide in 2012 and Recent Trends," *Studies in Family Planning*, vol. 45, no. 3 (September 2014), pp. 301–14, <https://doi.org/10.1111/j.1728-4465.2014.00393.x>; see also annotation on p. 62 of this report.
  - 4 John B. Casterline and Laila O. El-Zeini, "Unmet Need and Fertility Decline: A Comparative Perspective on Prospects in Sub-Saharan Africa," *Studies in Family Planning*, vol. 45, no. 2 (June 2014), pp. 227–45, <https://doi.org/10.1111/j.1728-4465.2014.00386.x>; see also annotation on p. 59 of this report.
  - 5 United Nations, *Montevideo Consensus on Population and Development* (Montevideo: 12–15 August 2013, [repositorio.cepal.org/bitstream/handle/11362/21860/S20131039\\_en.pdf](http://repositorio.cepal.org/bitstream/handle/11362/21860/S20131039_en.pdf)).
  - 6 David L. Carr et al., "Un Análisis Multinivel de Población y Deforestación en el Parque Nacional Sierra de Lacandón (Petén, Guatemala)," *Documents d'anàlisi geogràfica*, no. 52 (2008), pp. 49–67, [ddd.uab.cat/record/33401/](http://ddd.uab.cat/record/33401/).
  - 7 David L. Carr, "Resource Management and Fertility in Mexico's Sian Ka'an Biosphere Reserve: Campos, Cash, and Contraception in the Lobster-fishing Village of Punta Allen," *Population and Environment*, vol. 29, no. 2 (November 2007), pp. 83–101, <https://doi.org/10.1007/s11111-008-0062-0>; see also annotation on p. 97 of this report.
  - 8 Sergio Franco Maass et al., "Cambio de Uso del Suelo y Vegetación en el Parque Nacional Nevado de Toluca, México, en el Periodo 1972–2000," *Investigaciones Geográficas*, vol. 61 (2006), pp. 38–57, available in Spanish at [www.redalyc.org/pdf/569/56906104.pdf](http://www.redalyc.org/pdf/569/56906104.pdf).
  - 9 Luis Rosero-Bixby et al., "Bosque y Población en la Península de Osa, Costa Rica," *Revista de Biología Tropical*, vol. 50, no. 2 (June 2002), pp. 585–98, available in Spanish at [www.revistas.ucr.ac.cr/index.php/rbt/article/view/16460/15974](http://www.revistas.ucr.ac.cr/index.php/rbt/article/view/16460/15974).





» PERSPECTIVE

# Experts Reflect on the Research

Vicky Markham

Laying the foundation for the FPESA project in 2014 and early 2015, we contacted experts that had some experience in both fields for guidance, as well as to obtain their takes on the state of research connecting family planning, population, and environmental sustainability.

There aren't many such experts, but they can be found. Defying the disciplinary walls that separate reproductive health from the environmental sciences, a small group of researchers has delved over the past few decades into possible connections between these two fields. Many of the individuals whom we interviewed contributed significantly to the design of our search for scientific evidence on the linkages.

Logic and research suggest that growing populations tend to contribute to various environmental stresses. So, by extension, if wider use of family planning slows population growth, it should generally produce some benefits in slowing the pace of human-caused environmental change. Experts agreed, however, that this relationship is complex, under-researched, and not well or uniformly documented.

Reproductive health, family planning, population, and the state of the environment interact in individual human lives—sometimes intensively, especially in

low-income communities where livelihoods are linked closely to local natural resources. However, research (and the funders behind it) rarely examines this integrated dynamic. In the professional development community, demography, health, and individual environmental topics typically fall into silos, reflecting the disciplinary specialty of researchers or the focus of funders.

In developing countries, some community-based programs work to improve family planning access and natural resource conservation at the same time. But experts noted that even where there are evaluations of such “population, health, and environment” (PHE) programs, they may not be widely

published or otherwise communicated, especially in peer-reviewed journals. This results in lost opportunities for information sharing in research communities that potentially are interested in the connection between family planning and environmental sustainability—as well as in policy and advocacy circles and in the PHE program community itself.

There is a natural tension between research and community well-being when documenting the effectiveness of PHE programs. The urgency of addressing problems on the ground—such as poor management of natural resources or limited access to reproductive health services—calls for near-term results, with less attention to

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*If wider use of family planning slows population growth, it should generally produce some benefits in slowing the pace of human-caused environmental change.*

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## PERSPECTIVE >> Experts Reflect on the Research

longer-term efforts to improve scientific understanding of what works, how, and why. Undergoing peer review becomes even less likely under such funding and under time pressure to “just do it,” with or without documentation and evaluation.

“If I had to identify a gap in attention to population-environment and family planning and environmental sustainability issues universally, the need for more peer-reviewed research on these integrated topics would be it,” noted [Mark Montgomery](#), a senior associate at the [Population Council](#) and a professor of economics at Stony Brook University in New York.

### A New Field, A New Way of Thinking

Several experts suggested that the integrated character of connections between family planning and environmental sustainability is a hindrance to research, requiring as it does holistic observation and data collection that few experts receive training to do and that few funders are accustomed to supporting. Data points add up differently, and units of analysis differ, complicating measurement and assessment of their interactions.

“The community working on family planning and environmental sustainability is mainly advocates, policy specialists, campaigners, and journalists—but not researchers,” noted [Lynne Gaffikin](#), a medicine and public health associate professor at Stanford University. “We need to cultivate researchers and provide the money [to support research]. We need to establish this as a new field of research study, a new way of thinking, because you can’t solve new problems with old ways of thinking.”

Despite a considerable volume of literature analyzing or at least drawing attention to population-environment linkages, very little of this research takes the additional step of asking if family planning is an option for addressing the connection. Several experts interviewed noted the relative absence of any mentions of reproductive health and family planning—or, for that mat-

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*The key is harnessing donors to understand that family planning and environmental sustainability linkages are the logical next step to the existing population-environment research, so we have support to take our work to the next level.*

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ter, other potential topics related to population change, such as education and the status of women.

On a positive note, some experts pointed to recent increases in the application of monitoring, evaluation, and increasing the evidence base, and occasionally even peer review, in PHE programs, which may indicate increasing interest in these areas among funders and national governments.

“The next logical step . . . is evidence gathering and peer-reviewed research and publication,” said [Leona D’Agnes](#), former technical adviser at [PATH Foundation Philippines](#) and an independent consultant on PHE. “This doesn’t mean it wasn’t seen as important [before]. We just weren’t there yet because of the program focus, but now we are. The key is harnessing donors to understand that family planning and environmental sustainability linkages are the logical next step to the existing population-environment research, so we have support to take our work to the next level. We’re on the ground and see the dynamics and the research needs. Our job is to help the funders see where we are now and what is needed.”

### Pilot Studies, Then Scale Up

Among the key themes expressed by experts interviewed was a call for more, better research relating family planning and environmental sustainability. The experts suggested the need to identify priority research





## PERSPECTIVE >> Experts Reflect on the Research

needs in this area, to build a strategy, and to follow up with compelling proposals for funding. Researchers should consider pilot studies, then scale up. They should take advantage of existing in-country projects that could offer potential partners and research locations and engage developing-country researchers along with those from developed countries.

“The lack of research doesn’t mean a lack of linkages,” said Gaffikin. “We have to help the international donors see the link and that the integrated approach . . . is the emerging trend now.”

Combining peer-reviewed research on family planning and environmental sustainability linkages with operations research on PHE programs could benefit both researchers and field practitioners, some experts argued. In-country practitioners typically do not have the capacity to both implement programs and conduct research. But many, having conducted what they see as successful programs, now want to enhance their research documentation, publication, and dissemination. One possibility may be to link authors that have peer-reviewed papers under their belt, to those interested in pilot studies in PHE as practiced in communities.

“Many in-country NGOs [nongovernmental organizations] who are currently undertaking or want to undertake program work want it to be informed by science,” said [William Pan](#), an assistant professor of environment and health at Duke University. “But they can’t do both” program work and scientific research.

Pan cited the Ugandan organization [Conservation Through Public Health](#) (whose founder and CEO, [Gladys Kalema-Zikusoka](#), is a member of the FPESA network of assessors and authored “Family Planning and the Environment in Communities” on page 33) as an illustration of how successful PHE project work can attract attention from governments and international development assistance agencies. “Yet most NGOs who deal with these integrated issues are not always informed by science, and this is a problem that needs to be addressed. This is key, because NGOs’ role is to do

what science alone cannot, to focus on policy and advocacy. We need to bridge the scientist/activist divide.”

How to move forward? Experts generally agreed that research should explore how family planning relates to forces and factors that can bring about environmental sustainability. They also agreed that this needs to be integrated with the study of what works to improve livelihoods, food security, education,

economic opportunities, and the empowerment of girls and women.

Several interviewees noted the potential of the FPESA project itself to draw attention to the need to better integrate peer-reviewed research with PHE programs, to expand and diversify the community of engaged researchers, and to prioritize research needs. One priority, many said, is to work to convince potential funders about the importance of building the research on the linkage between family planning and environmental sustainability.

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Experts generally agreed  
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## Experts interviewed

**John Bongaarts**, Population Council, NY, United States

**Joan Regina Castro**, PATH Foundation Philippines, Makati City, Metro Manila, The Philippines

**Lisa Dabek**, Woodland Park Zoo, Seattle, WA, United States

**Leona D'Agnes**, independent consultant, Vientiane, Laos

**Janet Edmond**, Conservation International, Washington, DC, United States

**Alex C. Ezeh**, African Population and Health Research Center, Nairobi, Kenya

**Stephanie Feldstein**, Center for Biological Diversity, Tucson, AZ, United States

**Lynne Gaffikin**, Stanford University and Evaluation and Research Technologies for Health, Palo Alto, CA, United States

**Adrian C. Hayes**, Australian Demographic and Social Research Institute, Australian National University, Canberra, Australia

**Lori Hunter**, Institute of Behavioral Science, University of Colorado, Boulder, CO, United States

**Leiwen Jiang**, National Center for Atmospheric Research, Boulder, CO, United States

**Gladys Kalema-Zikusoka**, Conservation Through Public Health, Kampala, Uganda

**Shannon Kowalski**, International Women's Health Coalition, New York, United States

**Don Lauro**, African Grantmakers Affinity Group, Sacramento, CA, United States

**Jeffrey K. McKee**, Ohio State University, Columbus, OH, United States

**Mark Montgomery**, Population Council and Stony Brook University, New York, United States

**Camilo Mora**, University of Hawaii, Honolulu, HI, United States

**Susan P. Murphy**, Trinity College, Dublin, Ireland

**Karen Newman**, Population and Sustainability Network, London, United Kingdom

**Mikal Nolan**, Woodland Park Zoo Tree Kangaroo Project, Papua New Guinea

**William Pan**, Duke University, Durham, NC, United States

**Deepa Pullanikkatil**, North-West University, Mmabatho, South Africa

**Laura Robson**, Blue Ventures, London, United Kingdom

**Caroline Savitzky**, Blue Ventures, London, United Kingdom

**Daniel Schensul**, United Nations Population Fund, New York, United States

**Elin Torell**, University of Rhode Island, Kingston, RI, United States

**Eliya Zulu**, African Institute for Development Policy, Nairobi, Kenya







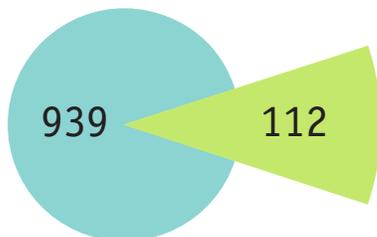
# Annotations

The annotations that follow offer brief perspectives on what each research paper offers relevant to the FPESA hypothesis that family planning is beneficial to environmental sustainability. We highlight here those hypotheses, data, methodologies, findings, and conclusions in each paper that led the FPESA staff to select it from among our large database of peer-reviewed papers. The annotations are not intended as summaries of the papers but rather as brief descriptions of their main findings and conclusions and their relevance to the FPESA hypothesis. The authors' published abstracts are available via the hyperlinks provided, many of which lead as well to complete papers available at no cost.

The FPESA database includes 939 papers published since 2005 that potentially shed light on the project's primary hypothesis that family planning promotes environmental sustainability. Staff and FPESA network assessors deemed 112 papers as "top-ranked," i.e., with certain relevance to the hypothesis, including to individual relationships depicted in our [conceptual framework](#) (see page 8). A selection of these 50 top-ranked papers—including all those collaboratively assessed by the FPESA network and others mentioned in the text of this report—is provided in this section, alphabetically by last name, in each topic category. We intend to post annotations of other top-ranked papers over time on the [fpesa.net website](http://fpesa.net).

Papers published since 2005 related to conceptual framework

Top-ranked papers with relevance to hypothesis



For additional annotations visit [www.fpesa.net](http://www.fpesa.net)

## Family Planning

**John B. Casterline and Laila O. El-Zeini, "Unmet Need and Fertility Decline: A Comparative Perspective on Prospects in Sub-Saharan Africa," *Studies in Family Planning*, vol. 45, no. 2 (June 2014), pp. 227–45, <https://doi.org/10.1111/j.1728-4465.2014.00386.x>. This paper was collaboratively assessed.**

Satisfying married women's unmet need for contraception to avoid unintended pregnancies significantly lowers fertility rates in most developing countries, this analysis finds. Only in sub-Saharan Africa does a weak relationship appear between satisfying unmet need and fertility decline. This is due, the authors conclude, to a combination of measurement problems and a "fundamentally different character of fertility decline" in that region.

The researchers worked with demographic surveys going back to 1974 to compare satisfaction of demand (a measure of family planning use by married women age 15 to 49 who say they do not want to become pregnant) with fertility change in that group. The analysis included surveys of 45 countries across Latin America and the Caribbean, Asia, and Africa.

Outside of sub-Saharan Africa, the authors found strong and consistent impacts of increases in satisfaction of demand for contraception and declines in fertility rates (the average number of live births that a woman in a specified country has during her lifetime). They found some evidence of a weak relationship in sub-Saharan Africa but conclude that it was statistically insignificant. They propose two reasons, probably working in combination, for this regional exception: 1) demographic surveys may have more difficulty determining attitudes about family planning and fertility in sub-Saharan Africa, and 2) high desired fertility and post-partum behaviors may simply make it less likely there





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than in other regions that meeting contraceptive needs will dramatically lower fertility.

► **Key quotes:**

“Increases of 50 percentage points in satisfaction of demand for limiting [i.e., family planning methods that allow women to realize the intention of having no more children] are common in fertility transitions in Asia, Latin America and the Caribbean, and North Africa, and such increases translate into an average decline in unwanted fertility of 150 births per 1,000 woman-years, a very considerable impact of satisfaction of unmet need on fertility. . . . Overall, the trends form a relatively tidy picture in which . . . fertility declines as a consequence of increased implementation of preferences regarding contraception.”

► **FPESA network assessments (10 total)**

were exceptionally favorable, with some caveats and attention to unanswered questions. Two assessments faulted the authors for a lack of clarity, perhaps reflecting publication in a journal aimed at family planning specialists. Other limitations mentioned were the focus on married women (since many unmarried women, including adolescents, also have an unmet need for contraception) and the possibility, acknowledged in the paper, that demographic surveys fail to accurately portray attitudes in sub-Saharan Africa.

One assessor from the region suggested that the paper undermines a key linkage in the FPESA [conceptual framework](#) (between family planning use and fertility decline; see page 8). Another from the region worried about bias or incomplete coverage in the sub-Saharan African surveys studied but praised the paper for its use of a large volume of surveys from developing countries generally. One assessor critiqued minor aspects of the authors’ methodology and faulted the unmet-need metric itself, saying that it fails to capture the ambivalence that some women may have about a specific pregnancy and birth. No assessors contested the paper’s main conclusion.

► **Overall assessment:**

Although this article does not mention environmental sustainability, it is valuable in quantifying a connection in the FPESA conceptual framework that may seem fairly obvious but requires verification. This is the sub-hypothesis that improving access to and use of family planning reduces

fertility and therefore slows population growth. The much weaker association of the linkage in sub-Saharan Africa undermines this verification (and hence, to some extent, the FPESA sub-hypothesis), especially because its cause is not well understood.

Family planning access and use is somewhat less influential in sub-Saharan Africa than elsewhere in the developing world in reducing fertility. If supported by additional research, that conclusion might underline the need for higher educational attainment by girls and women in sub-Saharan Africa and other interventions relating to their empowerment. These presumably would lead to smaller desired family size and—with appropriate access to family planning—the realization of that intention.

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**Lawrence B. Finer and Mia R. Zolna, “Declines in Unintended Pregnancy in the United States, 2008–2011,” *New England Journal of Medicine*, vol. 374 (3 March 2016), pp. 843–52, <https://doi.org/10.1056/NEJMsa1506575>.**

Over a recent three-year period, the share of U.S. pregnancies that were unintended fell to the lowest levels in decades, these authors report. The unintended pregnancy proportion dropped from 51 percent of all pregnancies to 45 percent between 2008 and 2011. In the latter year, approximately 2.8 million of the 6.1 million pregnancies occurring were unintended. Rates of unintended pregnancy dropped “across all strata of age, income, and race and ethnicity,” the authors write, although the most dramatic declines were among lower-income and minority groups.

The authors make the case that the most likely reason for these declines was increasing use of contraception, in particular “highly effective long-acting methods, particularly intrauterine devices.” These methods accounted for 12 percent of all contraception used in the United States in 2012, the authors noted, compared with 4 percent in 2007, “and this increase occurred in almost all demographic groups.” Roughly half of unintended pregnancies ended in unplanned births. (Another 42 percent led to abortions in 2012, with the rest ending in miscarriages). Not surprisingly, rates of unplanned births also fell significantly over the three years.





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For every 1,000 girls and women age 15 to 44, unplanned births fell from 27 in 2008 to 22 in 2011, a 19 percent drop. These declines were all the more significant because the United States has among the highest rates of unintended pregnancy in the developed world (no doubt still, if the proportion remains close to 45 percent).

► **Key quotes:**

“[T]he rate of the births that resulted from unintended pregnancies declined in virtually every income and education group. . . . Our findings show a substantial decline in the rate of unintended pregnancy in the United States between 2008 and 2011, to a historic low. Nonetheless, nearly half of all pregnancies in 2011 were still unintended, and major disparities remained among women and girls according to socioeconomic status and race and ethnic group.”

► **Assessment:**

Although the authors do not connect their findings to environmental sustainability, this paper may be among the best illustrations in our database of a key point in the FPESA [conceptual framework](#) (see page 8): increased use of family planning slows population growth. It does this by enabling women to avoid pregnancies that they do not want, at the time of the pregnancy or ever, and thus reduces fertility or at least delays childbearing based on the human right that women and their partners should determine if and when to bear children. The fact that unintended pregnancy rates fell more sharply among low-income women than among high-income women somewhat weakens the environmental impact of the trend, as income tends to correlate with per capita environmental impact. (For a fuller discussion of this paper and its implications for the FPESA primary hypothesis, see also blog at [fpesa.net/u-s-unintended-pregnancies-fell-good-for-the-environment](http://fpesa.net/u-s-unintended-pregnancies-fell-good-for-the-environment).)

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**Usman Khan and Jim A. Nicell, “Contraceptive Options and Their Associated Estrogenic Environmental Loads: Relationships and Trade-Offs,” *PLoS ONE*, vol. 9, no. 3 (March 2014), p. e92630, <https://doi.org/10.1371/journal.pone.0092630>. This paper was collaboratively assessed.**

Much as it may seem to defy logic, the use of estrogen-based birth control pills ultimately reduces estrogen pollution into the environment, at least in the United States, these authors conclude. Their analysis weighs multiple sources of environmental estrogen associated with human reproduction and its control. And it applies the controversial concept of parents’ environmental “legacy” embodied in the impact that their children and other descendants will have on the environment, as originally described and calculated for heat-trapping carbon dioxide emissions in [Paul A. Murtaugh and Michael G. Schlax, 2009](#) (see annotation on page 73).

Khan and Nicell take into account the savings, accrued by reductions in unintended pregnancy and unwanted births as a result of the use of family planning, in future estrogen secretion that would otherwise occur in later generations. Contraception also reduces pregnancies and births among users, who would otherwise make their own near-term polluting contributions of natural estrogens.

The authors calculate that discontinuing the use of the most common type of oral contraceptive would multiply estrogen pollution by a factor of 1.7. And they conclude that “13 percent of the net annual estrogenic load to the environment can be averted by fully meeting the contraceptive needs of the population of the U.S.A.”

The datasets used for the authors’ calculations are detailed in 15 supplementary documents, all available online. These include information on failure rates of different contraceptive methods in the United States as well as the incidents of unintended pregnancy and mistimed and unwanted births.

