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# POPULATION-HEALTH-ENVIRONMENT (PHE) SYNERGIES? EVIDENCE FROM USAID-SPONSORED PROGRAMS IN AFRICAN AND ASIAN CORE CONSERVATION AREAS

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## Abstract

Do Population-Health-Environment (PHE) initiatives provide synergies above and beyond more traditional singular efforts? Some development practitioners note the potential to combine solutions to population-environment (PE) together with health-environment (HE) initiatives for the global conservation of natural resources in developing countries while simultaneously improving human health and livelihood security. PHE advocates in the policy arena have promoted the importance of integrating "conservation, health, and family planning (FP) interventions" in the management of some of the world's most socio-economically impoverished as well as ecologically rich environments. However, scant scholarly evidence supports these claims. In this paper, we probe the potential effectiveness of integrated PHE investments for conservation outcomes. Data was collected in World Wildlife Fund (WWF) designated high priority marine and terrestrial conservation sites with USAID-sponsored PHE programs in the Philippines, Nepal, India, Mozambique, Madagascar, Kenya, Cameroon and the Central African Republic. We conducted individual and focus-group interviews with 754 individuals: WWF staff, staff from partner health and environment organizations, and local men and women in the program service areas. Quantitative and qualitative results indicate diverse, and in some cases dramatic, improvements in maternal and child health and conservation measures that overall appeared to benefit from the integrative PHE approach. Results also point toward the importance of promoting PHE interventions within the framework of livelihood improvement.

***Keywords:*** *Population-Health-Environment, conservation, sustainable development, family planning, fertility, migration.*

## 1. INTRODUCTION

### 1.1 Population, Health, and Environment Interactions

Growing population pressures on natural resources, especially fertility and migration, are among the core foci of Population-Environment (PE) research. Yet the relationships embedded in PE solutions vary significantly due to the complexities of different places. While highlighted in only a minority of studies as a major driver, PE dynamics is well established as a significant

determinant of land intensification, extensification, and degradation (Carr 2005; Carr 2002; Carr and Bilsborrow 2001; Miller et al. 2010; Mishra 2002; Pan et al. 2004; Walker et al. 2002). Fertility and in-migration have been positively linked to deforestation in Latin American agricultural frontiers (e.g., Carr 2008; Pan and López-Carr 2016) and migrant remittances have been observed to increase consumption and increase pressure on the local environment (Davis and Lopez-Carr 2010). Yet PE dynamics are far from simple. Where human populations depend on local natural resources for survival in remote areas of high biodiversity, per capita human impact on the environments of high conservation priority has been observed by some scholars to be particularly high in developed and developing regions and in marine and terrestrial environments (Chen and Lopez-Carr 2015; Carr, Suter, Barbieri, 2006).

Case studies have demonstrated that there is a large variation in regards to the effects that population change can have on local environments (Carr 2008; Carr et al. 2009). In response to the inherent complexity of these interrelated systems, researchers have applied models to tease out the relative impacts of different variables (Arlinghaus et al. 2008; Miller 2010). Some authors highlight how PE dynamics may form positive feedback loops, in which environmental decline contributes to high population growth rates, which further degrades environmental conditions (Bhattacharya & Innes 2008). More research is needed, however, to understand the relative contributions of distinct variables in impacting coupled PE outcomes under different population and environmental conditions and across distinct regional and local contexts. Even less is known about the role health and livelihoods play in PE dynamics and more research is needed in this area before conclusive evidence emerges.

### 1.2 Population and Environment in Protected Areas

Population pressures are particularly high in and around conservation priority areas in the developing world; these populations, in turn, suffer disproportionate climate change impacts on fragile subsistence agriculture based livelihoods (Aukema et al 2017). One widespread form of environmental intervention is the establishment of protected areas (PAs): politically delineated areas where human access or use is limited or prohibited. When excluding the needs of resource-dependent locals, hard-line, or "fortress", protection strategies can limit economic development opportunities and increase poverty at the local and nation scales, which, in turn, can lead to environmentally unsustainable resource use as locals forfeit future sustenance for near-term survival (Adams et al. 2004; Barrett, Travis, and Dasgupta 2011; Naughton-Treves, Holland, and Brandon 2005; Andam et al 2010).

Another unintended consequence of protected areas can be increased exploitation and degradation of the environment surrounding them, due to increased population growth outside of the borders, and in-migration to take advantage of NGO or government-sponsored development opportunities (Bamford, Ferrol-Schulte, and Wathan 2014; Carr 2009; Estes et al. 2012; Hartter et al. 2015; Wittemyer et al. 2008). When planned at multiple scales and across multiple institutions, environmental degradation surrounding Pas does not universally follow PA establishment (Joppa, Loarie, and Pimm 2009).