► **Key quotes:**

“[W]hile the issue of estrogen impacts on the environment cannot be addressed solely by meeting the population’s contraceptive needs, a significant fraction of the estrogenic mass released to the environment can be averted by improving the level with which their contraceptive needs are met.”

► **FPESA network assessments (eight total)**

were mostly enthusiastic about the strength and imaginative reach of this paper. One assessor called





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it “fascinating,” while another commended its “easy reading.” A few assessors were less impressed, questioning how dependable the data were and whether the findings were applicable to countries other than the United States. (The paper makes clear that the findings are limited to the United States. The researchers believe that their methodology is applicable elsewhere, along with their key finding: that eliminating estrogen-based contraception would not solve the problem of estrogen pollution.)

One assessor noted a significant problem with assessing environmental legacies: How can one know enough about the distant future to know how long a line of descendants will last, and what their environmental behavior will be? For the most part, Khan and Nicell acknowledged such limitations and offered their conclusions as an initial calculation relating to a question not previously examined.

► **Overall assessment:**

Although estrogen pollution itself may be a small component of environmental sustainability, the paper is especially relevant to the FPESA project in using rich data to test empirically a hypothesis on the impact of family planning directly on an environmental problem. (While not addressed in this paper, other research has linked estrogen pollution in U.S. waterways to the feminization of aquatic life and potentially to human health risks, particularly related to reproductive health.) Estrogen pollution comes not just from the use of estrogen-based contraceptives, but also from natural excretions, which themselves are reduced, now and in the future, by the use of birth control.

The originality of the research question and methodology strengthen the value of this paper. So does the authors’ calculation of the estrogenic legacy effect of oral contraceptive use. The calculation itself is questionable, requiring as it does assumptions about both fertility and behavior far into the future. Yet it seems obvious that if slowing population growth reduces environmental impacts in the short and medium term, lasting benefits will be likely as the demographic impact of slower growth is amplified in successive generations. The legacy effect deserves, but only rarely receives, investigation and discussion.

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**Gilda Sedgh et al., “Intended and Unintended Pregnancies Worldwide in 2012 and Recent Trends,” *Studies in Family Planning*, vol. 45, no. 3 (September 2014), pp. 301–14, <https://doi.org/10.1111/j.1728-4465.2014.00393.x>.**

Working with a variety of global datasets, these authors estimate that 85 million of the 213 million pregnancies that occurred around the world in 2012 were not intended by the pregnant women. The share of pregnancies that were unintended in more-developed countries was 47 percent; in less-developed countries, 39 percent. Of the world’s unintended pregnancies, 38 percent, or slightly more than 32 million, resulted in unplanned births. Regional proportions of unintended pregnancy vary from 35 percent of all pregnancies in Africa to 56 percent in Latin America.

► **Key quotes:**

“In many countries, women have more pregnancies and children than they want and become pregnant much sooner than desired.”

► **Assessment:**

In its opening statement, quoted above, this paper announces its importance for the FPESA [conceptual framework](#) (see page 8) and primary hypothesis. Although the authors make no mention of either population change or the environment, the data that they assembled support a keystone component of the FPESA framework: prevention of unintended pregnancy can significantly reduce fertility, slowing the pace of (or potentially in some countries even reversing) population growth. The integration of varying datasets demands some leverage in reconciling different methodologies for counting unintended pregnancy and its outcomes, which the authors acknowledge. These figures nonetheless stand as the best available on how many pregnancies worldwide are unintended and how many result in unplanned births.

The more than 32 million unplanned births estimated to have occurred annually in 2012 amounted to more than 40 percent of the number of births by which the world’s population grows each year. These numbers, however, are not strictly comparable. Many unintended pregnancies are simply mistimed—the pregnant women want eventually to





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be pregnant, but not for two or more years—so we cannot say that avoiding all unintended pregnancies would slow population growth as much as this comparison might imply. (Delayed pregnancies also slow population growth, albeit less powerfully than reduced fertility.)

Nonetheless, a world in which all pregnancies were intended would have significantly lower fertility and a more rapid deceleration of population growth than is currently occurring. If global commitments to improving access to family planning are achieved, the authors conclude, “we can expect the incidence of unwanted and mistimed pregnancies will decline in the coming years.”

**Lynn M. Van Lith et al., “Women’s Growing Desire to Limit Births in Sub-Saharan Africa: Meeting the Challenge,” *Global Health: Science and Practice*, vol. 1, no. 1 (1 March 2013), pp. 97–107, <https://doi.org/10.9745/GHSP-D-12-00036>.**

This paper undermines impressions—strong even in demographic and family planning circles—that emphasizing family planning for spacing rather than for “limiting” births (i.e., having no more births) is the route to greater uptake of contraception in sub-Saharan Africa. Studying *Demographic and Health Surveys* in 18 African nations published since 2000, the authors find higher-than-expected proportions of women seeking to end their childbearing and cite literature indicating that these proportions are growing.

Overall, 37 percent of all demand for family planning is for limiting births, and the age at which would-be “limiters” exceeds “spacers” is as low as the mid- or even early 20s in some countries, while averaging 33 in sub-Saharan Africa. (See Figure.) Even contraceptive users interested in avoiding pregnancy for good often end up using inappropriate methods for their needs, largely because of poor service provision or utilization. Those with the least education and lowest incomes are most likely to lack adequate information and help in ending childbearing.

A greater focus on meeting these needs by governments and reproductive health service providers would serve the interests and health of millions of women seeking never to be pregnant, the authors conclude. It also would contribute,

they add, to a more rapid transition toward lower fertility in sub-Saharan Africa, which currently has the world’s highest fertility rates on average.

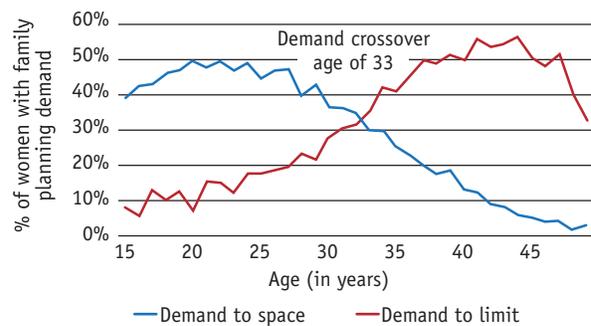
► **Key quotes:**

“Many permanent method users have had more than their ideal number of children. . . . Given that poorer women are less likely than wealthier women to use contraception, quality information and services may not be as available in poor or hard-to-reach areas. Further, since many women have exceeded their desired parity, we question whether family planning options are readily offered and available to postpartum women [i.e., those who have just given birth] when they may need these methods the most.”

► **Assessment:**

Although this paper does not address either population or environmental sustainability, it offers important survey evidence supporting a key component of both directional pathways in the FPESA hypothesis and [conceptual framework](#) (see page 8). This component hypothesizes that unintended pregnancy is an important factor in limiting women’s participation in social and economic affairs, as well as in perpetuating population growth. As the paper suggests, both of these factors act more powerfully in the case of women who become pregnant not at the wrong time, but when they wish never to be pregnant again. The paper also sheds valuable light on why the difference between spacing and limiting births is so important in family planning provision, use, and outcomes.

**Demand for Spacing and Limiting Births,<sup>a</sup> by Age**



<sup>a</sup> Averages weighted by population of women of reproductive age for all 18 analysis countries.

Illustration from the paper (page 100). Used by permission.





## Women

**Bina Agarwal, "Gender and Forest Conservation: The Impact of Women's Participation in Community Forest Governance," *Ecological Economics*, vol. 68, no. 11 (15 September 2009), pp. 2785–99, <https://doi.org/10.1016/j.ecolecon.2009.04.025>.**

Community forestry organizations in parts of India and Nepal that include high proportions of women, especially in their executive committees, tend to maintain healthier forests and to demonstrate more improvement in them over time, this author concludes. She based her work on multiple indicators (e.g., extent of canopy, biodiversity, growth of tree cover over time) and on verification by the community groups, government foresters, and her own and an assistant's direct observation. Although community forestry groups varied in their structure and makeup, the correlation between high women's representation and good forest management was strong and consistent in both countries.

The author took steps to eliminate potential biases, such as cultures that were supportive of both gender equality and forest conservation, from her analysis. Nor could "reverse causality"—positive forest outcomes leading to greater women's representation—have been a confounding factor, since membership formation of the organizations preceded the improvements in forest health. Even when governments granted forests that were smaller or more degraded than average allotments to community groups with high women's membership, these forests showed above-average improvements. The author speculates that women in these communities were able to apply a greater knowledge of plant care and sustainable use than men tended to have. They also may have worked more cooperatively than men tended to do to prevent tree theft and other misuses of the forests.

### ► Key quotes:

"In many regions (though not universally), knowledge of forest ecology is gendered: women are found to be better informed about firewood and fodder species and non-timber forest products, and men about timber species. . . . W2 [a



woman forestry organization member quoted in the paper]: "We labor hard for this forest. I feel like it is my own baby."

### ► Assessment:

This paper was among the strongest and most empirical that we reviewed on an important aspect of our [conceptual framework](#) (see page 8) that is not well represented in the literature: the impact of high levels of women's involvement on levels and types of environmental activities. The paper presents data that are abundant and consistent, demonstrating in detailed regression tables how strong the association is in the studied areas of India and Nepal between high proportions of women in community forestry organizations and improvement in the managed forests.

Although causality is hard to establish, the researcher demonstrates why the correlation can be assumed to represent direct influence from women's representation to healthy forests. She combines data and observation to produce a rich picture of women in Nepal and India cooperating to protect forests from theft—sometimes from other women, who in some districts were more likely to abide by the rules when women were heavily involved in forest management—and to foster balanced forest utilization and healthy tree growth.





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**Shannon Elizabeth Bell and Yvonne A. Braun, “Coal, Identity, and the Gendering of Environmental Justice Activism in Central Appalachia,” *Gender & Society*, vol. 24, no. 6 (December 2010), pp. 794–813, <https://doi.org/10.1177/0891243210387277>.**

Women in the environmental justice movement in the coalfields of central Appalachia, in the eastern United States, act in large part out of an identity as mothers, these authors argue based on 28 in-depth personal interviews with women and men in the region. (The other major influence on women’s activism is the interviewees’ strong sense of identity as “Appalachians,” based on deep roots in the region.) A commitment to solidarity with perceived masculine values and other attributes of “true manhood” discourages men from participating in the movement, the researchers found. Both women and men who were interviewed associated women’s environmental justice activism with the defense of their homes and children, while they believed that men in the region worry more about the security of their jobs and incomes and their standing with other men. Although specific to the region studied, these differences in attitude may shed light on gender differences evident in the environmental justice movement generally.

► **Key quotes:**

All quotes are from individuals interviewed, each of whom permitted the authors to use their real names.

Maria Gunnoe, whose house near a mountaintop-removal coal mine suffered a severe flood and after a later rainfall awoke to find her daughter dressed and ready to evacuate: “I found out one morning at 3:00 in the morning, it was thundering and lightning, and I go in, and I find her sitting on the edge of her bed with her shoes and her coat and her pants [on]. [Pauses, deep breath, voice cracks] And I found out then [pauses] what it was putting my daughter through. [Crying] And that is what *pissed me off*. How *dare* they steal that from my child! The security of being able to sleep in her own bed. The coal companies now own that. They now own my child’s security in her own bed. [Pauses] And how can they expect me as a mother to look over that? . . . All I wanted to do was to be a mother . . . in order for me to be a mother, and in order for me to keep my children safe, . . . I’ve

had—it’s not an option—I’ve had to stand up and fight for our rights. . . . As mothers of future generations of Appalachian boys and girls, we can’t allow them to steal this from our children—it’s too precious. And it can’t be replaced. . . .”

Bill Price: “Men were the coal miners, so it’s a little harder for them to let go of that sense of, you know, this is how I put cornbread on the table.”

Bo Webb (like Price, a rare male environmental justice activist): “For women—I think it’s a natural instinct to protect your children . . . you know, you gave birth to that child. And if someone is going to do some harm to your kids, you’re gonna rip their face off. . . . [Men] want to be in the old boys’ club. And they don’t want to mess with the status quo.”

► **Assessment:**

Based qualitatively on views expressed by just 28 women and men in one small part of the United States, this paper nonetheless contributed some of the most stimulating reading among the papers we found exploring gender connections with environmental attitudes and behavior. Although it is hard to extend these viewpoints beyond the participants’ region, this paper demonstrates that some women, and men familiar with them, connect their activism on environmental justice with motherhood—and, by extension, to healthy and successful motherhood. This opens a door to the question of how reproductive health and rights, including family planning, might relate to attitudes about the environment and the capacity to become active in such movements as environmental justice. (While some might argue that the focus of environmental justice is people rather than the environment per se, we would counter that the environmental issues involved make women’s engagement in the environmental justice movement relevant to our research.)

The authors stress that the women they interviewed had to adjust to the concept of working outside the home to defend those inside it. Family planning facilitates this type of “extra-domestic” expenditure of time and energy, we would note. It allows women to avoid unplanned births or delay planned ones that would limit their ability to take time away from parental duties. The paper also notes that around the turn of the 20th century, middle- and upper-class women “initiated and led most environmental campaigns in the United States.” If accurate, this fact could be explained in part by these





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women’s relatively greater capacity to manage the timing and frequency of childbearing. This paper does not explore these possible connections, however, and we have not yet identified others that do, leaving a research gap to be filled.

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**Sylvie Burgnard, “The Family Planning Service and the Pill in Geneva (1965–1980): A Step Towards Women’s Emancipation?”** *The History of the Family*, vol. 20, no. 1 (28 January 2015), pp. 24–40, <https://doi.org/10.1080/1081602X.2014.987308>.

Between 1965 and 1980, family planning services in Geneva opened up new possibilities for increased autonomy among women in the Swiss municipality, the author concludes based on the records of both the provider organization and a feminist group that had written commentaries about the services. Although the services originally were aimed at “stable” married couples, they were embraced by single and adolescent women as well. The availability of contraception contributed to the rise of feminism, spurring a transformation from seeing sex as a marital behavior necessary for reproduction to seeing it as a source of pleasure and individual identity subject to women’s own decision making about sexual expression and its place in their lives. The net impact was empowerment and an increase in autonomy.

► **Key quotes:**

“Despite the normative orientation of the family planning service [i.e., its mission to help married couples plan their families], women were actually making use of it to get information according to their own ideas of and needs for contraceptive solutions. . . . [T]he pill, as a technological innovation, was indeed a factor of empowerment that women were willing and ready to seize. . . . [T]he family planning service offered a greater degree of autonomy to those women and helped to widen their field of action answering a real demand, [helping] women to access means that allowed new sexual conduct. It thus provided a ‘space where social change could take place.’”

► **Assessment:**

This article is specific to the rise of a feminist sensibility and the sexual revolution in Geneva in the 1960s and 1970s and may seem at first glance scarcely related to the FPESA



[conceptual framework](#) (see page 8). It is more a narrative based on historical records of two organizations in this period than an empirical study. We highlight it because it is among a very small number of peer-reviewed papers that we identified that support the hypothesis that provision of family planning services can contribute directly to women’s empowerment.

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**Christina Ergas and Richard York, “Women’s Status and Carbon Dioxide Emissions: A Quantitative Cross-national Analysis,”** *Social Science Research*, vol. 41, no. 4 (July 2012), pp. 965–76, <https://doi.org/10.1016/j.ssresearch.2012.03.008>.

Testing the hypothesis that societies exhibiting greater gender equality are less damaging to the environment, the authors find that per capita carbon dioxide (CO<sub>2</sub>) emissions tend to be lower where women have higher political status, all else equal. They argue that this correlation strongly supports the need to involve women more effectively than currently in climate science and policymaking.

The first half of the paper offers a summary of existing evidence from around the world that women are more likely than men to want to protect the environment and to act in ways likely to do so. The authors speculate that this greater sensitivity to the environment is due not to “natural” or biological differences between the sexes, but to gendered socialization, through which women are more likely to care for children and to worry about their future and, in many societies, to work more directly with the environment and natural resources.





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► **Key quotes:**

“[C]onsiderable evidence from multiple nations suggests that women generally express different concerns than men with regards to environmental problems, are more risk averse, and are less optimistic about the potential to solve problems by relying solely on technical fixes. There is evidence that organizations and governments act differently when women are better represented in positions of power, and the rise of women’s status in a nation is associated with greater support for environmental protection. There are a variety of explanations for these gender differences, but multiple strands of theories suggest that greater gender equality in societies may help to curtail environmental degradation. . . .

“Unsurprisingly, it has been well established that population size and growth influence environmental impacts. . . . [W]omen’s political status has a respectably strong effect, . . . stronger than the effects of any variables other than GDP per capita in the models. Thus, it is not only the case that women’s political status has a statistically significant effect on CO<sub>2</sub> emissions; it is also the case that its effect is at least as substantial as several other factors that have been recognized as contributing to emissions. . . . Improving women’s status around the world may be an important part of efforts to curtail greenhouse gas emissions and prevent dramatic climate change from undermining the long-term prospects of societies.”

► **Assessment:**

This paper is among the few that provide empirical evidence supporting an important pathway in the FPESA [conceptual framework](#) (see page 8). This pathway suggests that by reducing the opportunity costs of unintentional child-bearing, family planning allows women to become more active in their communities and civil society, and that their greater participation—especially when supported by higher status—may help protect the environment.

Ergas and York unfortunately find no compelling evidence for mechanisms that would explain how higher status for women would mean lower CO<sub>2</sub> emissions in their societies. But the fact that the correlation that they find between the two is strong offers at least a stepping stone on a trail of evidence that family planning can benefit the environment, regardless of its impact on population growth. As a side

benefit, the paper offers a review of relatively recent literature suggesting that women are more likely than men to value and care for the environment, including some plausible reasons for why this might be the case.

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**Shah Md. Atiqul Haq, “Nexus Between Perception, Environment and Fertility: A Study on Indigenous People in Bangladesh,” *Sustainable Development*, vol. 21, no. 6 (November/December 2013), pp. 372–84, <https://doi.org/10.1002/sd.515>.**

A survey of 50 women and men in an indigenous village within a national park in Bangladesh demonstrated somewhat higher environmental awareness among women. This was in the context of overall low awareness in the village of connections between large family size and environmental impacts on the forest and park. A slightly higher share of women than men (8 percent versus 6 percent) agreed with the statement that “family planning can reduce fertility and lessen impacts on [the] environment in the future.”

► **Key quotes:**

“People who live in a forest area or rural area in developing countries basically depend on environmental resources for their livelihood and subsistence. The people have regular interaction with the environment and they understand changes of environmental factors in regards to land productivity, water level and biodiversity. Therefore, the local community should try to manage economic activities and population growth without damaging the carrying capacity of the environment where resources could be replenished for human and other forms of life for a long time.”

► **Assessment:**

Although both the sample size and gender attitude and knowledge differences reported are quite small, the paper has value in testing the views of indigenous people in a developing country, in this case Bangladesh. The responses modestly support the thesis that women tend to have somewhat greater awareness than men of environmental conditions and connections of family planning and fertility to them. Given the views that the author, a native of Bangladesh, expresses about these connections, the paper also supports our secondary





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hypothesis, that the family planning-environment linkage that we are studying is of interest to researchers in developing as well as developed countries.

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**Aaron M. McCright, “The Effects of Gender on Climate Change Knowledge and Concern in the American Public,”** *Population and Environment*, vol. 32, no. 1 (September 2010), pp. 66–87, <https://doi.org/10.1007/s11111-010-0113-1>.

U.S. women were modestly but consistently more concerned than men about climate change from 2001 to 2008, this study finds based on Gallup polling data in the period. Moreover, the author finds that “women exhibit more scientifically accurate climate change knowledge than do men”—although they also “tend to underestimate their climate change knowledge more than do men.” The study did not examine gender differences in behavior related to climate change.

► **Key quotes:**

Looking across the polls, “a greater percentage of women than men believe that global warming is happening now (59 percent to 54 percent) and is primarily caused by human activities (64 percent to 56 percent). Also, a greater percentage of women than men (66 percent to 60 percent) agree that most scientists believe global warming is happening.”

► **Assessment:**

Based on the reviews of pre-2005 literature found in the papers that we surveyed, there seems to be less research on gender differences and environmental attitudes and behavior published in 2005 and afterward than prior to that year. This paper was among the few that we found that identified and quantified such differences. Although the differences were fairly modest, their consistency in particular contributes to the evidence that women are more concerned than men about human-caused climate change.

Defying stereotypes about women’s interest in and understanding of science, this study finds that women were somewhat more knowledgeable than men about the science underlying the consensus that human emissions of greenhouse gases are dangerously warming the earth’s climate. Although the paper does not mention family

planning and does not consider gender differences in behavior, its findings on gender differences in attitudes and scientific understanding modestly support the thesis that women who are empowered by the use of family planning might become more active in climate change mitigation and adaptation.

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**Kari Norgaard and Richard York, “Gender Equality and State Environmentalism,”** *Gender & Society*, vol. 19, no. 4 (August 2005), pp. 506–22, <https://doi.org/10.1177/0891243204273612>. This paper was collaboratively assessed.

National parliaments with higher proportions of women members are significantly more likely than others to ratify environmental agreements, this paper concludes. Controlling for factors such as gross domestic product (GDP), development, population size, political rights, and urbanization across 130 nations, the authors constructed a model that succeeded in explaining more than two-thirds of the variation across countries in the ratifications of 16 environmental treaties occurring through April 1999. The model results led the authors to conclude that “gender variation has a stronger association with state environmentalism [defined here as ratification of the treaties] than any other factors except per capita GDP and population . . .”

As case examples illustrating the importance of gender in parliament, the authors compare Norway and Singapore, at similar levels of development but with widely varying records on both gender balance in parliaments and in ratification of environmental agreements. (Norway performs much better on both indicators.) The authors review ecofeminist and related theories for why gender equality might favor environmental protection, but acknowledge that their results do not offer evidence for any specific theories. (See Perspective, “Are Women More Environmental?,” on page 36.)

► **Key quotes:**

“If women tend to be more environmentally progressive, the inclusion of women as equal members of society—as voters, citizens, policy makers, and social movement





participants—should positively influence state behavior. . . . [G]ender equality may affect behavior of both women and men, creating an atmosphere in which environmentally progressive state behavior is viewed as positive. . . . If women both perceive environmental risks as greater and are less willing to impose these risks on others, higher status of women may lead to more environmentally progressive policies as women put their views and values into action.”

► **FPESA network assessments (two total)**

were neutral-to-uncertain about the value of this paper. One assessment noted that the authors established a correlation between female representation in parliaments and ratification of environmental treaties but did not contribute evidence or suggest mechanisms by which that representation helped drive the ratifications. More useful than this kind of crosscutting study (i.e., comparing widely varying countries and governments to each other), this assessor suggested, would be longitudinal studies that examined the relationship between women’s representation in parliaments and environmental agreements over time.

► **Overall assessment:**

We identified few papers that shed light on our sub-hypothesis that empowered women are more likely than men on average to promote environmental sustainability. This paper provides valuable evidence of an intriguing correlation that lends support to that thesis. Moreover, it includes a valuable summation of some past literature related

to ecofeminist theory on why gender equality might support environmental protection.

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**Saseendran Pallikadavath et al., “Post-sterilization Autonomy Among Young Mothers in South India,” *Journal of Biosocial Science*, vol. 47, no. 1 (January 2015), pp. 75–89, <https://doi.org/10.1017/S002193201300059X>.**

Currently married women younger than 30 in south India who had undergone sterilization had “significantly higher autonomy in household decision-making and freedom of mobility compared with women who had never used any modern family planning method,” these authors find. They base their conclusion on data from India’s *National Family Health Survey*, carried out in 2005 and 2006, supplemented by interviews in one village each in the states of Tamil Nadu and Kerala. The authors report that women sterilized at early ages in effect jumpstarted the social status generally reserved for older women in their areas. The paper calls for policies to “capitalize on women’s autonomy and free time resulting from early sterilization and low fertility.”

► **Key quotes:**

“Accepting sterilization after having the desired number of children . . . increased women’s autonomy within marriage—particularly with husbands. In Tamil Nadu, having fewer





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children enabled women to work more hours . . . and thus contributed significantly to the family economy. . . . Women had significant control of the money they earned and most of them had bank accounts. . . . Husbands in this study reported consulting their wives before making any important decisions. Women in Tamil Nadu in these circumstances also had greater freedom to visit places within and outside the village. . . .

“The findings of this study have important policy implications as female sterilization continues to dominate family planning in India; age at female sterilization continues to decline, and sterilization takes place with fewer children. While women should be given choice of family planning methods, the potential social merits of female sterilization should not be understated. Policies and programmes are needed to tap the autonomy benefits of female sterilization for women’s further education and employment. This could include flexible age criteria for entering jobs in the government sector and relaxed criteria for entering and completing formal courses in colleges and universities.”

► **Assessment:**

The paper raised eyebrows among the FPESA project team, with findings that support a potentially controversial hypothesis. Defying common sensitivities about sterilization and especially young age at sterilization, possibly influenced by external pressure, the authors find benefits of the practice for women’s status and empowerment within their families. Both women’s decision-making capacity and their mobility increased shortly after undergoing sterilization, the authors report. The sequence leaves little likelihood of causation in the reverse direction, i.e., that higher autonomy made early sterilization more likely.

The authors describe some of the attitudes that led to the popularity of female sterilization, including men’s inaccurate belief that male contraception will make it harder for them to perform physical work. They also reported that the two-child family norm was common in the study areas of Kerala and Tamil Nadu, with parents believing they could provide “better education and a good standard of living” to this many children and no more.

The authors leave some ambiguity on the voluntarism associated with women’s choice of sterilization for family planning. On the one hand, they state that “poor women in both the

villages [where qualitative data was collected] were influenced by free provision of the sterilization operation.” Most received monetary benefits for undergoing the operation. On the other hand, the authors report that “women preferred to undergo sterilization to protect their health from the harmful effects of repeated pregnancies.” In their conclusion, the authors make clear their own belief that “women should be given choice of family planning methods.”

The paper is among the few that the FPESA project identified documenting that family planning can lead to women’s empowerment. This makes it especially relevant to the empowerment pathway of the FPESA [conceptual framework](#) (see page 8) from family planning to environmental sustainability. The findings offer evidence that family planning—in this case, sterilization under conditions of low fertility in one region of India—can contribute directly to improved status and autonomy for women.

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**Anita Raj et al., “Prevalence of Child Marriage and Its Effects on Fertility and Fertility-control Outcomes of Young Women in India: A Cross-sectional, Observational Study,” *The Lancet*, vol. 373, no. 9678 (May 2009), pp. 1883–89, [https://doi.org/10.1016/S0140-6736\(09\)60246-4](https://doi.org/10.1016/S0140-6736(09)60246-4).**

Among a sample of nearly 15,000 women in India age 20–24 years who had ever wed, marriage before age 18 was significantly associated with high fertility, multiple unwanted pregnancies, repeat childbirths in less than 24 months, non-use of contraception before first birth, and female sterilization, these authors calculate. They call for increased enforcement of existing policies to prevent child marriage. (Marriage prior to age 18 has been illegal in India since 1978, but its occurrence among girls is nonetheless widespread.) The authors declare that improved family planning access, education, and support are “urgently needed”—not only for women married before age 18, but for their husbands and families—“to reduce the high fertility and poor fertility outcomes” among those married before age 18.

► **Key quotes:**

“Our study shows that nearly half of adult Indian women aged 20–24 years were married before the legal age of





18 years, with rural, poor, less educated girls. . . most vulnerable to the practice. . . . The reported prevalence of child marriage is consistent with previous research in India and represents a 5 percent reduction compared with national data from 1998–99, suggesting that the practice of early marriage in India is slowly decreasing. Nonetheless, the prevalence of child marriage remains unacceptably high. More than one in five women aged 20–24 years, about half of those married as children, were married before 16 years of age. . . .

“These results suggest that neither recent progress in economic and women’s development, nor existing policy or programmatic efforts to prevent child marriage and promote maternal and child health, have been sufficient to reduce the prevalence of child marriage in India to that of most other developing nations. . . . These women are more likely than those who are married as adults to report early, frequent, and unplanned pregnancies, typically from lack of contraceptive use. . . . India should establish reduction of child marriage as an essential element of programmes and interventions to build on the existing priorities of family planning and maternal and child health.”

► **Assessment:**

Even as the prevalence of child marriage has decreased modestly in recent years, global attention to its impact on the human rights and the health of tens of millions of girls and young women has grown. This makes research on the practice and its consequences all the more important. Although the direct impacts on individual girls and women is understandably the main focus of interest, the effects on their child-bearing have implications for the wider world as well.

This paper is a rare example of peer reviewed research that lends support to both the demographic and non-demographic pathways in the FPESA [conceptual framework](#) (see page 8). Clearly, if child marriage could be ended, the impacts on fertility—not just reducing unintended pregnancies, but delaying intended ones to later years in women’s lives—would slow population growth. At the same time, such a development would be a powerful contributor to improved opportunities and greater autonomy for women. By emphasizing the importance of family planning for women married prior to their 18th birthdays, the authors also make clear the importance of this for lower fertility and later childbearing along with better chances of health and well-being.

## Climate Change

**Sajini F. Iwejungi, “Demographic Change and Climate Change: The Nigerian Experience,” *Journal of Environment and Earth Science*, vol. 3, no. 1 (2013), pp. 80–85, <http://www.iiste.org/Journals/index.php/JEES/article/view/4009/4063>.**

This author announces as the “broad objective” of her paper “to establish a link between demographic change and climate change in Nigeria.” Conceding that “the method employed is fundamentally descriptive,” she assembles evidence for both her country and the world that population growth and such activities as oil extraction, gas flaring, agriculture, and deforestation are causing climate change in Nigeria “as opposed to natural causes.” She calls for family planning, delayed marriage, government encouragement of families of three children “to a couple and not just to a woman,” and “improving the economic status of women” to slow the growth of population.

► **Key quotes:**

“[I]n the long term, lower fertility will lead to a reduction in . . . greenhouse gas emissions. However, it is important to note that lower fertility is associated with economic development. Therefore efforts to limit the growth of human population in Nigeria must go hand in hand with efforts to achieve low carbon paths of development. That includes reducing the consumption of fossil fuels such as oil, gas and coal so as to curb the adverse effects of climate change.”

► **Assessment:**

This paper is not an empirical exploration of data but rather a critical look at the global and Nigerian forces that contribute to greenhouse gas emissions and that undermine climate change adaptation and resilience. The author marshals her findings to urge the slowing of Nigeria’s population growth, based on the argument that it contributes to climate change in Nigeria and worldwide and hampers efforts to adapt to the impacts of climate change. The author makes specific proposals to achieve slower growth. These are rooted in individual choice and reproductive rights, although she calls at one point for





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“social pressure” to encourage families of three or fewer children. The paper’s authorship by a Nigerian woman supports the FPESA project’s secondary hypothesis, on the diversity of interest in the family planning-environment link.

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**Inmaculada Martinez-Zarzo et al., “The Impacts of Population on CO<sub>2</sub> Emissions: Evidence from European Countries,” *Environmental and Resource Economics*, vol. 38, no. 4 (December 2007), pp. 497–512, <https://doi.org/10.1007/s10640-007-9096-5>.**

Population growth appears to have a significant impact on carbon dioxide emissions in countries that recently joined the European Union (EU), these authors find. By contrast, it has a “non significant” impact in those countries that have been in the EU since 1995. For every 1 percent of population growth between 1975 and 1999 in eight countries that joined the EU in 2004 (e.g., the Czech Republic, Hungary, and Poland), CO<sub>2</sub> emissions grew 2.73 percent, according to the paper’s analysis. In 15 countries that were members of the EU since 1995 (e.g., Germany, the United Kingdom, and France), a 1% increase in population led to only a 0.55% increase in emissions.

These different impacts apparently stemmed from such trends as less-rapid growth of energy-intensive economic sectors among the older EU states during the study period. The authors compared a variety of past studies on the relative impact of population growth on emissions growth and called for more attention to this factor—in combination with economic structure and changes in per capita GDP—in policy development on climate change mitigation. Their model did not allow them to predict any emissions changes resulting from population decrease, currently occurring in a few EU member states.

► **Key quotes:**

“A great number of studies confirm an overall upward trend in global emissions along the last decades that share two characteristics. First, emissions have grown faster than population and second, this relationship is more pronounced for developing countries than for developed countries. . . . [Our] results indicate that a review of the [EU] emissions policy that takes into account the characteristics of the new EU members, would be desirable.”

► **Assessment:**

This paper is worth studying despite serious shortcomings. Its methodology is accessible only to those well-versed in statistics. The authors are so careful in their caveats concerning data gaps and uncertainties in their model that they appear less than fully confident in their findings. The policy target at which the research is aimed is the Kyoto Protocol, which the EU both ratified and championed but which is no longer a guiding force in climate change mitigation policy. Yet the paper succeeds in advancing analytical methods for understanding what forces influence countries’ greenhouse gas emissions and drawing some important conclusions that will gain importance as governments become more serious about curbing emissions. Although the article mentions neither population policy nor family planning, it offers a rare focus on population dynamics and the environment in Europe. By looking at population’s relationship to climate change strictly within the EU, the paper also avoids complicating controversies surrounding developed- versus developing-world contributions to human-caused climate change.

The paper’s central conclusion that population change has different magnifying effects on emissions in different countries, depending on development level and economic structure, is an important reminder. These factors require careful comparison in well-crafted models that consider individual regional and country specifics. The finding that CO<sub>2</sub> emissions tend to respond more to population growth in less economically advanced newer members of the EU may be useful for considering population’s influence on emissions in developing versus developed countries generally. The authors’ effort to refine the classic IPAT equation, in which environmental impact equals population times affluence times technology, is even more important today than when their paper was published in 2007. The 175 countries that signed the Paris accord on climate change on April 22, 2016 will need such analytical help in weighing how to turn their voluntary emissions-reduction pledges into real action in the years ahead.

The paper also includes a useful overview of research going back to the 1970s on how population change might affect the environment. It offers a detailed description of the STIRPAT equation that is increasingly used in models like the one used in this research. (STIRPAT stands for





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“stochastic impacts by regression on population, affluence, and technology.” It is a more rigorous statistical update of the IPAT equation. Moreover, in the only such example that the FPESA project encountered in a peer-reviewed paper, the authors include a brief annex on legislation relevant to their findings, with information on how to access legislative details. That adds policy relevance to their work.

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**Paul A. Murtaugh and Michael G. Schlax, “Reproduction and the Carbon Legacies of Individuals,”** *Global Environmental Change*, vol. 19, no. 1 (February 2009), pp. 14–20, <https://doi.org/10.1016/j.gloenvcha.2008.10.007>.

Under medium scenarios of future fertility and carbon emissions, having a child generally leads to the addition of many times the amount of emissions that an individual personally contributes during her or his lifetime, these authors calculate. As a supplement to advice on how lifestyle decisions can reduce an individual’s lifetime emissions, this paper proposes adding responsibility for the impacts of what could be called a reproductive “afterlife”: those emissions caused by each biological child and that child’s descendants until the original parent’s genetic line dies out. The authors estimate ranges for what they call “legacy” emissions—those that an average individual can expect to be effectively responsible for in having a child—in the 11 most populous countries in the world.

For the United States, having a child multiplies such emissions by 5.7 times the individual’s own lifetime emissions, assuming middle-range fertility and emissions projections. In Japan, which has lower per capita emissions and a lower fertility rate than the United States does today, the average projected legacy emissions would be 2.4 times per child. The calculations are based on a pro-rata calculation of surviving descendants’ emissions based on their genetic connection to the original parent—i.e., half a child’s emissions are assigned to the parent, one-quarter a grandchild’s, and so on, until there are no further descendants. (See Figure.) Average lineages in the model last about four centuries before a parent’s last descendant dies without reproducing, based on the fertility and life-expectancy projections for each of the 11 countries.

The authors use these calculations to show that having a child causes long-term emissions additions that much more than offset any emissions savings from plausible behavior changes during one’s lifetime. They conclude that such behavior changes are no less needed, because their impact is more immediate than those of legacy emissions. They nonetheless call for more attention to the climate change impacts of long-term emissions legacies that result from reproduction.

► **Key quotes:**

“Our basic premise is that a person is responsible for the carbon emissions of his descendants, weighted by their relatedness to him. . . . Under the constant-emissions scenario, the average emissions added by having a single child range from 56 tons (Bangladesh) to 9,441 tons (United States). . . . Clearly, the potential savings from reduced reproduction are huge compared to the savings that can be achieved by changes in lifestyle. . . .

“This is not to say that lifestyle changes are unimportant; in fact, they are essential, since immediate reductions in emissions worldwide are needed to limit the damaging effects of climate change that are already being documented. The amplifying effect of an individual’s reproduction documented here implies that such lifestyle changes must propagate through future generations in order to be fully effective, and that enormous future benefits can be gained by immediate changes in reproductive behavior.”





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► **Assessment:**

The idea that having a child will affect future environmental impacts is hardly new to discussions of humans’ impacts on the environment. This is the basis of most attempts to calculate the impact of population growth on climate change, water scarcity, and other kinds of environment change or natural resource availability. What makes this paper unusual is the authors’ emphasis on an individual parent having a single new child, with calculations of what they call the “legacy” of such an instance of childbearing. So far as the FPESA project has been able to determine, this is the first use of the concept of a legacy effect, which was later used by Usman Khan and Jim A. Nicell, 2014 (see annotation on page 61), to study the impact of contraception on estrogen pollution.

Although the overall methodology and message of this paper may be controversial—some may disagree with the premise that parents are responsible for their descendants’ environmental behavior and impacts—this is an important, possibly even a landmark, paper. Individual reproductive decisions and behavior are central to the thesis that feasible differences in future population size will have significant long-term effects on the environment, a key FPESA sub-hypothesis.

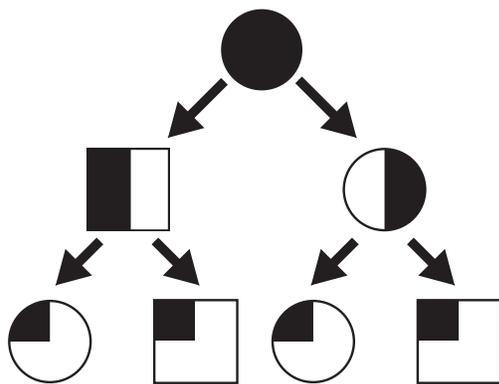


Illustration of the propagation of genetic units in a family tree. Circles indicate females, and squares indicate males. The original female has one daughter and one son, each of whom also has one daughter and one son. The blackened areas indicate the number of genetic units (a total of one in each generation in this example).

*Illustration from the paper (page 15). Used by permission.*

The idea that parents leave an environmental legacy through reproduction is simultaneously logical yet questionable when applied quantitatively. Can assumptions about fertility and per capita emissions be meaningful four centuries into the future? Perhaps not. Yet through such imaginative efforts, researchers can provide some measure of how individual reproduction and fertility may matter to the environment that future generations experience. The quantification of environmental legacy is unlikely to be valid in considering how family planning may affect environmental sustainability, but the concept itself is valid. This paper pioneers in its exploration.

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**Brian C. O’Neill et al., “Global Demographic Trends and Future Carbon Emissions,” *Proceedings of the National Academy of Sciences*, vol. 107, no. 41 (12 October 2010), pp. 17521–26, <https://doi.org/10.1073/pnas.1004581107>. This paper was collaboratively assessed.**

Perhaps the most widely cited peer-reviewed paper in the past decade on population-environment connections, this work projects that a low trajectory of world population growth could contribute between 16 and 29 percent of the carbon dioxide emissions savings needed by 2050 to avoid a 2-degree Celsius warming of the global climate. This is in comparison to a projected middle path of growth. Such an emissions savings is broadly equivalent to what would be saved by ending all deforestation by the same year.

By 2100, the low-growth trajectory would reduce global CO<sub>2</sub> emissions by between 37 and 41 percent. The estimates are based on a model integrating population, economic, and technological trends. The authors also consider the impacts of urbanization and population aging on changes in greenhouse gas emissions. Neither of these factors influenced emissions changes as did feasible variation in population growth.

The authors also consider the role of family planning in achieving a low population growth trajectory. They cite a 1995 U.S. government estimate that fully meeting the unmet need for family planning in the United States





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would reduce fertility there by 0.2 children per woman. And they independently estimate that meeting this need would reduce fertility by 0.6 to 0.7 children per woman in developing countries. Although the average person in developing countries contributes much less to CO<sub>2</sub> emissions than the average person in developed countries, both regions would contribute far less emissions in this century on the lower population growth trajectory.

► **Key quote:**

“Family planning would have a substantial environmental benefit.”