### 1.3 Family Planning and Poverty

Research on the relationship between high fertility and poverty has evolved through a number of contrasting viewpoints (Kelley 1988; Merrick 2002; Sinding 2009). The religious and political controversies that can accompany contraception initiatives can cause difficulty in successful implementation and adoption. Despite this, it does seem to be clear that nearly all women choose to plan their families when given the choice and that providing family planning resources along with the other necessary conditions of economic development can result in

significantly improved poverty reduction rates in the developing world. FP is accompanied, or enabled, by increased investment in human capital in the form of health and education spending, and increased labor force participation for women (Ashraf, Weil, and Wilde 2013; Canning and Schultz 2012; Das Gupta, Bongaarts, and Cleland 2011; Miller 2010).

### 1.4 Family Planning and Conservation

In addition to economic improvements, associations have emerged in some research between family planning and conservation outcomes. Although research in this area remains nascent, several studies have demonstrated that family planning significantly lowered pressures on local conservation outcomes (Das Gupta, Bongaarts, and Cleland 2011; Stephenson et al. 2013). More, appropriately designed research is needed to demonstrate potential family planning-conservation synergies (Bremner et al 2013). Recent calls for holistic human and planetary health research and practice may serve as a ripe framework for advancing such research (Whitmee et al 2015).

### 1.5 Health and Environment

Health-Environment (HE) dynamics describe a wide range of issues including disease transmission, nutrition, fertility, and access to healthcare. Some argue that the developing world typically faces the same HE problems as the developed, just without as many resources to combat their effects (Von Schirnding 2002). However, HE dynamics are significantly more problematic in developing countries where ecosystem services of surrounding natural environments are often compromised, which can exacerbate socio-economic challenges and lead to poor health. The former has been studied in some depth, while the latter is just recently receiving due attention. Nutrient deficiency is often a direct result of poor water quality (Reimann et al. 2003), chronic lung disease a result of air pollution (Smith 1993), and lack of proper shelter a driver of vector-borne environmental diseases (Von Schirnding 2002). These are some complex and multidimensional dynamics inherent in coupled HE processes.

Climate change promises winners and losers in the HE equation. In much of the developing world, it will further exacerbate already existing HE problems. Climate change has been identified as a key driver of the increasing rates of disease among populations, especially among children, as well as in decreasing food security (Brown and Funk 2008; Lobel 2008; UNICEF 2008; Shea 2007; López-Carr and López-Carr 2014). For the most part, climate change HE solutions to date have been designed to provide mitigation measures for developing regions (Ali and Jacobs 2013; Chapman et al. 2014; Gaffikin 2013; Lopez-Carr and Marter-Kenyon 2015). Ultimately, where population pressures collide with climate change and natural resource pressures, population size, dynamics, and distribution are key variables in sustainable development solutions (Lopez-Carr et al. 2010; 2014; 2016). While the literature is now large on human impacts on the environment, less is known about how populations interact with the environment to produce salutary environments for people and the planet.

### 1.6 PHE Evidence

As the effects of global environmental change are becoming increasingly deleterious, identifying population and health, independently and in conjunction, as components of environmental consequences is critical for a successful analysis of resource management. Conversely, identifying resource impacts on human population and health outcomes is essential for achieving holistic health policies (Pan and Lopez-Carr 2016). Population-Health-Environment is an integrated framework for development initiatives. PHE projects attempt to

improve outcomes in all three dimensions by combining the solutions to population-environment (PE) with health-environment (HE) for the global conservation of natural resources in developing countries. In doing so, PHE recognizes the importance of considering "conservation, health, and family planning interventions" in the management of some of the world's most impoverished as well as ecologically rich environments (Hahn, Anandaraja, and D'Agnes, 2011; Honzak and López-Carr 2012; López-Carr 2013).

PHE was adopted as an approach by a number of international development agencies and organizations at the beginning of the new century, including the United States Agency for International Development (USAID), the World Wildlife Fund (WWF), Johnsons and Johnson Foundation, Pathfinder International, The Packard Foundation, and others (Honzak and Lopez-Carr 2012). It has been championed by sources in conservation and development agencies and think tanks in the so called 'grey literature', notably by the Woodrow Wilson Center and its Director of Population, Environmental Security, and Resilience, Roger-Mark De Souza (e.g. De Souza, Williams, and Meyerson 2003). USAID and multiple international and local organizations have implemented a number of initiatives in the developing world in places such as the Phillipines, Ethiopia, Kenya, Madagascar, Nepal, and Tanzania (Hahn, Anandaraja, and D'Agnes 2011; Harris et al. 2012; Hoke et al. 2015; Gonsalves et al. 2015; Sinaga et al. 2015; Torell et al. 2012).

Numerous evaluations suggest integrated PHE program effectiveness compared to single sector initiatives. A comparative cross-sectional evaluation of a PHE project's family planning (FP) outcomes in Ethiopia (n=960) found that the program was effective in this regard, as well as providing "better integration of environmental conservation activities…into FP and health activities" (Sinaga et al. 2015). A qualitative, interview-based evaluation of a different PHE project in Ethiopia found that integration of a community based FP intervention into an existing environmental program resulted in positive outcomes and synergies (Gonsalves et al. 2015). Similarly, the introduction of FP content into an existing marine conservation program in coastal Madagascar led to increased access of FP services, which was enhanced by infrastructure and networks of the pre-existing program. Positive synergies were achieved as community members who have not engaged in the conservation initiative were contacted and engaged when they accessed FP services. In addition, researchers found that this combination of interventions resonated positively with locals' perceptions of the program and enhanced the marketing and education efforts (Harris et al. 2012; Mohan and Shellard 2014).