► **FPESA network assessments (three total)**

found the article to be scientifically strong and compelling, although two assessors expressed concern that the model was not fully explained or easily comprehensible, making the calculations and the paper hard to follow for the lay public. One assessment noted as well that the United Nations population projections that were the basis for the paper have since been superseded by later projections that would likely affect the emissions calculations. This is a common problem in scientific literature based on population data that are in a state of constant change. (See illustration from this paper in Perspective, “[Convince Them to Say It](#),” on page 39.) See also the annotation for the related [Brian C. O’Neill et al., 2012](#), below.)

► **Overall assessment:**

From its ambitious conception to its careful modeling and quantification of demographic impacts on emissions, this paper deserves the fame it has garnered. Its communications value could have been improved by clearer, more accessible writing and explanation, although the concepts and findings are not simple ones to convey. By virtue of its mathematical sophistication, the results obtained, and the articulation of its implications for family planning policy, this paper is in the top tier of relevance among papers assessed in the FPESA project. It strongly supports the hypothesis that family planning promotes environmental sustainability. The authors hope to refresh the paper’s model with newer data, comparing the results to the original paper, which would be valuable.

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**Brian C. O’Neill et al., “Demographic Change and Carbon Dioxide Emissions,” *The Lancet*, vol. 380, no. 9837 (14 July 2012), pp. 157–64, [https://doi.org/10.1016/S0140-6736\(12\)60958-1](https://doi.org/10.1016/S0140-6736(12)60958-1).**

This paper complements [Brian C. O’Neill et al., 2010](#) (see annotation) in offering alternative approaches for testing the likely impact of slowing population growth on carbon dioxide emissions. Based on both “back-casting” through examining past correlations between the two trends and on scenarios for future population and emissions change, the authors conclude that “slow population growth would probably . . . have climate-related benefits.” The authors also find emissions growth to be “closely proportional” to population growth, with significant but less-proportional effects from urbanization (which increases emissions) and population aging (which decreases them). They project similar savings in emissions from lower population paths to those identified in the earlier paper. (See Figure.)

► **Assessment:**

This paper supplements and adds value to [Brian C. O’Neill et al., 2010](#), both by describing a wider range of earlier research on population and climate change and by considering historic correlations that strengthen the likelihood that demographic and climate trends are closely linked. “Global Demographic Trends . . .,” however, remains the stronger paper, based as it is on calculations emerging from a comprehensive model that takes multiple population dynamics, economic trends, and technologies into account.

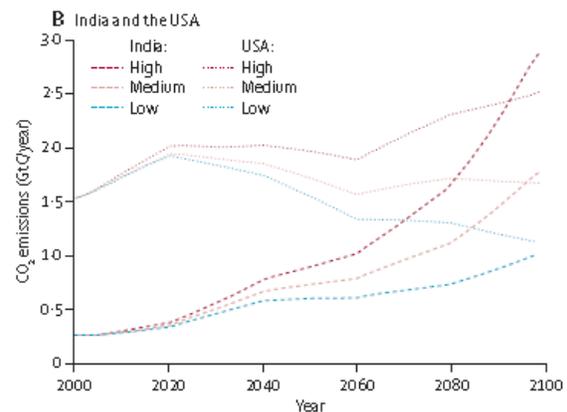


Illustration from the paper (page 161). Used by permission.





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**David Satterthwaite, “The Implications of Population Growth and Urbanization for Climate Change,” *Environment & Urbanization*, vol. 21, no. 2 (October 2009), pp. 545–67, <https://doi.org/10.1177/0956247809344361>.**

Between 1980 and 2005, there was little association between rapid population growth and either high emissions or rapidly growing emissions of carbon dioxide, this paper concludes. Comparing emissions and population growth rates by country during that period, the author demonstrates that those countries with the most rapid population growth also had per capita emission levels that were very low and that were mostly growing slowly or not at all. He argues against extreme positions on the linkage of family planning, population, and climate change. While pointing to a “shared abhorrence [by most commentators on this linkage] for past coercive ‘population control’ measures,” he supports “everyone’s right to and need for good quality, available, affordable sexual and reproductive health services that includes family planning.”

► **Key quotes:**

“[I]t is not the growth in (urban or rural) populations that drives the growth in greenhouse gas (GHG) emissions but rather, the growth in consumers and in their levels of consumption. . . . If the lifetime contribution to GHG emissions of a person added to the world’s population varies by a factor of more than 1,000 depending on the circumstances into which they are born and their life choices, it is misleading to see population growth as the driver of climate change.”

► **Assessment:**

This paper deserves credit as a peer-reviewed quantification of the argument that population growth matters little to climate change, because those populations that are growing the fastest tend to have the lowest per capita emissions. The FPESA project focused on this work as potentially undermining FPESA’s primary hypothesis. The author successfully quantifies and validates the paper’s key point—that lower fertility correlates globally with higher per capita greenhouse gas emissions. This correlation reduces the likelihood of significant near-term emissions reductions if family planning succeeds in reducing family size in high-fertility countries.

But the author seems to define “population” as only the number of people in low-income countries and equates population growth with rapid population growth. Contrasting growth in population with growth in consumers is puzzling, as consumers are certainly a population, and one that is a large and expanding share of the world’s growing total. No recent peer-reviewed literature that the FPESA project uncovered posited “population growth as the driver of climate change,” although perhaps other writings have done so.

The author’s findings underline the importance of avoiding overstatement in advocating family planning to help slow climate change, but the findings neither undermine nor support the FPESA hypothesis. The paper does not demonstrate that lower fertility among consumers or any other sub-population would be irrelevant to future human greenhouse gas emissions. This is especially noteworthy given the need for economic development accompanied by emissions growth in the lowest-emitting, fastest-growing populations—a need that the author supports in the paper.





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# Water

**W. Buytaert and B. De Bièvre, “Water for Cities: The Impacts of Climate Change and Demographic Growth in the Tropical Andes,” *Water Resources Research*, vol. 48, no. 8 (August 2012), pp. 1–13, <https://doi.org/10.1029/2011WR011755>.**

Exploring the likely future of water supply to four capital cities in South America’s Andes mountains—La Paz, Lima, Quito, and Bogotá—the authors conclude that “expected demographic changes are very likely to outpace the impact of climate change on water availability and should therefore be the priority for local policymaking.” (See Figure.) Climate change is projected to modestly increase precipitation in and around these cities, although higher temperatures will cause more water to evaporate, offsetting any increase in precipitation and exacerbating any decrease.

The researchers find that a more likely source of significantly diminished per capita freshwater availability will be the greater than 2 percent annual population growth occurring and projected—as a result of natural increase and migration—in all of the cities and the nearby areas from which they draw their water. The authors call for more-detailed research on population change in the study cities and urge “mobilizing new water resources in the near future” as a management strategy to respond to the projected impact of population growth on water availability in the four cities.

► **Key quotes:**

“From the analysis in this paper, it is clear that the stress on water resources in the major cities in the tropical Andes will increase markedly in the future. The main driver of the increased stress, however, is population growth, which may increase water demand by up to 50 percent in 2050. The impact of climate change is much more uncertain. But despite the uncertainties in the climate projections, the combination with population growth is very likely to result in decreasing water availability per capita.”

► **Assessment:**

Despite public and news media presumptions that future water scarcities will be driven by human-caused climate

change, those papers that the FPESA project surveyed that quantitatively compared the impacts of climate change and population growth identify the latter as the more-likely and larger influence. This is due in part to the complexities of how warmer temperatures in different places will alter water supply through changing precipitation, evaporation, and plant transpiration. That contrasts with the near certainty that growing populations will significantly raise demand for finite supplies of renewable fresh water.

The authors shed light on this logical assertion by considering both population and climate projections for four tropical big cities in the Andes. They note that these cities may not be typical of others around the world, but that they demonstrate quantitatively two key points: 1) that climate change could increase or decrease the water supply, with uncertain net impacts on availability, and 2) that projected population growth will more reliably raise the demand for fresh water, decreasing the per capita supply no matter how climate change affects precipitation and evaporation.

Few papers build on this conclusion or recommend any specific policies that might slow the growth of demand from population increase (which, in the case of the study cities, owes much to migration from nearby rural areas). This paper is no exception, calling for increasing the supply and storage of water to meet the future growth in demand that is likely to occur, whether complicated or not by climate change.

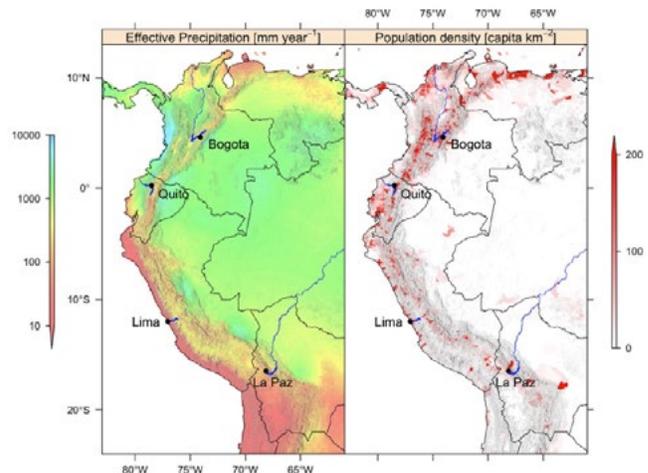


Illustration from the paper (Figure 1, page 3 of 13). Used by permission.





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**Richard C. Carter and Alison Parker, “Climate Change, Population Trends and Groundwater in Africa,”** *Hydrological Sciences Journal*, vol. 54, no. 4 (2009), pp. 676–89, <https://doi.org/10.1623/hysj.54.4.676>.

While the effects of climate change on African groundwater are likely to be significant, they are uncertain in both direction (they could decrease or increase the amount of water in aquifers) and magnitude, these authors conclude. Based on a review of climate and population projections for the continent, they find the impact of demographic change to be more likely and larger than that of climate change. Roughly half of Africa’s population currently relies on shallow or deep groundwater, they estimate. And they note that development increases per capita water use for hygiene, food security, and improved livelihoods.

Comparing scenarios of climate change without population growth, and scenarios of population growth without climate change, the authors find much more impact on groundwater from the latter. The combination of population growth and urbanization with rising food demands and energy costs will “dwarf the likely impacts of climate change on groundwater resources, at least in the first half of the 21st century,” they write.

► **Key quotes:**

“Africa’s population is increasing rapidly [and] will place massively increased and concentrated demands on water resources, both for domestic and industrial use in the towns and cities, and for agricultural use in the rural areas and urban fringes. This increase in demand is likely to dwarf any likely reductions in renewable fresh water resources consequent upon climate change. . . .

“Research into the likely future impact of climate change on groundwater recharge is needed, but an equal priority should be placed on: (i) monitoring of groundwater levels over the long term to establish actual change, as a reality check on models and projections; (ii) developing sound conceptual and quantified models that explicitly link climate variability and change, population growth and water demand, land use and land cover change, hydrology and water resources; (iii) quantifying likely future urban and agricultural demands

on fresh water resources, and on groundwater in particular; (iv) finding environmentally and functionally sustainable solutions for the present and near-future water emergency represented by the massively expanding need for domestic, industrial and (especially) agricultural water in Africa.”

► **Assessment:**

The availability of fresh water for present and future generations reflects a complex combination of multiple factors that are hard to untangle and project for the future. Groundwater is especially challenging, with inadequate data on current supplies around the world and gaps in understanding about the mechanisms and time scales for recharging groundwater supplies as they are drawn down for irrigated agriculture and other uses. This paper explores these questions in detail, considering, for example, how climate change might alter not just the amount of rainfall in Africa, but its timing and intensity. These strongly influence how much water runs off in surface streams and how much it recharges aquifers.

Given the uncertainty in projections on how climate change will affect Africa’s groundwater, the authors place far more confidence in population projections, which indicate much faster growth in Africa than in any other major world region throughout the 21st century. More people, and especially more urban residents, they reason, will place far more demands on groundwater, especially as the continent industrializes and its agriculture relies increasingly on irrigation.

The paper may be subject to criticism based on strong subjective wording (they call their findings “cause for alarm” three times) and on the authors’ obvious concern about the risks of Africa’s rapid population growth. Skeptical readers might wonder if their research is subject to a predetermined conclusion. We found no evidence that this was the case, however. In their analysis of available data and the logic of their argument, the authors point the way for future research comparing potential determinants of future water supply and demand. They may place too much confidence in population projections, however. These do attract more scientific consensus than do the more-diverse projections of climate change impacts, which rely on a range of possible emissions scenarios interacting with natural systems that are still not well understood. Population, however, is also subject to unpredicted developments and could unfold differently than expected.





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**Yongbo Liu and Yanning Chen, “Impact of Population Growth and Land-Use Change on Water Resources and Ecosystems of the Arid Tarim River Basin in Western China,” *International Journal of Sustainable Development & World Ecology*, vol. 13, no. 4 (2006), pp. 295–305, <https://doi.org/10.1080/13504500609469681>.**

Stream flow in the headwaters of the Tarim River increased over the last three decades of the 20th century, even as flow declined in the river’s main stem, the authors find. “This implies that human activity, rather than climate change, dominated the recent environmental changes in the river basin,” they state. The human activity causing water shortage, they conclude, results from population growth and cultivated land expansion downstream from the Tarim’s headwaters. Other impacts are water pollution, loss of vegetation, soil salinization, desertification, and dust storms.

► **Key quotes:**

“Large population growth and cultivated land expansion in the upper reaches of the river have created heavy pressures on water and land resources in the river basin and dramatically reduced the volume and quality of water to downstream reaches. . . . [M]ore scientific research is needed to provide valuable technical support for government policymaking and sustainable development in the river basin [including on] environmental consequences of changes in population, land use and economic development.”

► **Assessment:**

Dealing with changes in one river basin, this paper illustrates a simple methodology that can be used to determine whether climate change or human activity relating to local population growth are more causally related to water shortage. The authors measure headwater stream flow and find it increasing, indicating that water supply is not the problem for this basin. If climate is changing over the three decades of study, it apparently has been increasing, rather than shrinking, supplies of fresh water.

Yet water shortage and attendant human and environmental impacts have been acute in the watershed, leading the authors to blame population growth and attendant increases in human activities requiring water withdrawal and consumption. The

Tarim River basin may be an extreme example of human demand overwhelming any water supply volatility from climate change in a watershed. In theory, nonetheless, the authors’ analytic methodology could be applied in any watershed to compare water supply and demand trends and allocate relative causation of water shortage between climate change and growth of human demand, much of it related to increases in population in the watershed.

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**Robert I. McDonald et al., “Urban Growth, Climate Change, and Freshwater Availability,” *Proceedings of the National Academy of Sciences*, vol. 108, no. 15 (12 April 2011), pp. 6312–17, <https://doi.org/10.1073/pnas.1011615108>. This paper was collaboratively assessed.**

By 2050, population growth in developing-world cities will multiply the number of urban dwellers who are perennially short of water nearly sevenfold, from today’s 150 million to 1 billion people, this paper concludes. Much higher numbers would face seasonal shortages, based on one published indicator of per capita water shortage. Examining the availability of fresh water within urban areas—and ignoring water delivery, quality, and use efficiency—the authors compared demographic and climate change scenarios for cities of more than 100,000 people and applied these to how the availability of fresh water would change for each urbanite from 2005 to 2050. The threshold of shortage used was 100 liters of water per person per day for all social uses, from manufacturing to flushing toilets.

The scale of population growth was much more important than climate change in causing water shortage, with the latter force contributing an additional 100 million people to the water-short category by 2050. The dramatic increase in urban water shortage by mid-century, the authors note, could mean that the ecosystems of rivers feeding many developing-country cities would no longer function, resulting in a significant loss of biological diversity. On a positive note, the authors note that it is easier to project population growth than climate change impacts on water supply, which makes it easier to plan ahead for future shortages.





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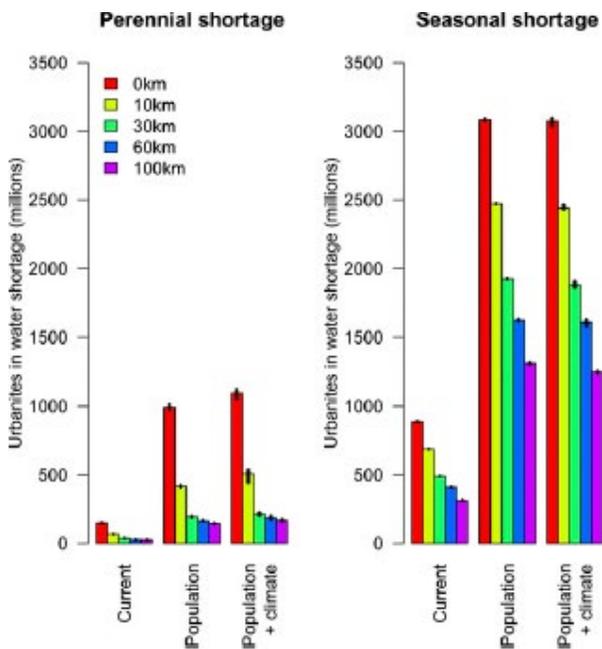


Illustration from the paper (Figure 1, page 2 of 6). Used by permission.

► **Key quotes:**

“Climate change does not greatly change the aggregate number of urban residents facing seasonal shortage, although the effect for particular cities may be large. . . . Our model results suggest that population growth will have a large effect on urban water shortage.”

► **FPESA network assessments (10 total)**

were generally positive, although some called attention to unanswered questions. Is urban population increase more from natural increase or from in-migration from rural areas? Could water be better managed or used more efficiently? One assessor questioned the paper’s relevance to the FPESA primary hypothesis, since even in a world of near-universal use of family planning and small families, urbanization would still bring more people to water-short metropolitan areas. (While true, the point misses the value of research that aims to better understand precisely how population growth may cause a shortage of a critical natural resource. A key objective of the FPESA project is to identify such research.) Although the authors made clear their intention to analyze solely water availability rather than delivery, quality, or the possibilities for greater use-efficiency, the failure to consider these topics weakened the paper’s strength and relevance in the eyes of a few assessors.

► **Overall assessment:**

Despite legitimate concerns about using rigid thresholds of water shortage to project future water shortages, the paper is valuable for demonstrating quantitatively how forcefully population growth can bring on scarcity of this critical but finite natural resource. If a critical minimum per capita need for any finite natural can be established, growth in population means a diminution in the share available to each person—until, at some point, the available share sinks below the minimum threshold, resulting in a determination of scarcity.

As other annotations in this subsection indicate, this paper is one among several in the FPESA database that conclude that population change matters more than climate change to a sustainable balance between humans and critical natural resource bases. The paper’s conclusions are all the more important both because the world’s population is more than half urban and projected to continue urbanizing in the future, and because water shortage is often attributed in the news media and elsewhere as resulting from climate change rather than from growth in population.

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**Emmanuel Obuobie et al., “Assessment of Vulnerability of River Basins in Ghana to Water Stress Conditions Under Climate Change,” *Journal of Water and Climate Change*, vol. 3, no. 4 (December 2012), pp. 276–86, <https://doi.org/10.2166/wcc.2012.030>.**

Without any impacts of climate change, the White Volta River basin will reach a state of water scarcity by 2050 due to population growth, the paper projects, while the Pra River basin will reach absolute water scarcity by the same year. (These water classifications are based on benchmark ratios of available renewable fresh water per person per year developed by Swedish hydrologist Malin Falkenmark in the 1990s.) Climate change is expected to raise temperatures in both watersheds and will aggravate the projected shortages of water. The authors call for measures to slow population growth and to improve water management in the basin.

► **Key quotes:**

“Population growth, obviously, needs to be controlled in the two basins. This could be achieved through the





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promotion of and accessibility to family planning services, female education and empowering women to take up income-generating activities that bring them direct income. It is generally known that educated women delay child-bearing and usually have fewer children compared to the uneducated. Also, women involved in activities that bring them direct income tend to have fewer children as they perceive child birth to be major interruption to income generation. . . . [R]esults further indicate that population growth is likely to contribute much more strongly to water shortage than climate change [is likely to].”

► **Assessment:**

Falkenmark developed her water availability benchmarks based on developing countries’ experience with development in the second half of the 20th century, so there is some question about how applicable the benchmarks are or will be to individual watersheds in the 21st century. Nonetheless, the benchmarks represent a widely used measurement of renewable freshwater supply over time from precipitation. (The benchmarks are relevant to groundwater supplies only to the extent that these are renewable, i.e., refilled by precipitation.) Since the benchmarks are based on the ratio of renewable fresh water to an area’s population, it is not surprising that applying them to watersheds would show a strong impact of population growth in those watersheds. The calculation nonetheless reflects an important truth that is unaffected by improved water-use efficiency or new water technologies: renewable water supplies do not vary much, and, as populations grow, there is less water overall for each person to share.

As this paper illustrates, applying Falkenmark’s benchmarks can be useful in projecting future water supply in any country or watershed, helping to determine the relative impacts of current and projected population growth, with or without climate change. While this paper recommends “population control,” it is apparent from the details of their recommendation that the authors do not mean the term to imply coercive measures to slow population growth. Nor do they limit their recommendations to addressing population, as they also call for “water use efficiency, water conservation, conjunctive groundwater-surface water use and maintenance of environmental integrity.”

More problematically for their findings, the authors appear to project future populations assuming continued

growth at current rates, rather than based on plausible assumptions that fertility will decline and growth will slow. Their calculations thus may overstate the impact of population growth on the watersheds’ water supply. The use of questionable demographic methodology and population policy terminology in this otherwise incisive paper helps illustrate the need for expansion, standardization, and education in population-environment research.

## Biodiversity

**Jeffrey McKee, Erica Chambers, and Julie Guseman, “Human Population Density and Growth Validated as Extinction Threats to Mammal and Bird Species,” *Human Ecology*, vol. 41, no. 5 (October 2013), pp. 773–78, <https://doi.org/10.1007/s10745-013-9586-8>. This paper was collaboratively assessed.**

Both the density and growth of human populations are causally related to increases in the number of threatened bird and mammal species, this paper concludes. The authors predict that the average country in which human population is growing will experience on average a 3.3 percent increase in the number of threatened species from 2010 to 2020. Countries with declining human populations between 2010 and 2015 can expect a 2.5 percent reduction in the number of threatened species on average during that period, according to the analysis. (The term “threatened” applies to animal or plant species likely to become endangered—vulnerable to imminent extinction—due to loss of habitat or diminishing numbers of individuals.)

The paper ambitiously aims to “test the veracity of the hypothesis that there is a . . . causal link between human population density and threats to species of mammals and birds.” The authors provide a graph of the number of new threatened species that their model predicts by 2050 in the 114 countries for which data were available. The researchers worked with country population data from the U.S. Census Bureau as well as lists of threatened birds and mammals from the United Nations and two conservation organizations for the countries assessed. Islands and very small countries were excluded from the analysis out of concern that these data would skew the study results artificially toward a





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population impact on species survival. The authors concede limits of their methodology and model, but argue that these best suited the available data.

The model tests were based on comparing changes in numbers of threatened species in each country from 2000 to 2010 and seeing how these correlated both with human population density and rates of human population growth in each country over the decade. Although the relationships were scarcely linear, they came closer than other tested correlations, such as with GDP. Moreover the authors found no “threshold effect” from growing human population density; even countries with significant numbers of threatened bird and mammal species saw increases in these numbers as human populations rose. The strong correlations identified “establish a degree of certainty that human population density is a key ultimate cause, and probably in many places a proximate cause [i.e., the one closest or most direct] of species of mammals and birds becoming threatened with extinction,” the authors conclude.

► **Key quotes:**

“There is no doubt that a multitude of factors go into diminishing the availability of resources that mammals and birds need to survive as viable species . . . Yet human population density is demonstrably at the core of extinction threats to mammals and birds. . . . The data reveal that if future conservation efforts are to be sustainable, they must not leave human population density out of consideration, and indeed should include them in the forefront.”

► **FPESA network assessments (seven total)**

were uniformly positive about the paper and its relevance to the primary FPESA hypothesis. Some assessors noted that its accuracy depends on the reliability of the species and population data. (The accuracy of the data on threatened species is less certain than data on national human populations. Species richness among birds and mammals is nonetheless among the most closely monitored indicators in biology.) Several assessments suggested that the focus on the national level or the exclusion of islands and small states are potential weaknesses. Two assessors expressed disappointment that no data were applied that would suggest how per capita economic activity or consumption correlate with threatened species. One assessor wondered about the impact of corruption and human mobility. No assessment challenged the paper’s basic conclusion.

► **Overall assessment:**

Assuming reasonable data accuracy, the authors have identified strong correlations that are hard to explain without considering human population density and growth to be threatening the survival of bird and mammal species. The fact that both density and growth strongly correlated with increases in threatened species from 2000 to 2010 adds to the paper’s strength. It is hardly plausible that threats to animal survival are causing human population density and growth. Nor is it easy to imagine some third force simultaneously increasing both human population and the number of threatened animal species. Until better and more geographically detailed data on population and other factors are available, this paper stands as strong evidence that current human population density and growth undermine the chances of survival for terrestrial bird and mammal species.

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**Camilo Mora and Peter F. Sale, “Ongoing Global Biodiversity Loss and the Need to Move Beyond Protected Areas: A Review of the Technical and Practical Shortcomings of Protected Areas on Land and Sea,” *Marine Ecology Progress Series*, vol. 434 (2011), pp. 251–66, <https://doi.org/10.3354/meps09214>. This paper was collaboratively assessed.**

The establishment and expansion of protected areas for conservation, while helpful in preserving habitats and species, is an inadequate long-term strategy given the continued expansion of human numbers and activities worldwide, these authors conclude. They conduct a comparative review of previously published literature to discern trends in protected area establishment on land and in the oceans, in human population and activities, and in the health of biological diversity. A series of graphs shows that various measures of biodiversity are declining even as the number and extent of marine and terrestrial protected areas has risen significantly in recent years. Currently, there are more than 100,000 such areas, 4,435 of them in the oceans. Protected areas cover nearly 13 percent of the land’s surface and 0.65 percent of the oceans.

It would require decades or even centuries of expansion at current growth rates before protected areas would be adequate for long-term biodiversity protection, the authors





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calculate. And even this would do little against such threats as climate change, pollution, and introduced species. Moreover, the authors assert, continued expansion of protected areas will conflict with development as human populations and economies grow. The authors review the projected growth of human population and institutional efforts to reduce poverty and encourage universal economic development. They speculate on the conflicts that these trends will pose for the needed expansion of protected areas and conclude that stabilizing human population and reducing per capita consumption of natural resources offer more promising strategies than protected areas for conserving the earth's biodiversity.

► **Key quotes:**

"[A]lternative solutions targeting human demand for ecological goods and services, while ensuring human welfare[,] should be prioritized and brought to the forefront of the international conservation agenda. In our view, the only scenario to achieve sustainability and to resolve the ongoing loss of biodiversity and its underlying causes will require a concerted effort to reduce human population growth and consumption and simultaneously increase the Earth's biocapacity through the transference of technology to increase agricultural and aquacultural productivity. The fact that human population growth may also lead to economic . . . and societal . . . problems suggests that targeting human population growth directly would be worthwhile and could become more effective if advocated simultaneously from social, economic and ecological perspectives."

► **FPESA network assessments (nine total)**

were favorable, with one assessor calling the paper "a very balanced review of challenges that face . . . biodiversity." Some criticized it for generalizing on protected areas and on population-related impacts without more effectively detailing which factors are most likely to affect which types of areas and how. Assessors tended to credit the authors for supplementing the call to stabilize human population with others to reduce consumption and to share and apply technology to increasing the earth's agricultural and biological capacity. Some also noted that further research could build from this paper to explore the best strategies for long-term biodiversity conservation.

One assessor felt that the authors stressed local demographic pressure on biodiversity without acknowledging the role of

remote threats from oil spills, mining, logging, and other impacts related to consumption in developed countries. Another felt that the authors demonstrated correlation rather than causation by population growth of biodiversity threats. An assessor who works on population, health, and environment (PHE) projects in communities felt that the paper accurately reflects her own experience but wished for more attention to population impacts on land-based protected areas.

► **Overall assessment:**

This is fundamentally a literature review marshaled for a logical argument rather than an empirical study presenting fresh data or findings. It is nonetheless thorough in its references on protected areas and biodiversity and strong in constructing its argument. Author Mora, a native of Colombia, is among the few scientists of Latin American origin making strong statements on the importance of population linkages to the environment. The article makes no mention of family planning, education, or the status of women and could be seen as less than fully sensitive to the critical importance of rights-based strategies in "targeting human population growth directly." The logic and literature that the authors assemble nonetheless lend themselves to the argument that stable human populations and ecological footprints offer more hope than the expansion of protected areas for the long-term conservation of biodiversity.

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**Camilo Mora et al., "Global Human Footprint on the Linkage Between Biodiversity and Ecosystem Functioning in Reef Fishes," *PLoS Biology*, vol. 9, no. 4 (5 April 2011), p. e1000606, <https://doi.org/10.1371/journal.pbio.1000606>.**

More-diverse assemblages of fishes living in and near coral reefs are more vulnerable to the impacts of nearby dense human populations, these researchers conclude. This result contrasts with a common presumption that diversity might protect against such stress, the authors state. More biodiversity was correlated with greater biomass in these fish assemblages, with no leveling off evident in this relationship as biodiversity increased. Although human population density alone poorly predicted how much biomass a reef might have, the interaction of population density and biodiversity predicted this well. Fishing assemblages characterized by





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greater biodiversity faced greater proportional reductions in biomass in response to denser human populations nearby.

The human activities that are most stressing reef fish species, the authors write, are “fishing, coastal development and land use stressors” such as construction and fertilizer application. The authors note that 75 percent of coral reefs occur near settled areas, and that almost all countries with coral reefs are projected to double their populations in a century or less. In a recommendation that spurred debate among the 55 co-authors of the paper (see Perspective, “[Convince Them to Say It](#),” on page 39), the paper calls for family planning and other strategies to slow population growth near coral reefs in addition to other steps to maintain biodiversity in these ecosystems.

► **Key quotes:**

“[W]e compared human population density to proxies for fishing, coastal development, and land use. Our results indicated that human density is highly and significantly related to the intensity of all three activities. Although the high collinearity among these proxies prevents us from making statistical inferences about causality, the fact that all proxies have been shown to affect reef fish assemblages suggests that the patterns described here may emerge through a combination of multiple human activities. . . . The main effect of human population growth expected by 2050 is a greater density of people living near reefs. This effect may be exacerbated by urbanization, which is likely to accelerate in developing countries, particularly in coastal areas.

“This highlights the urgent need to implement comprehensive reef governance at local, regional, and global scales to maintain biodiversity and confront the variety of drivers and stressors associated with coastal habitation, as well as long-term strategies (improvements in education, empowerment of women, family planning, poverty alleviation, etc.) to curb the growth of coastal human populations. Policy tools that address the socioeconomic roots of overfishing, biodiversity loss, and reef degradation are clearly necessary.”

► **Assessment:**

With its 55 co-authors led by a biogeographer from Colombia, this paper manifests its own diversity, supporting the FPESA’s secondary hypothesis that interest in the family planning-environmental link is widespread. As Kenneth R. Weiss documents in his Perspective article “[Convince Them to Say It](#)” (see page 39), it required considerable discussion to convince all of the co-authors to join Mora in calling for family planning and the education and empowerment of women to slow population growth near reefs. But all eventually agreed to the recommendation and attached their names to the paper. Their detailed data analysis of reef fish in the Pacific and Indian Oceans and the Caribbean Sea in relation to biodiversity, biomass, and proximity to dense human populations qualifies this paper as original and empirical. It contributes significant evidence that human population density and the activities associated with it directly threaten the survival of reef fish—and disproportionately threaten those in the most biologically diverse assemblages.

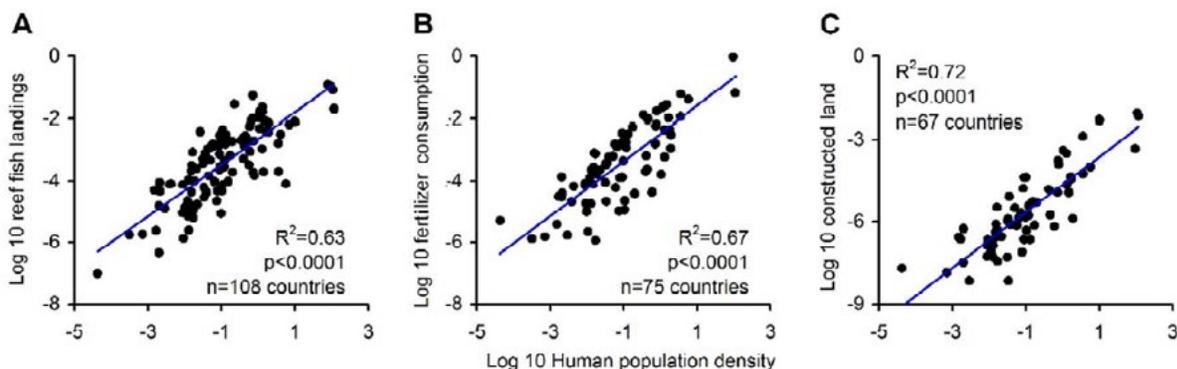


Illustration from the paper (page 5). Used by permission.





## Land and Forests

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**Tesfahun Fentahun and Temesgen Gashaw, "Population Growth and Land Resources Degradation in Bantneka Watershed, Southern Ethiopia," *Journal of Biology, Agriculture and Healthcare*, vol. 4, no. 15 (2014), pp. 13–16, [iiste.org/Journals/index.php/JBAH/article/view/14198/14506](http://iiste.org/Journals/index.php/JBAH/article/view/14198/14506).**

Landholdings in the studied watershed shrank from 0.68 hectares (1.7 acres) per household in 1994 to 0.48 hectares (1.2 acres) in 2007, contributing to land degradation, deforestation, and the migration of farms to upland and marginal areas, these authors found. They attribute the trend largely to population growth, which has led to the subdivision of landholdings among multiple children, leading some to seek and develop new land to farm. Working with population data collected from 1984 to 2010 and supplementing these with surveys and focus group interviews, the authors conclude that population growth, at a pace above average for Ethiopia, has been principally responsible for farmland expansion to sloping land and other marginal areas and for the loss

of indigenous trees in the watershed. The increased use of sloping land for cultivation and the loss of trees increased soil erosion in the study period, the authors found.

### ► Key quotes:

"Deforestation, decline of soil fertility, local climate variability and change, wildlife reduction, gully formation, drying of springs and stream, problems of water quality and water quantity during dry seasons are some of the significant biophysical changes due to the effects of population growth in the study watershed. . . . [D]ue to improper utilization of the land by the rapidly growing population, the productive potential of natural resources such as forest, soil and water were lowered. Thus, introducing and further expansion of family planning and off-farm activities will alleviate the problem. Furthermore, integrated watershed development will conserve natural resource degradation."

### ► Assessment:

Combining data from literature and survey questionnaires with focus group interviews and their own observation, the Ethiopian authors find strong correlations between population growth and the declining size of landholdings, increasing migration to sloping and other marginal





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farmland, and deforestation. Their conclusion that population growth is the main player in these trends is plausible and logical, but the causative role is not supported beyond the correlations presented. Like a number of other African researchers whose work the FPESA project reviewed, these authors show no hesitation in calling for expanded family planning as one strategy for addressing the problem of land degradation. This connection, too, goes unsupported by data. This paper is among a group that assume, without demonstrating, a causative role of population growth in environmental degradation and a causative role of family planning in slowing population growth. Recognizing at least that these linkages are not the entire story, the authors add a call for integrated watershed development.

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**Derek D. Headey and T.S. Jayne, "Adaptation to Land Constraints: Is Africa Different?" *Food Policy*, vol. 48 (October 2014), pp. 18–33, <https://doi.org/10.1016/j.foodpol.2014.05.005>.**

An empirical examination of how rural African households respond to constraints on cropland found that rural Africans in countries with high ratios of people to land want to limit the size of their families but are not able to achieve their reproductive intentions due to unmet need for family planning services. Reducing fertility is all the more important for such families because intensification of agricultural production on limited landholdings is not faring well in Africa, the authors found. Diversifying into non-farm employment, too, has been much less successful there than elsewhere.

"Farm sizes in these high density countries declined sharply from the 1970s to the 2000s," the authors state, due to subdivision among numerous children in large families. Higher population densities in Africa have an influence on family size, they conclude, "commensurate in size to other well-known determinants of fertility such as female education and income." They argue that underinvestment in family planning in densely populated African countries is hampering fertility declines that "would gradually alleviate land pressures [and] have been linked to reductions in poverty and substantial improvements in maternal and child health and nutrition, and faster economic growth."

► **Key quotes:**

"[R]ural Africans in land constrained countries desire smaller families, but have thus far benefited little from family planning policies. These findings underscore the need for a coordinated multi-sectoral approach to sustainably reduce poverty in the region. . . . [W]e find novel evidence that desired fertility rates in rural areas decline in response to higher rates of population density, but achieved fertility rates do not. In other words, high density countries in Africa face large gaps in unmet contraception needs, suggesting that family planning policies would be more efficacious in these countries than in more land abundant regions. . . .

"[T]he low adoption of modern technologies such as fertilizers and seeds is well documented, as are the links between population growth and [soil] nutrient mining in Africa. . . . [Our] results suggest that higher rural population density may indeed reduce *desired* fertility rates, but that inadequate access to family planning services has thus far inhibited the achievement of those fertility reductions. . . . In the case of high density countries in Africa . . . our results suggest that there is indeed a substantial demand for family planning services, at least among the female population."

► **Assessment:**

This well-constructed paper is among a handful in the FPESA database that successfully address a wide range of the linkages and sub-hypotheses that the project is exploring. Considering possible reasons for Africa's poor progress in agricultural development, especially compared to Asia's, the authors comfortably and empirically integrate the role not just of population growth but also of lack of access to family planning and larger-than-desired fertility as a critical factor.

The authors note frankly that data on land and agriculture are poor in many African countries, especially in the least-developed ones, and caution that the reliability of their findings should be judged accordingly. But they nonetheless plow ahead into a field that few other specialists on land and agriculture have dared to venture into: family planning policy and the gap between fertility intentions and outcomes. Their key findings on this (included among other findings not directly related to





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population or family planning), even with the data caveats, are important. They provide evidence that reducing unmet need for family planning, especially in the areas with the greatest land constraints and least-productive agriculture, is among the highest-priority policy measures to address food insecurity on the continent.

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**Anders Henrik Sirén, “Population Growth and Land Use Intensification in a Subsistence-based Indigenous Community in the Amazon,”** *Human Ecology*, vol. 35, no. 6 (December 2007), pp. 669–80, <https://doi.org/10.1007/s10745-006-9089-y>. This paper was collaboratively assessed.

Population growth in Sarayaku, a lightly populated indigenous community in eastern Ecuador, appears to have had little impact on deforestation in the area over the last seven decades, despite a growth rate of 1.6 percent a year over this period, this paper concludes. The area of agricultural land grew at only 0.4 percent a year, despite almost complete reliance on subsistence farming. The community’s demographic growth nonetheless may be unsustainable, the author suggests. The productivity of agricultural land is declining, and farmers must walk farther to fields and work harder on them. Land scarcity may be contributing to some conflict in the community and to efforts to secure off-farm employment alternatives.

► **Key quotes:**

“[T]he apparent sustainability observed in shifting cultivation systems of Amazonian indigenous people may depend more on low population densities than on any inherent sustainability in the shifting cultivation system itself. . . . [One] way to adapt to land scarcity is community fission [splitting off of groups from communities, which occurred in Sarayaku] or relocation. . . . [S]uch fissions reduce competition for land for cultivation, and such competition for resources may be an underlying cause of social conflict.”

► **FPESA network assessments (eight total)**

were almost unanimously favorable. Some assessors wondered if technological, governmental, and other external

factors might have influenced the relationship between population growth and land use. One assessor suggested that the FPESA [conceptual framework](#) (see page 8) should be modified to reflect the importance of such factors. Another suggested that institutional constraints on shifting cultivation mentioned by the author (e.g., the presence of schools in the communities) were not adequately addressed in the study. Yet another assessor offered a neutral overall assessment, finding the paper unconvincing in directly connecting either land-use change or resource scarcity to population growth.

► **Overall assessment:**

Although hardly definitive in its study of population growth and deforestation in indigenous communities (and with no attention to reproductive issues such as family planning), this paper offers value to the FPESA project on several fronts. It is based on the author’s doctoral thesis and demonstrates the potential of such theses to advance methodology and research in the family planning–environmental sustainability linkage. As is the pattern in this literature, the author fails to identify convincingly a direct causation between population growth and agricultural constraints or deforestation. He acknowledges significant constraints in data collection, but he was not dissuaded and found credible ways to make best-possible estimates for his analysis.

The author constructs a narrative of the livelihood of the people in southeastern Ecuador and probes for changes that may have resulted from population growth. The correlations between that growth and the area under cultivation, forest, and fallow (formerly cultivated land abandoned to nature to regain fertility) are obvious but not strong, but the author does not stop with this conclusion. He finds that land productivity losses have no other obvious cause beyond the stable per capita agricultural activity multiplied by modest population growth. These may have affected the community’s livelihood and social relations and may require governance and other institutional efforts for adaptation to continued demographic pressure. Overall, his conclusions are plausible and suggest avenues and the need for further research on the complexities of population growth in relation to land use and resources.





## Food

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**Mary O. Agada and Edwin M. Igbokwe, “Food Security and Coping Strategies Among Ethnic Groups in North Central Nigeria,”** *Developing Country Studies*, vol. 4, no. 8 (2014), pp. 31–44, [iiste.org/Journals/index.php/DCS/article/view/12196/12549](https://iiste.org/Journals/index.php/DCS/article/view/12196/12549).

A survey of 340 households in north-central Nigeria found that nearly half of them were food-insecure. Higher incomes and producing one’s own food were associated with higher levels of food security, while larger households tended to be less food-secure than smaller ones. Most food-secure households were only barely so, the researchers found. Both categories of households coped by eating less-preferred foods and smaller portions, suggesting that “calorie consumption was just at the threshold of adequacy” in the region. The researchers call for education on family planning methods in the region to enhance food security.

### ► Key quotes:

“Although some may argue that large households provide farm labour, which compensates for the cost of food and other social needs, this does not automatically improve food security as it is subject to many variables, which are beyond the control of the household. Therefore, rural households in the region should be educated on family planning methods to enable them to reduce the number of children they bear or improve child spacing, thereby enhancing food security.”

### ► Assessment:

This paper was among several by African authors that highlighted correlations between large household size—mostly, but not exclusively, related to having many children—and food insecurity. While the association between high fertility and food insecurity is a sensitive one in international development and food security discussions, it was notable that, at least for some African researchers, evidence points to the connection and inspires recommendations for improved access to and education on family planning. Although these papers tend to assert, more than demonstrate, causal links between the use of family planning and greater food security, they offer some support

for the main FPESA hypothesis and more firmly support the second, showing diverse and especially African interest in the family planning-environment linkage.

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**Jesse H. Ausubel et al., “Peak Farmland and the Prospect for Land Sparing,”** *Population and Development Review*, vol. 38, suppl. s1 (February 2013), pp. 221–42, <https://doi.org/10.1111/j.1728-4457.2013.00561.x>.

Decreasing rates of population growth worldwide and improving crop yields have spared much of the land (and associated nature) that might otherwise have been needed for cultivation, these authors conclude based on a study of recent agricultural and demographic trends. Moreover, they predict, there is no reason not to expect these trends to continue even as global affluence increases and population continues to grow for some time. The authors apply a variation of the longstanding population-environment equation IPAT (impact equals population times affluence times technology), using United Nations and World Bank food and population data from 1961 to 2010.

Based on the calculations’ results, the authors declare that the extent of farmland worldwide has peaked, leaving a “wide expanse” of nature to be spared from agriculture forever. They suggest that the rising corn yields of prize-winning Iowa farmers “suggests no approaching biological limits” to future yield growth. And they project that a food supply of 3,100 kilocalories (or calories, in popular usage) per person per day will be available in 2066, nearly 50 percent more than minimums needed to avoid malnutrition, using only today’s cultivated land or even less. Among their findings: The growth of per capita caloric intake appears to level off at modest rates of affluence, not rising further when incomes continue to grow. And the slowing of world population growth after 1970 played an important role in sparing land for nature that otherwise would have gone into farming.

### ► Key quotes:

“Absent the slowing of population, evolving tastes, and improving agricultural practices, unimaginable destruction of Nature would have occurred [between 1961 and 2010]





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. . . . The envisioned cropland peak rises in part from another peak, that in the rate of population growth. . . . [U]nlike humanity’s striving for affluence, its striving for food has limits that help meet the challenge. The survival level near 2,000 [calories]/person/day sets a lower limit. The upper limit at, say, 4,000 set by obesity is the one that moderates the ratio of food to GDP. . . .

“Allowing for wild cards, we believe that projecting conservative values for population, affluence, consumers, and technology shows humanity peaking in the use of farmland. Over the next 50 years, the prospect is that humanity is likely to release at least 146 MHa [million hectares, or 323 million acres], one and a half times the size of Egypt, two and a half times that of France, or ten Iowas, and possibly multiples of this amount. . . . [W]e are confident that we stand on the peak of cropland use, gazing at a wide expanse of land that will be spared for Nature.”

► **Assessment:**

We were drawn to this paper because, in its almost over-the-top optimism about the future of global food production, it seemed a strong candidate for undermining the proposition that family planning can contribute to a sustainable food supply. The authors fail to take into account likely impacts of climate change and falling supplies of water for irrigation, helping to explain why their conclusions contrast with more pessimistic assessments on future food production. (They note the recent expansion of farmland for energy crops but argue that, “as the shortcomings of biofuels become evident to government,” this land will return to food crops.) In general, however, their findings and predictions seem based on valid data and a logical methodology, albeit with a questionable certainty that crop yields will grow indefinitely in the future.

As we explored the paper in more depth, we realized that, to some extent, it lends support to our primary hypothesis. While the authors themselves see no reason for concern about food sustainability, they attribute this in large part to the fact that world population growth slowed dramatically after 1970. The take-up of contraception use by most of the world’s reproductive-age women facilitated this easing of growth, although the authors do not mention this. Their work could be seen as a case study offering evidence that family planning promotes a sustainable outcome: spared

nature owing to food demand is lower than it otherwise would be.

A second intriguing finding relates to consumption: the authors find evidence that per capita caloric intake faces limits beyond which it no longer grows with affluence. (How much food and how rich a diet, after all, can one person eat?) It would be hard to demonstrate such limits with all categories of consumption. But, at least in the case of caloric intake, an upper limit on consumption suggests that in a fully developed world in which poverty were eliminated, only population and technological change, along with modest variations in dietary taste, would affect food supply and the land required to provide it.

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**Julian A. Lampiotti et al., “A Strategic Framework for Improving Food Security in Arab Countries,” *Food Security*, vol. 3, suppl. 1 (February 2011), pp. 7–22, <https://doi.org/10.1007/s12571-010-0102-3>.**

A range of strategies that “will require a global response” is needed to improve food security in Arab countries, these authors recommend. Because of increasingly scarce water supplies and arable land, due to the region’s changing climate and its fast-growing population, Arab countries are especially vulnerable to rapid swings in food prices and to the health and social problems that result. The poor in urban and rural areas fare worst when food prices soar. Some Arab countries have no more room to expand sustainable water use, while their populations continue to grow at rates well above the global average. The authors call for several strategies to “reduce vulnerability to price shocks”: better access to family planning services; promotion of education, research and development to increase agricultural productivity; more-efficient food supply chains; and financial instruments that can hedge price risk.

► **Key quotes:**

“Any food security strategy must first address the issue of demand growth. . . . Access to family-planning services must be improved. Arab countries have extremely high population growth rates; their combined population rose from 73 million in 1950 to 333 million currently, and is expected to reach nearly 600 million by 2050.”





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► **Assessment:**

Food security is an essential attribute of an environmentally sustainable society. These authors, all specialists on the topic in World Bank and United Nations-related institutions, integrate multiple components of supply and demand to issue a well-argued alarm about the future of food security in Arab countries. Although it is not empirical research and hence does not directly support FPESA's [conceptual framework](#) (see page 8), the paper presents a range of data to make the case for an urgent global response to increasing price volatility and food insecurity that are becoming acute in Arab countries. Published just one month before Syria's civil war began, the paper notes that “[f]ood price shocks can push people above the poverty line into poverty, and worsen the condition of those who are already poor.”

The authors' focus on ways to address this volatility is broad and holistic. Their call for better access to family planning in the region to help reduce food demand is unusual from researchers based in UN and similar intergovernmental agencies. The authors accept the evidence that family planning and education lower fertility and slow population growth, although they make no mention of the possibility that empowering women might help as well. Family planning is well-positioned among their recommendations—not as a cure-all, but as the first-mentioned in a range of development interventions that can improve food security in a particularly fast-growing region.

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**Mark L. Wahlqvist et al., “Rethinking the Food Security Debate in Asia: Some Missing Ecological and Health Dimensions and Solutions,” *Food Security*, vol. 4, no. 4 (December 2012), pp. 657–70, <https://doi.org/10.1007/s12571-012-0211-2>.**

Asia faces a more serious risk of food insecurity than is often recognized, these authors state. A major, but unappreciated, source of concern is the continent's large and still-growing population. After a wide-ranging review of food issues in the continent that is home to 60 percent of humanity, the authors call for policies to encourage “concerted family planning and enlightened migration policy,” along with the encouragement of plant-based diets and better integration of food production with health and environmental concerns.

The authors' first recommendation for avoiding future food shortage is to slow population growth, not only through family planning but “by encouraging female education and greater gender equality,” along with “enlightened migration.”

► **Key quotes:**

“Food security is often seen in a relatively short time frame, but a much longer perspective is needed. Threats from climate change, longer term pressure from population growth and urbanisation and a range of other structural factors need to be considered and planned for. Above all the issues of sustainability need to be taken very seriously. . . . A striking omission from the MDGs [United Nations Millennium Development Goals] is the failure to address population size and the related viability of localities through family planning, local livelihoods and environmental management. . . . As populations increase and the full impacts of climate change are felt, competition for the scarce resources of food and water has the potential to destabilise the region . . . [Strategies to slow population growth] are urgently required to mitigate the growing mismatch between the net food supply and need.”

► **Assessment:**

Although not an empirical study, this integrated review of issues and data on Asian food security offers valuable ideas related to the primary FPESA hypothesis. Unusually for experts on food and agriculture, the authors are comfortable with an analysis that integrates population change (including aging) and family planning. They see the relationship of population growth to food insecurity not just through the lens of food supply, but through water quantity and quality, soil fertility, fisheries, and social impacts. They also consider food's impact on reproductive health, noting that some substances tainting food can disrupt the human endocrine system and, through that, fecundity (the ability to conceive and bear children).

The paper asserts, but does not demonstrate causality from, the use of family planning leading to slower population growth, leading to reduced food insecurity. The authors nonetheless marshal a wide range of evidence that the scale of demand for food in Asia is huge and growing, due to growth in both population and affluence. Global trade and technological innovation will not be enough to satisfy this demand, they assert. That creates risks that are





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underappreciated by most governments, with little planning under way for the food shortages that the authors warn may lie ahead.



**Mesfin Welderufael, “Determinants of Household Vulnerability to Food Insecurity in Ethiopia: Econometric Analysis of Rural and Urban Households,” *Journal of Economics and Sustainable Development*, vol. 5, no. 24 (2014), pp. 70–79, [iste.org/journals/index.php/jeds/article/view/17506/17926](http://iste.org/journals/index.php/jeds/article/view/17506/17926). This paper was collaboratively assessed.**

The number of people in households significantly predicts vulnerability to food insecurity in urban and rural areas of the Amhara region of Ethiopia, this paper concludes. Household size was second only to unemployment in urban areas and “drought shock” in rural ones in correlating with consumption of fewer than the adult equivalent of 2,200 calories per day per person, the quantitative empirical study found. An additional factor contributing modestly to food insecurity was having a male head of household, a point of some interest to the FPESA hypothesis but not explained or speculated on in the paper. The author recommends family planning promotion among a suite of policy responses to the high level of food insecurity in the region (48 percent of households), with a special focus on the poorest fifth of households.

► **Key quotes:**

“This [study] strongly supports that [agricultural] input access by the poor, promotion of family planning, enhancing livestock packages, creation of employment opportunities, [and] delivery of food aid for emergency needy groups can mitigate food insecurity in the study area.”

► **FPESA network assessments (11 total)**

were overwhelmingly favorable, but with one neutral assessment and one that was dismissive of any scientific value for the FPESA hypothesis. One assessor who judged the paper to be strong suggested that it supports the idea that education enhances the use of family planning, adding that education should be represented as doing this in the FPESA [conceptual framework](#) (see page 8). Two assessors criticized the vagueness of “household size” in assessing

the relationship of fertility or family size to food insecurity. (This term, a common one in African literature on food security, acts as an imperfect proxy for fertility, given that households can contain multiple parents and their children.)

One assessor wished to see data points, not provided in the paper, on the age of household members. Another wished for an approach to food insecurity as a continuum, rather than a binary issue of security versus insecurity. Use of family planning could accelerate population aging, this assessment suggested, which, in turn, might increase food insecurity, as older people might be unproductive food consumers. Another assessor noted the lack of data on population density and the amount of land cultivated by households. Two assessors called attention to frequent English-language deficiencies in the writing and/or editing of the paper and worried that there might be a similar propensity to err in data analysis. While finding the statistical correlation of household size and food insecurity valuable, one assessor noted the absence of a more detailed consideration of exactly how the former caused or contributed to the latter.

► **Overall assessment:**

We chose this paper to assess collaboratively and annotate in large part because it is broadly representative of many papers in our database by African authors. Several of these papers reviewed in detail so far find strong correlations between large family (or household) size and food insecurity and include family planning among recommended policy responses. These authors clearly concluded from the evidence they assembled that the correlation was evidence of a causative influence from high fertility to household food insecurity.

Such a chain of logic—from the conclusion that high fertility negatively affects environmental attributes to the recommendation of improved family planning—is not uncommon among African authors, and rarer among non-African ones. No single one of these articles is definitive or will singlehandedly convince skeptics. Collectively, however, they help build the case that an impressive number of African researchers has concluded that the population-environment linkage is real, important, and supports family planning among its implications.





## Consumption

**Kyle W. Knight and Eugene A. Rosa, “Household Dynamics and Fuelwood Consumption in Developing Countries: A Cross-national Analysis,” *Population and Environment*, vol. 33, no. 4 (June 2012), pp. 365–78, <https://doi.org/10.1007/s11111-011-0151-3>. This paper was collaboratively assessed.**

A study of fuelwood consumption, household size and numbers, and population in 87 developing countries found that decreasing household size tends to boost the amount of fuel that each person in a population consumes. This leads to the paradoxical conclusion that reduced fertility—which slows population growth but also contributes to smaller household size—makes an independent contribution to greater fuelwood consumption.

Yet the authors also found that growth in population is likely a larger net driver than increased per capita consumption caused by smaller households to a country’s total increase in fuelwood use. When the greater population is multiplied by the higher per capita fuelwood consumption, it is the former multiplier that exerts more influence on the equation’s sum. Some 3 billion people, overwhelmingly in developing countries, rely on fuelwood for cooking and heat, which the authors assert contributes at least marginally to deforestation and perhaps more

significantly to the deterioration of forest habitat and the degradation of biodiversity.

The authors applied a model based in the STIRPAT equation to tease out the various influences on change in fuelwood consumption in each country. (For the meaning of STIRPAT, see [Inmaculada Martinez-Zarzoso et al.](#), 2010, annotation on page 72.) The authors cite earlier literature also finding that lower fertility can contribute to smaller households and, through this, higher per capita consumption. (They note that other forces also can lead to smaller households, such as increases in divorce and cultural shifts away from living in extended families.) They suggest that this complex relationship between lower fertility, population growth, and per capita and total consumption may affect biodiversity and natural resources other than fuelwood in developed as well as developing countries.

### ► Key quotes:

“Consistent with previous research, total population has a significant, positive effect on total fuelwood consumption [in the study’s primary model]. This supports the widely verified finding that population size is a major driving force of resource consumption and environmental degradation. . . . [W]hile family planning and associated policies and programs are the typical response to population growth, our results indicate that these responses may have unintended consequences that diminish their environmental benefits. In particular, reducing fertility rates decreases population growth, but at the same time may contribute to decreasing household sizes and growth in the number of households.”

### ► FPESA network assessments (seven total)

were mostly favorable, with one assessor suggesting that the consumption-increasing impacts of lower fertility found in this study should be made more clear in the FPESA [conceptual framework](#) (see page 8). The paper was seen as clear and understandable and the study as reproducible, ideally with data for more countries if they could be found. Two assessors criticized methodological aspects of the authors’ model. One of these also wished for more ideas in the paper on how to address the greater consumption of smaller households. A third assessor felt that the study failed to examine what it is about the fertility-household size connection that increases per capita consumption—





possibly a connection to increasing affluence (not explored in the study) as much or more than economies of household scale (which was explored). A few assessors missed a deeper exploration on whether, how, and to what extent family planning and lower fertility themselves directly or indirectly affect per capita consumption, ideally compared to other factors, and suggested that this key question for the FPESA hypothesis remains unanswered.

► **Overall assessment:**

This study is the clearest that we evaluated that explores an important feature in our [conceptual framework](#): the dashed arrow and box leading from lower fertility to higher per capita consumption as a possible confounding effect in the family planning-environmental sustainability linkage. Using a statistical model in what appears to be a sensible way and focusing on consumption of a key resource in developing countries, the authors make an important finding. Reducing the size of households (a likely outcome of the use of family planning, although this link is not closely examined) tends to increase the per capita consumption of fuelwood in a country. This undermines what the authors contend is the overall environmental benefit of slowing population growth, although they find that the effect does not overwhelm that benefit altogether. As several assessors noted, the study is well crafted and communicated and offers an important finding. Yet it is hardly definitive, and the questions of whether the use of family planning increases per capita consumption and how this might affect a population's total consumption over time remain to be more fully explored.

As an added bonus, the authors include in a footnote a helpful discussion of the terms “driving forces” and “drivers,” which have been seen as controversial and sensitive in the context of discussing how population growth affects the environment: “The term ‘driving forces’ or ‘drivers,’ familiar to several areas of research in the physical sciences such as plate tectonics and statistical thermodynamics, is new to the social sciences. More importantly, it has been universally adopted by natural scientists studying global environmental change to refer to what are presumed to be the most important factors producing environmental change. In the more generic language of science they are independent variables, particularly ones shown to have environmental effects.”

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**Ronald Lee and Andrew Mason, “Fertility, Human Capital, and Economic Growth Over the Demographic Transition,” *European Journal of Population*, vol. 26, no. 2 (19 June 2010), pp. 159–82, <https://doi.org/10.1007/s10680-009-9186-x>.**

Fertility decline and accompanying population aging are unlikely to lead to economic decline, this paper finds—and for a reason that may be relevant to the environment. Low fertility is associated with increased per capita consumption, as parents and societies invest in the human capital—chiefly education and health—of each child in smaller generations. Applying a demographic-economic model that integrates data from the experience of 19 rich and poor economies between 1994 and 2004, the authors conclude that rising investment in human capital as fertility declines diverts money from current consumption. Yet any reduction in economic growth is more than compensated by the higher per capita consumption that this investment in children eventually yields.

The authors stress that they are not declaring that lower fertility directly causes increased per capita consumption, only that it is strongly associated with it in their model. Although the paper addresses economic rather than environmental aspects of this higher consumption, the finding is relevant to ongoing debates about the impacts of both population and consumption change on environmental sustainability.

► **Key quotes:**

“[A] number of . . . factors . . . may influence the choice of fertility . . . . These include cultural differences in valuation of numbers versus quality; differences in the relative price of parental consumption, and human capital; the changing availability of new parental consumption goods; differences in child survival; [and] differences in the rate of return to education or in older age survival probabilities . . . . The availability of contraceptives can also be interpreted as influencing the price of numbers of children.”

► **Assessment:**

At the center of the FPESA [conceptual framework](#) (see page 8) is a dotted box representing the possibility that, by reducing fertility, the use of family planning might actually encourage higher per capita consumption of natural resources. Although





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this paper makes no mention of either family planning or the environment, it does address this important possibility—and finds it to be more likely than not.

Because the authors' interest is in assessing how lower fertility might affect economic growth, they treat consumption in purely economic terms, rather than as the energy or materials consumption that would interest environmental researchers. Nonetheless, they make an additional finding that is environmentally relevant: when fertility falls, according to their model, per capita consumption increases, but the consumption of the total population does not rise proportionally. Parents and societies continue to divert money toward human capital investment that might otherwise have been spent in current consumption of goods (e.g., housing, clothing, and entertainment). The model leaves unanswered whether fertility decline nonetheless tends to shrink or boost a population's net consumption over time, compared to what these would have been without fertility decline.

It is unclear how closely the paper's model resembles real-world demographic-economic interactions. Although the authors repeatedly call it a "simple model," most lay readers would not find it so. The authors also call the model "very stylized," and concede that it is "a very unrealistic characterization of population and the economy" because it uses only three age groups. The model describes hypothetical demographic transitions over a period of two centuries. Nonetheless, it incorporates recent demographic and economic experience in such countries as India, Japan, Mexico, the Philippines, Thailand, and the United States.

The paper contributes evidence, at least, that the use of family planning may contribute indirectly to higher per capita consumption. As with the paper by [Knight and Rosa, 2012](#) (see annotation on page 92), however, this paper does not undermine the demographic pathway from family planning to environmental sustainability in the FPESA [conceptual framework](#). Neither these papers, nor any others that we have studied, offer evidence that fertility decline raises net population consumption levels economically or environmentally.

The Lee and Mason paper also illustrates a dilemma that we face in the search for evidence that family planning contributes to environmental sustainability. A fair amount of

demographic literature explores the impact of family planning and fertility decline on economic growth, as this paper does. When researchers interested in the impact of family planning on the environment encounter this economic literature, an obvious question is what impact economic growth tends to have on environmental sustainability. Perhaps due to the search terms that we employed, our literature search did not yield any papers treating this question, and we have been unable to address it in our work.

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**Khalid Zaman et al., "Determinants of Electricity Consumption Function in Pakistan: Old Wine in a New Bottle," *Energy Policy*, vol. 50 (November 2012), pp. 623–34, <https://doi.org/10.1016/j.enpol.2012.08.003>.**

Applying various statistical tests "to determine the causality direction between electricity consumption and its determinants" in Pakistan, this paper concludes that from 1975 to 2010 population growth had the greatest influence on consumption growth. This was followed closely by economic growth and more distantly by foreign investment. The authors found a nearly one-to-one, unidirectional causal link between population and electricity consumption during the period. This means that a percentage of growth in Pakistan's population caused the same percentage of growth in electricity demand, while changes in that demand had no demographic impact.

► **Key quotes:**

"The coefficient value of population growth indicates more than [a] one to one relationship with electricity consumption. This supports the conventional approach to the energy-population nexus, according to which the population levels determine energy demand, i.e., the larger the population, the more the total energy required and the population exogenously determines energy consumption. The second major contributor to increase electricity consumption in Pakistan is the real GDP per capita, which contributes almost 0.973 percent, which is near [to a] one to one relationship with electricity consumption."

► **Assessment:**

Electricity shortages have become acute in Pakistan in recent years, causing frequent blackouts in cities and rural areas. This





## Environment and Fertility

Steven Arnocky et al., “Environmental Concern and Fertility Intentions Among Canadian University Students,” *Population and Environment*, vol. 34, no. 2 (December 2012), pp. 279–92, <https://doi.org/10.1007/s11111-011-0164-y>.

paper links population growth strongly and directly to the trend of rising electricity consumption, noting that, in 2008, electricity supply fell 15 percent short of rising demand. As is the case with many of the papers selected as most relevant to the FPESA hypotheses, we cannot adequately evaluate the methodology or judge the accuracy of its findings. In applying multiple statistical tests to its data and documenting their methods in detail, the authors appear to have succeeded at something attempted in few of the papers that we evaluated: a precise quantification of the influence of population growth on an environmental issue.

Pakistan’s electricity is generated using a variety of energy sources, all of which have environmental impacts such as water use and carbon dioxide emissions. The domestic sector—i.e., private residences—is the largest consumer of electricity, according to the paper. The question of population’s influence on electricity consumption is clearly environmentally relevant. The authors deserve credit for their ambition and boldness not just in quantifying the roles of population, economic growth, and foreign investment, but in calling these roles causal rather than merely correlative.

Despite the relative weight of population’s influence on electricity consumption that the authors document, they make no suggestions for addressing Pakistan’s population growth, currently at nearly 2 percent annually. They instead urge economic growth, energy efficiency, and increased foreign investment. That said, whether or not their methodology stands up to future scrutiny or their results are confirmed by future research, these authors are modeling a quantitative approach to population-environment analysis that deserves attention and possibly emulation.

An attitudinal survey of 139 Canadian university students found that individuals’ levels of concern about the general state of the environment and the health impacts of pollution predicted their attitudes about having children. In general, those students who were more worried about pollution and health tended to want fewer children than those who were less worried. The correlation with lower intended fertility was not evident, however, among those who had a more general concern about the state of the environment, despite attitudes about having children that were similarly negative to those concerned about pollution and health.

The authors acknowledge that their study did not demonstrate that environmental or pollution concerns *per se* cause reduced fertility intention, but call their findings “an important early step” in empirical examination of how environmental perceptions affect fertility intention and fertility itself.

### ► Key quotes:

“Fertility decisions are highly complex and involve many factors not examined here. It is likely that other factors such as perceived behavioral control and perceived norms affect the relationship between environmental concern and fertility intentions. Of notable interest is the complex interplay between the desires of both partners in the reproductive process.”

### ► Assessment:

The study is localized, involving a modest-sized group of students in Thunder Bay, Ontario, and it relies on a statistical analysis of their responses to qualitative questions about their concerns and attitudes toward the environment and reproduction. The paper nonetheless sheds some light on a key FPESA question: Does a deteriorating environment motivate lower fertility intention and hence more demand





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for family planning? The answer could be important to a negative feedback loop relating to family planning and the environment—i.e., as an environment deteriorates, fertility declines in response, mitigating further deterioration.

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**Ann E. Biddlecom et al., “Environmental Effects on Family Size Preferences and Subsequent Reproductive Behavior in Nepal,”** *Population and Environment*, vol. 26, no. 3 (January 2005), pp. 583–621, <https://doi.org/10.1007/s11111-005-1874-9>.

As the labor time that was required to find animal fodder increased due to deforestation and vegetative decline, women and men in a rural group of communities in Nepal were more likely to want larger families, and pregnancies were more common over a three-year period, this study found. The results lend credence to a “vicious circle” argument that deteriorating environmental conditions spur women and men to prefer larger families, despite the further deterioration that the associated population increase may cause. This vicious circle, mostly explored with reproductive behavior in developing countries, is generally attributed to a desire by parents for more family labor to compensate for growing natural resource scarcity.

When fodder came from public rather than private land, the study finds, the correlation with increased desired family size was strengthened. The authors could not verify that other measures of resource scarcity, such as the actual level of vegetative cover (in contrast to time invested in collecting fodder), affected either desired family size or the likelihood of pregnancy.

In an effort to see how local environmental change affects desired family size, the authors used an existing survey of 1,805 households in the rural Chitwan Valley in south-central Nepal. (The same survey and sample were used, with different results, by [Dirgha J. Ghimire and Paul Mohai, 2005](#) (see annotation on page 98), who explored a slightly different question: how the perception of changes in agricultural productivity affected the likelihood of using contraception.) Acknowledging the difficulty in confirming a causative link between environmental change and fertility intentions, Biddlecom et al. call for further research and also suggest a positive application of their findings: successful



efforts to reduce the loss of fodder, for example through the promotion of fuel-efficient stoves, might encourage smaller family size and slower population growth in this region of Nepal and comparable areas.

► **Key quotes:**

“[T]he more dependent households are on public lands for natural resources and as households have to search farther for natural resources, the larger the family size desires of men and women. The evidence supports the vicious circle argument that resource scarcity and reliance on public lands have a positive effect on fertility preferences and behaviors. However, measures of the abundance of trees and shrubs, time to collect fuel wood, source of fuel wood and whether any young children in the household collected fuel wood were not significantly associated with family size desires. . . . [T]he results do not suggest large gender differences in the ways that the environment shapes fertility preferences.”

► **Assessment:**

To understand how family planning relates to environmental sustainability, it would be useful to have a better sense of how a deteriorating environment—or, for that matter, an improving one—affects individuals’ and couples’ reproductive aspirations and outcomes. If people want fewer children when experiencing environmental



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degradation, there is hope for a negative feedback loop that might discourage future population growth, perhaps lowering the risk of even more degradation. If they want more children, the “vicious circle” that these authors refer to could lead to an acceleration of both population growth and environmental decline. This paper, based on a sample population in Nepal, suggests that the vicious circle can indeed operate—although Ghimire and Mohai, working with the same sample and a different methodology, find the opposite effect more plausible. As other annotations in this subsection demonstrate, there is a diversity of findings on the important question that Biddlecom et al. explore.

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**David L. Carr, “Resource Management and Fertility in Mexico’s Sian Ka’an Biosphere Reserve: Campos, Cash, and Contraception in the Lobster-fishing Village of Punta Allen,” *Population and Environment*, vol. 29, no. 2 (November 2007), pp. 83–101, <https://doi.org/10.1007/s11111-008-0062-0>. This paper was collaboratively assessed.**

A keen awareness of resource and livelihood limits, in combination with effective reproductive health services, led to universal contraceptive use among married couples and small families in a small lobster-fishing community in Mexico’s Yucatan peninsula, the author reports. Hemmed in by a biosphere reserve on one side and the Caribbean Sea on the other, the village of Punta Allen (population 400 in the late 1990s) “has remained largely immune to the pressures of population growth from in-migration or from natural increase.” Probing how this has occurred through interviews, the author finds the community unusually well-educated and aware of the outside world (“Several locals actually referred to the ‘global demographic explosion problem.’”) Wealth in assets and income did not appear to significantly affect family size. Exposure to entertainment media helped spread a small-family norm, the author speculates.

In the village health clinic, a climate of trust and focus on the client’s well-being appear to have contributed to the enthusiasm with which the village has embraced birth control. A powerful influence on contraceptive use, the author reports, is a consensus that there is no more land for

expansion of a growing population, and only so many lobsters in the nearby waters to be shared among fishers and fish consumers. Consciousness of such limits is reinforced by a privatization of the livelihood resource commons. Fishing zones are divided into a fixed set of parcels, or *campos*, the ownership of which passes only through inheritance to sons. Along with other fishing restrictions, this institution discourages both in-migration (immigrants must secure permission from *campos* owners to fish) and families of multiple sons, who would be forced to share the fixed areas fished by their fathers.

This system sets up some gender differences: male *campos* owners tended to want a son, even while desiring small families, whereas females reported less interest in the sex of their offspring. Men also tended to cite economic reasons for limiting family size, whereas women were more likely to “invoke the aesthetic value of environmental conservation.” Universal agreement on the value of family planning and small families nonetheless directs the community’s demography. By the early 1990s, the remote fishing village had one of the smallest household sizes in its region—3.9 persons—and by the time of the author’s visit in 1997, Punta Allen had below-replacement fertility, which, if maintained, could result in population decrease in the village and access to more lobsters for each fisher.

► **Key quotes:**

“[T]o say that Punta Alleños have simply parroted western cultural values is incorrect. Rather, villagers seem to possess both a surprising level of western sophistication and a more organic understanding of their relationship to their unique environment. . . . [Punta Allen] is a rare case for a community its size in the developing world—perhaps a unique case considering that the 100-percent [contraceptive] user rate has been accomplished without external aid to bolster contraceptive supply or demand, but rather as the result of community will. There are several reasons that appear to contribute to small ideal and actual family sizes in Punta Allen. Some of these include a medical clinic staff effective in promoting family planning, cooperative and private resource ownership, changing cultural attitudes, geographical limitations to population and economic growth, and a desire to protect the beauty of the natural environment for aesthetic and economic motives.”





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► **FPESA network assessments (five total)**

were favorable, although one assessor felt that the qualitative nature of the research detracted somewhat from its strength and suggested the possibility of researcher bias favoring the conclusions reached. One assessor noted that the study appears to have assumed that children are born only to married residents of Punta Allen, as only married people were interviewed. This assessor also questioned the value of research performed in the late 1990s without updating, given the FPESA’s focus on the last decade of literature. (The paper that Carr published in 2007 is an English-language version of a Spanish-language paper published in 2000 and qualifies for our consideration. No time limit was placed on the date that data were collected or on publications of earlier versions in languages other than English. We lacked the capacity to check for early data collection or publication of articles in other languages.) But assessors generally agreed that the paper’s findings were essentially credible and exceptionally strong in supporting the overall FPESA hypothesis. “Punta Allen is a best practice model for other villages in the developing world,” one assessor wrote.

► **Overall assessment:**

Although qualitative rather than quantitative—as well as non-comparative, as there was no control or other alternative community studied—this paper is among the most relevant of all that we assessed to the full spectrum of the FPESA hypothesis. The study is based largely on interviews in one village in a rapidly modernizing developing country (and, unfortunately for our purposes, with data collected nearly two decades ago). It presents a remarkable phenomenon rarely documented in a developing country. Good reproductive health services (including both access to and promotion of family planning), a conservation-oriented privatized resource commons, and the united will of a well-educated community all joined forces in Punta Allen to produce a universal pattern of low fertility that favors sustainability of livelihoods and the local environment. The story is encouraging, although an update on the community’s family planning and demographic status would be useful. Only an accumulation of comparable examples will demonstrate a predictable outcome from similar conditions. The paper nonetheless offers an important case study supporting the primary FPESA hypothesis.

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**Dirgha J. Ghimire and Paul Mohai, “Environmentalism and Contraceptive Use: How People in Less Developed Settings Approach Environmental Issues,” *Population and Environment*, vol. 27, no. 1 (September 2005), pp. 29–61, <https://doi.org/10.1007/s11111-005-0012-z>.**

Villagers surveyed in Nepal who believed that local agricultural productivity had declined in the previous three years were significantly more likely to use contraception than those who saw productivity as stable or improving, this paper concludes. Perceptions that groundwater levels had dropped in the same period also were associated with higher contraceptive use, but the correlation was weak and possibly not statistically significant.

In an effort to see how perceptions of environmental change affect fertility intention and contraceptive use, the authors used an existing survey of 1,805 households in the rural Chitwan Valley in south-central Nepal. (The same survey and sample were used, with different results, by [Ann E. Biddlecom et al.](#), 2005; see annotation on page 96. Those authors explored a slightly different question: how changes in vegetative cover and additional time spent gathering fodder affected desired family size and the likelihood of pregnancy.) Ghimire and Mohai applied several controls to remove such likely influences on contraceptive use as educational attainment, family size, and whether parents used contraception.

In their paper, the authors acknowledge the study’s limitations and make clear that they cannot establish that the perception of deteriorating environmental conditions directly caused increased contraceptive use, only that the two were correlated in the study population. They recommend future research with more detailed surveys, extending over longer time periods, to further clarify whether environmental deterioration prompts greater use of contraception in different populations.

► **Key quotes:**

“Those [in the study population] who think their environment is deteriorating use contraceptives at higher rates than those who think the environment is improving or is about the same. Particularly noteworthy about this finding is that the effect of the perception about environmental





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degradation is much stronger on contraceptive use than several other variables considered as prime predictors of contraceptive use, such as schooling, work for pay, and number of children. . . . Our finding is consistent with most recent findings that suggest that environmental scarcity, rather than inducing higher demand for children as suggested by demand theory, acts as a check on population growth.” (Demand theory posits that environmental degradation prompts higher desired fertility, called the “vicious circle” in Biddlecom et al., as additional children may contribute family labor that may counteract the depressing effect of degradation on livelihoods.)

► **Assessment:**

Although not represented in the FPESA [conceptual framework](#) (see page 8), the idea that a deteriorating environment might prompt greater use of contraception is important to the project’s primary hypothesis. It also supports the rights basis embedded in the hypothesis. It may be that many individuals and couples seek to have fewer children because they believe that the environment is degrading, whether out of concern about their family welfare or for the environment generally, or both. If so, they deserve help in putting their family planning objectives into effect, in a win-win for both their own desired fertility and the environment itself—assuming that slower population growth does slow environmental degradation. This paper did not explore this assumption. The authors’ limited study of whether environmental perceptions influence fertility intention provides useful empirical data on a question that deserves more study. For a diversity of findings on this overall topic, see other annotations in this section.

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**Karina M. Shreffler and F. Nii-Amoo Dadoo, “The Role of Intergenerational Transfers, Land, and Education in Fertility Transition in Rural Kenya: The Case of Nyeri District,” *Population and Environment*, vol. 30, no. 3 (January 2009), pp. 75–92, <https://doi.org/10.1007/s11111-009-0077-1>.**

Increasing scarcity of farmland to pass on to sons was a major reason that fertility declined in the Nyeri district of the Central Province of Kenya in the 1980s and 1990s, focus group participants revealed in conversation

transcripts studied by these researchers. In what they describe as a qualitative study with “findings more suggestive than definitive,” the authors conclude that the steadily diminishing size of landholdings in the district probably contributed significantly to the success of Kenya’s family planning program there in the late 20th century. Landholding size had fallen rapidly with the high fertility of the mid-20th century, since in this province social norms required that land be divided equally among sons.

From 1978 to 1998, as land became increasingly subdivided in the province, fertility fell from more than eight children per woman to fewer than four in the province. All the focus group respondents lived through this transition, and they recalled it in detail in the conversations, recounting that it reflected changing attitudes on family size due in part to land shortage.

► **Key quotes:**

“Both men and women, especially younger, more-recently married respondents, reported making a decision on the number of children to have immediately after getting married by assessing the size of the land either in the matrimonial home or the share that belonged to the husbands. . . . The causality of the land-fertility relationship as indicated by participants . . . reveals that decisions to limit family size are often based on the availability of resources. The participants repeatedly mentioned the importance of bequeathing these resources to their children. In the face of scarce resources, family size is likely to decrease.”

► **Assessment:**

This paper is based on a relatively small sample of participants—76 in nine focus groups—which raised the question within the FPESA project team as to whether it justified the statement ending the key quotes above. The authors themselves are modest in their own claims about their findings. They argue that the detail and consistency of the descriptions provided by the participants justifies a presumption that more research will turn up similar findings elsewhere. For the FPESA hypothesis, this paper lends at least some support to a key part of our hypothesis: in some settings, family planning can help women and couples adjust their childbearing to environmental conditions, in turn helping to mitigate future resource scarcity.





## Population, Health, and Environment Projects

**Leona D'Agnes et al., "Integrated Management of Coastal Resources and Human Health Yields Added Value: A Comparative Study in Palawan (Philippines)," *Environmental Conservation*, vol. 37, no. 4 (December 2010), pp. 398–409, <https://doi.org/10.1017/S0376892910000779>. This paper was collaboratively assessed.**

A challenging effort to conduct a comparative experiment on an ongoing population, health, and environment (PHE) community-based project led to a clear finding, despite some research barriers and setbacks. The researchers conclude that integrating community-based efforts on both coastal resource management (CRM) and family planning produced better outcomes for local marine conservation, human health, and poverty alleviation than pursuing either conservation or reproductive health on its own.

Twelve indicators of conservation, food security, and reproductive health yielded statistically significant trends. In a Philippines island municipality where efforts to improve both conservation and reproductive health were combined, 8 of the 12 outcome indicators reflected desirable trends (i.e., in the direction of positive conservation, population, health, and overall sustainability outcomes). One other reflected an undesirable trend, and three were neutral. In another municipality that received help only on reproductive health, and in a third getting help only in coastal resource management, most outcomes were neutral or reflected undesirable trends.

The authors speculate that greater community participation and "buy-in" in the municipality where integrated development occurred contributed to better outcomes in this group. Opposition to family planning also seemed to weaken when the topic was linked to food security. Youth sexual activity fell and contraceptive use rose solely in the integrated group, although fertility fell equally in the integrated and reproductive health-only groups.

While acknowledging significant limitations to their research and the need for more such studies, the authors conclude that "it will be difficult to ensure long-term sustainability of CRM gains and prevent over-use of coastal resources unless integrated forms of management that combine conservation with family planning are delivered simultaneously and with community involvement." By enhancing the sustainability of the CRM improvements documented in the project, the study results also imply that integration of family planning could help improve the return on conservation investments.

### ► Key quotes:

"[P]opulation factors are often overlooked in conservation strategy formulation. The Philippine National Biodiversity Strategy and Action Plan, for example, recognizes population pressure as a root cause of biodiversity loss, but does not propose actions to address that threat. . . . The IPOPCORM model [described in this paper] uses a holistic approach to achieve food security by simultaneously (1) improving management of coastal resources; (2) supporting alternative livelihoods among fishers to reduce fishing pressure; and (3) easing population pressure by expanding access to family planning services."

### ► FPESA network assessments (*seven total*):

were mostly favorable, with some dissent and more-detailed commentaries than usual, both pro and con. There was disagreement, even among generally favorable assessors, on whether the methodology employed was sound enough to justify the study's conclusions and whether author bias toward integrated development efforts might have affected the study results. Assessors applauded the study authors for conducting innovative research while also needing to manage program operations; for clarity in their presentation and writing (including methodology and tables); and for creative efforts to compensate for study limitations. Given the expense of such research, one assessor worried that it might be difficult to go much further in studying the effectiveness of PHE programs.

One assessor felt that the findings were too uncertain for usefulness in supporting the FPESA hypothesis that family planning can contribute to environmental sustainability. Another noted that the project and study's foundation in human rights is "essential for any intervention on reproductive health in developing countries."





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► **Overall assessment:**

The FPESA project identified this paper as the most empirical and strongest in evaluating outcomes of a population, health, and environment project. This assessment is generally shared among PHE practitioners. Randomized controlled trials are the gold standard in empirical research, and it would be useful to find (or first, to fund) such trials linking family planning to environment and conservation. This study stretched for that objective and, given real-world obstacles, fell short. A planned control site receiving neither CRM nor family planning interventions, for example, had to be dropped because development investments during the study period from local government and other sources disqualified it as a pure control. The authors noted the study's limitations frankly but were unable to assess their impacts on the strength of the study's findings.

Despite these drawbacks, the effort to design and execute even a quasi-experimental study of the outcomes of PHE projects is commendable and, in both its failures and successes, could model future research on this development strategy. The results are helpful in developing an evidence base, not just on PHE, but on the overall linkage of family planning to conservation and environmental sustainability. The fact that birth rates fell in both the integrated and reproductive health-only interventions helps demonstrate the value of family planning services in reducing fertility rates. Obvious common themes connect the FPESA project's mission with those of the PHE concept, so we watch this field carefully. We can recommend this paper, along with a few other less empirical ones on PHE in our database, to advocates of both family planning and conservation as evidence that integrating both may yield a whole greater than its parts.

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**Alasdair Harris et al., "Integrating Family Planning Service Provision Into Community-based Marine Conservation," *Oryx*, vol. 46, no. 2 (April 2012), pp. 179–86, <https://doi.org/10.1017/S0030605311000925>.**

In Velondriake, a group of communities occupying a locally managed marine area in southern Madagascar, a three-year effort to integrate marine conservation with family planning services found few social barriers to the

use of contraception. The project significantly increased the uptake of family planning over the study period. The strategy, executed as part of a population, health, and environment (PHE) program, resulted in the avoidance of an estimated 355 unwanted pregnancies that otherwise would have occurred among a total population in the study area of 7,260.

The authors calculated that in addition to providing significant health benefits, the integrated services averted an ecological footprint of over 267 global hectares, based on average per capita environmental impacts in Madagascar. Costs were low, roughly US\$12,000 per year for contraceptives and family planning personnel, compared to \$85,000 spent annually on core natural resource conservation activities. The authors report that community members themselves welcomed help with family planning in part because of their own convictions that population pressures were reducing their fish catches and degrading other natural resources.

► **Key quotes:**

"By providing access to sexual and reproductive health services, Velondriake's clinics are empowering women to take control of their own future with the expanded life opportunities, whilst also engaging them in conservation. In this way the programme has strong potential to be transformative, not only through its own intrinsic public health and environmental benefits but also through its effects on attitudes, aspirations and self-confidence, all of which are fundamental to helping women participate as key stakeholders in conservation efforts. . . . [F]ishers commonly express concern that catches are declining . . . because of pressures from overpopulation. . . .

"Communities in the region have long recognized that population pressures threaten to undermine ongoing conservation efforts being developed to enable these communities to manage their marine and coastal resources sustainably. The provision of sexual and reproductive health services is thus accepted by Velondriake communities as a logical and natural resource management measure, and is seen by many villagers as a more rational, pragmatic and relevant conservation intervention than managing marine resource use through gear restrictions or spatial or temporal access controls."





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► **Assessment:**

This study is primarily a report on the results of a single PHE program, without attempting an ambitious comparison to comparable communities not receiving interventions or limited to either reproductive health or conservation interventions. (See [Leona D'Agnes et al.](#), 2010, annotation on page 100.) Its value lies in its limited quantification of steadily increasing uptake of family planning over the three years of the program effort, along with the authors' own more qualitative impressions of the reasons for these outcomes. (The paper's findings are somewhat weakened by insufficient data for comparison with the pre-intervention period.)

The authors' effort to quantify environmental impacts by estimating an averted ecological footprint from avoided unintended pregnancies probably would face some skepticism among conservation and environmental scientists. They nonetheless deserve credit for putting forward an indicator for discussion, given how difficult it is to show robust and lasting environmental benefits resulting from small-scale and short-term PHE projects. Given how few peer-reviewed studies of outcomes of PHE are found in the literature, this paper provides a useful overview of the concept and its impacts in one group of communities. Especially notable is the authors' conviction that the people in the community that the program serves clearly see the connections between their own demographic growth and the degradation of the resource base on which their livelihoods depend.

**Theresa H. Hoke et al., "Integrating Family Planning Promotion into the Work of Environmental Volunteers: A Population, Health and Environment Initiative in Kenya," *International Perspectives on Sexual and Reproductive Health*, vol. 41, no. 1 (March 2015), pp. 43–50, [www.guttmacher.org/pubs/journals/4104315.html](http://www.guttmacher.org/pubs/journals/4104315.html).**

Despite lacking health training and, in many cases, full literacy, environmental outreach workers in the Green Belt Movement (GBM) proved adept at educating rural women and men about family planning, this article reports. They also became enthusiastic promoters of the practice, responding in surveys that they believed family planning slows the growth of local populations, reducing consumption of natural resources and environmental degradation. The surveys also demonstrated that the so-called Green Volunteers' work interested men in family planning and stimulated spousal conversations on the topic, potentially increasing acceptance of the practice.

All of the 42 volunteers surveyed said they could name two or more natural resources affected by population growth. Groups of community members and tree-nursery workers (not associated with GBM), totaling an additional 174 respondents, also participated in focus groups. These participants tended to support the work of the Green Volunteers and to share their positive views about family planning and conservation.

► **Key quotes:**

"[B]y facilitating access to family planning services and publicizing their role in preventing unplanned pregnancies, environmental programs can offer a practical, immediate action that contributes to future conservation of natural resources. Meanwhile, the PHE [population, health and environment] approach offers family planning programs arguments beyond those related to health benefits to use when encouraging couples to plan pregnancies and consider contraceptive use. . . .

"Two-thirds [of the 42 surveyed Green Volunteers] reported that it was completely acceptable to discuss family planning at public meetings, and the remaining third said that it was sometimes acceptable, depending on the message.





When asked what family planning has in common with tree planting and GBM's other core activities, all Green Volunteers were able to articulate at least one way in which their new responsibilities were consistent with the GBM mission; the most common response was that slower population growth reduces consumption of natural resources and environmental degradation. All 42 Green Volunteers indicated their interest in continuing their EHP [environment, health and population] activities; 35 spontaneously mentioned a desire to continue educating on family planning in particular. . . .

"Specifically, GBM volunteers and members of the communities they served grasped the concept that contraceptive use for healthy timing and spacing of pregnancies could improve family well-being, increase women's economic productivity and conserve natural resources."

**► Assessment:**

This paper is valuable both for validating the concepts behind PHE—generally called EHP here to make the concept more acceptable for these audiences by placing the environment first. The responses of 216 volunteers, community members, and tree nursery workers produce more qualitative than quantitative data on the Green Belt Movement's work on family planning and conservation. Those response nonetheless add evidence that PHE can offer a catalytic integration of interventions to address both a deteriorating local environment and unmet need for contraception.

Moreover, the responses indirectly support the FPESA project's secondary hypothesis, that the family planning-environment linkage is of widespread interest well beyond educated audiences and the industrialized world. While many of the Green Volunteers are described as "semi-literate," their experience apparently tells them that adoption of family planning will slow population growth. And that, in turn, "reduces consumption of natural resources and environmental degradation." Finally, several volunteers and community members suggested that family planning facilitates women's work outside the home, including on conservation. The fact that the FPESA project has been unable to find literature supporting this assertion makes such comments interesting and useful.

## Disease

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**Anibal E. Carbajo et al., "Is Temperature the Main Cause of Dengue Rise in Non-endemic Countries? The Case of Argentina," *International Journal of Health Geographics*, vol. 11, no. 26 (2012), pp. 1–11, <https://doi.org/10.1186/1476-072X-11-26>.**

Efforts to model factors influencing the spread of dengue fever cases in Argentina found a combination of geography, climate, and population to be the most accurate predictor, these authors report. When considering each set of factors in isolation, however, demographic ones—especially the number of people in a province—proved most accurate in predicting where the infectious tropical disease would spread. Geographic factors, chiefly the distance between vulnerable humans and standing water, were second most likely to predict the spread of dengue fever. In comparison with these two categories, increases in temperature were least likely to predict where the disease would occur and spread.

Had only climatic factors been an issue, the authors note, a 2009 dengue epidemic in Argentina would not have been expected to happen until a 2-degree Celsius (3.6-degree Fahrenheit) rise in temperature occurred, well after 2050. Curiously, decreases in population in many districts were associated with high dengue occurrence. The researchers speculate that this relates to emigration from poverty-stricken areas already vulnerable to the disease. Another possibility is labor migration to countries or areas where the disease is more prevalent, with subsequent transmission to family members on visits home.

The authors recommend considering all three categories of factors when projecting the likely spread of dengue fever, with particular attention to where population density is high or changing significantly in either direction.

**► Key quotes:**

"Higher human population may be related to increased virus pressure resulting from higher travel rates. In addition, bigger cities are associated with more susceptible and overcrowded population and greater availability of containers acting as breeding habitats for *A. aegypti* [mosquitoes that carry the virus] as a consequence

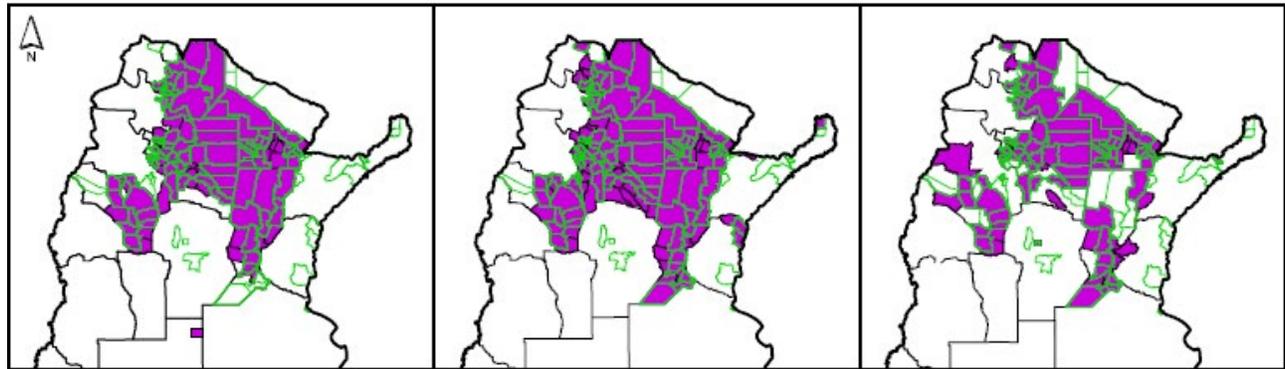




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Dengue occurrence according to the partial models.

Predicted dengue occurrence according to each of the partial models. Left, geographic; Middle, climatic; Right, demographic.



- Green square: District with dengue cases
Purple square: Modeled dengue occurrences
White square: Province

Illustration from the paper (Figure 5, page 6 of 11). Used by permission.

of uncontrolled urbanization. . . . Climate cannot be considered the main predictor of dengue distribution, as in fact demographic variables performed better [in the researchers' predictive models]."

Assessment:

Infectious disease may not immediately strike observers as being closely connected to environmental sustainability. But the global spike in emerging diseases in recent years demonstrates the interaction of environmental and human factors in influencing health. Projections of likely impacts of human-caused climate change often evaluate prospects that tropical infectious diseases such as malaria and dengue fever—a painful and sometimes fatal mosquito-borne viral disease affecting some 50 million people worldwide—will spread into temperate regions. Other factors often mentioned as causes of the spread of infectious diseases are increasing population density and the ease and speed of long-distance travel. These interactions became especially relevant in 2016 with the spread of the Zika virus, which has been linked with the birth defect microcephaly. Zika thus

brings a new urgency to universal access to contraception—needed for women and their partners at risk of infection to make their own decisions on the best timing of pregnancy for their circumstances.

It is in this context that this paper takes on particular relevance to the FPESA primary hypothesis. If its model, calculations, and conclusions are accurate and applicable elsewhere, it prioritizes three factors that are most likely to influence the spread of dengue fever: population, climate, and such geographic considerations as distance between people and standing water. As it happens, the same species of mosquitoes that spread dengue—chiefly Aedes aegypti and Aedes albopictus—also spread Zika. The paper finds that population density is the best predictor—better than distance to standing water, better than increases in temperature—of where dengue infection is likely to occur most readily. If this is confirmed by future research, it offers yet another issue related to environmental sustainability in which fertility decline, facilitated by family planning, may prove helpful over time.





## Crosscutting

**Corey J. A. Bradshaw and Barry W. Brook, “Human Population Reduction Is Not a Quick Fix for Environmental Problems,”** *Proceedings of the National Academy of Sciences*, vol. 111, no. 46 (18 November 2014), pp. 16610–15, <https://doi.org/10.1073/pnas.1410465111>. This paper was collaboratively assessed. See also three published responses to this paper at <https://doi.org/10.1073/pnas.1421989112>, <https://doi.org/10.1073/pnas.1422507112>, and <https://doi.org/10.1073/pnas.1501763112>, and the authors’ reply to two of these at <https://doi.org/10.1073/pnas.1423102112>.

Based on these authors’ projections, no realistic policies—and not even a one-time global catastrophe killing billions of people—would result in sufficient reductions in human population size to offer near-term solutions to environmental problems. Reversing rising global consumption offers a more realistic strategy for resolving these problems in that time frame, they assert. Over the long term, however, voluntary family planning and “reproduction education” could reduce future population size enough to alleviate pressure on natural resources, along with providing a range of health and other social benefits. The authors calculate that a world without unintended pregnancies would likely have about 7.5 billion people in 2100, while a two-child average family size worldwide would result in almost 3 billion more people by that year.

### ► Key quotes:

“Perhaps with a more planned (rather than forced) approach to family planning, substantial reductions in future population size are possible. Better family planning could be achieved not only by providing greater access to contraception, but through education, health improvements directed at infant mortality rates, and outreach that would assuage some of the negative social and cultural stigmas attached to their use. A greater commitment from high-income countries to fund such programs, especially in the developing world, is a key component of any future successes. . . .

“There are clearly many environmental and societal benefits to ongoing fertility reduction in the human population, but here we show that it is a solution long in the making from

which our great-great-great-great grandchildren might ultimately benefit, rather than people living today. It therefore cannot be argued to be the elephant in the room for immediate environmental sustainability and climate policy.”

### ► FPESA network assessments (10 total)

were predominantly favorable, although they included some strong criticisms and two overall neutral ratings. One assessor called the idea framing the research—that population reduction might be a near-term solution for environmental problems—a “straw man” not asserted seriously by anyone. This assessor noted that the authors’ own projections show the possibility of having far fewer people on the planet in 2100 if needs for family planning are fully met. One assessor argued that the authors ignored the possibility that, on local scales, feasible slowdowns in growth could produce valuable near-term environmental benefits, particularly for biodiversity and ecosystem health.

Two assessors used the word “arbitrary” in describing assumptions behind some of the authors’ population-growth scenarios, including the catastrophic ones. To its credit, the paper provoked unusually lengthy and thoughtful assessments. “[W]hat is the optimum population that would not exert pressure on the environment?” one assessor wondered. “[T]he world is already experiencing the benefit of fertility reduction in this century,” another wrote.

### ► Overall assessment:

This paper comes close to testing the primary FPESA hypothesis and appears at first glance to undermine it, especially given its provocative headline, which helped it garner some media attention. It is not part of the FPESA hypothesis, however, to assert that family planning is a “quick fix for environmental problems.” It is well understood that demographic momentum spurred by humanity’s vast childbearing population will propel growth for years or decades even after fertility rates fall to replacement level. The paper authors themselves declare that pressures related to population size do stress the environment and that family planning and related policies can brake and eventually reverse population growth. It seems extreme to assert, as the authors do, that only people living six generations in the future will see any environmental benefits from fertility reductions that begin today.

Two aspects of the paper distinguish it as somewhat unusual: One, the authors attempted a test of the demographic





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impacts of an undefined global catastrophe, resulting in the loss of 2 billion and 6 billion lives over five-year periods in the middle of the century. This is a type of mortality-increasing scenario that is absent from demographers' population projections. Oddly, however, the events and the conditions causing such a global calamity are assumed to place no constraints on fertility after five years. Two, the paper stimulated a published debate, with three scholars strongly criticizing its methodology and conclusions in a subsequent issue of the journal in which the paper was published. (The paper authors rejected two of the criticisms and stood by their work.) Such exchanges appear so far only in one other case in the FPESA database and are rare in scientific journals generally. It might be useful to the search for evidence and knowledge if there were more such scholarly debate.

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**Graeme S. Cumming et al., "Implications of Agricultural Transitions and Urbanization for Ecosystem Services,"** *Nature*, vol. 515, no. 7525 (6 November 2014), pp. 50–57, <https://doi.org/10.1038/nature13945>.

Population growth and urbanization increase the scale of human interaction with the environment to the point that societies could fall into traps that lead to their collapse, these authors argue based on a wide-ranging review of human-ecological interactions throughout history. Using case examples of China, Niger, Sweden, and other countries, they describe "green traps" as those encountered by growing populations that live in close connection to local natural resources. When growing populations adjust to increasing density by developing technologies that remove people from direct interactions with nature, as occurred in the Industrial Revolution, these populations risk running into "red traps." In these traps, there is little awareness of dependence on the environment until key tipping points are crossed. Modern civilization's increasing reliance on economic systems that insulate people from feedback on environmental conditions threatens sustainable resource use, the authors conclude.

► **Key quotes:**

"[I]f a local equilibrium between resource use and human population size is maintained, a 'green loop' that avoids

long-term degradation of ecosystems can be sustained. The green loop starts to break down when human populations grow as a result of technological change that increases food supply and life expectancy. . . . The key slow-changing variables in the system are increasing human population and population density, which create amplifying feedbacks that rapidly ratchet up the demand for ESS [ecosystem goods and services] and non-ESS; technological change, which accelerates population growth and enables a growing proportion of people to obtain their livelihoods in ways unrelated to agriculture; and a loss of biodiversity, which can lead to eventual socioeconomic collapse. . . . Ageing and declining post-peak human populations will bring new dynamics and possibly, if sufficient biodiversity remains, the potential to return to more direct interactions with ESS. . . .

"The red loop has bought . . . societies additional time, and the best-case scenario is that socioeconomic feedbacks within the red loop (for example, declining fertility, or simply longer inter-generational times and smaller families) could reduce population growth and ecological footprints before these systems enter a red trap and collapse."

► **Assessment:**

This paper is more a theoretical and historical review than an empirical test of the authors' ambitious hypothesis. Yet it provides an important and thought-provoking analytical overview of interactions of humans and their natural environment over time. It makes no mention of family planning or any other strategy or policy that might influence population change. It is nonetheless a rare exploration of the actual mechanisms by which population growth can threaten environmental sustainability.

Technological adaptation to stresses caused by increasing population density, the authors argue, can have the positive result of better nutrition and longer life expectancy—at least temporarily. But the price paid is continued expansion of new environmental stresses that may become evident, and hazardous, only when they are too late to successfully mitigate or adapt to. This article is relevant not just to FPESA's hypotheses but to the project's mission: the consideration of whether family planning, via demographic and non-demographic pathways, might help modern civilization avoid a "red trap" that leads to environmental and social collapse.



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Is there a scientific evidence base demonstrating that the use of family planning contributes to environmental sustainability? This report explores that question based on a two-year collaborative review of more than 900 peer-reviewed research papers from around the world published from 2005 through early 2016.

No scientific discipline systematically examines or confirms the influence of voluntary family planning on environmental problems. Looking at pathways that lead through the slowing of population growth and the empowerment of women, however, the **Family Planning and Environmental Sustainability Assessment (FPESA)** found a wide-ranging literature generally affirming that this influence is both real and constructive.

FPESA identified considerable evidence supporting—and very little refuting—the statement that the practice of voluntary family planning promotes environmental benefits and that expanding access to it can help bring about an environmentally sustainable world that meets human needs. The diversity of researchers interested in the family-planning connection to the environment is high, the report also concludes.

The report features the project's findings, perspectives on major related issues by eight authors, and an annotated bibliography containing assessments of 50 of the most compelling papers relevant to the linkage.



Through research and outreach that inspire action, the **Worldwatch Institute** works to accelerate the transition to a sustainable world that meets human needs. The Institute's top mission objectives are universal access to renewable energy and nutritious food, expansion of environmentally sound jobs and development, transformation of cultures from consumerism to sustainability, and an early end to population growth through healthy and intentional childbearing.