A robust evaluation of a fully integrated PHE program in Nepal found positive outcomes in pre-determined population, health, and environmental outcomes (Hahn, Anandaraja, and D'Agnes 2011). In the Philippines, D'Agnes and others (2010) demonstrated the success of integrated PHE in tackling both reproductive health and sustainable fishing practices, as compared to separate interventions. Similar island-based PHE projects have been implemented in places like Madagascar and Kenya and have also shown success (Hoke et al. 2015). Non-peer reviewed published evaluations of PHE programs told much the same story (Diamond 2010). We found no published work where PHE programs were deemed to be ineffective, save one non-academic publication where the program's impacts seemed very limited (Torell and McNally 2013). However, more attention will be required to scale-up PHE projects through improved standardization of data collection and analysis (De Souza 2008; Ghiron et al 2014).

In this paper, we review the evidence linking population, health and environmental outcomes in WWF-managed PHE programs in several priority global conservation areas. We describe the study sites and data collection below followed by a presentation of results of overall program effectiveness. We conclude by summarizing findings and discussing future research opportunities and policy implications.

## 2. METHODS

### 2.1 Study Sites

We evaluated a multi-country PHE program, funded by USAID and Johnson & Johnson Foundation during the first decade of the new millennium. The countries involved in the project included the Philippines, Nepal, India, Mozambique, Madagascar, Kenya, Cameroon, and the Central African Republic. The program sites were chosen, in collaboration with WWF, because of their designation as high priority marine and terrestrial conservation areas, and the urgency of need for the local populations. The particulars of the project differed for each site, but each shared goals to facilitate the provision of basic health care, FP, and promote environmental conservation. Promotors of PHE believe that conducting these efforts in concert adds value to each independent outcome. In remote, ecologically rich ecosystems, people's well-being is closely tied to the sustainability of the natural resource base. In such regions, of which six of the eight studied are home to indigenous peoples, survival and well-being depend largely on subsistence agriculture and successful stewardship of natural resources through hunting and gathering, fishing and forest resource extraction for food, medicine and building materials. People with some of the highest poverty, fertility and mortality rates on Earth interact intimately with some of the most precious ecosystems. In sum, this is where the human-environment coexistence is in flux; it is where human populations grow most rapidly, suffer most acutely and directly depend upon and effect the richest forest and marine ecosystems.

The eight PHE sites are located within marine and terrestrial ecosystems in southern and Southeast Asia and central and eastern Africa and Madagascar, ranging from 80 to over 20,000 square kilometers (Table 1). Quirimbas National Park (QNP) in Mozambique and Kiunga Marine National Reserve (KMNR) in Kenya combine marine and terrestrial systems. The Roxas District project of the Philippines in the Coral Triangle is a marine site.

**Table 1.** Geographic and Human Landscapes Evaluated, Conservation Area, and Subjects interviewed.

| **Country** | **Priority place** | **Ecoscape** | **Area (sq km)** | **Number in focus meetings** |
|---|---|---|---|---|
| Philippines | Coral Triangle | Marine | 1,174 | 118 |
| Nepal | Eastern Himalayas | Terrestrial | 83 | 64 |
| India | Eastern Himalayas | Terrestrial | 600 | 144 |
| Madagascar | Spiny Forest | Terrestrial | 21,000 | 4 |
| Mozambique | Coastal East Africa | Marine & Terrestrial | 7,500 | 210 |
| Kenya | Coastal East Africa | Marine & Terrestrial | 600 | 74 |
| CAR | Congo Basin | Terrestrial | 3,159 | 60 |
| Cameroon | Congo Basin | Terrestrial | 21,789 | 80 |
| ***Totals*** | | | ***55,905*** | ***754*** |

The remaining five sites are terrestrial. The Indian and Nepalese sites face each other across their country's borders south of the foothills of the Himalayas, in a region known as the Terai Arc. Madagascar's site is in the unique dry Spiny Forest. Lastly, the Central African Republic (CAR) and Cameroon sites are nestled deep within the Trinational Sangha landscape in the Congo Basin's humid tropical forest. Each site is home to anywhere from 10,000 to 125,000 people with the number of communities ranging from 7 to 130. The CAR and Philippines sites had 7 communities. The Mozambique site had 130 communities. The remaining sites had 11-

32 communities with populations ranging in size from a few hundred to a few thousand people (Table 2).

**Table 2.** Demographics of Intervention Sites.

| Country | Evaluation Site | Target population | Target communities | Demographic stage | Desired no. children |
|---|---|---|---|---|---|
| Philippines | Coral Triangle | 22,500 | 7 | Middle | 2.5 |
| Nepal | Eastern Himalayas | 18,300 | 32 | Early-Middle | 2.5 |
| India | Eastern Himalayas | 50,000 | 25 | Early-Middle | 2.5 |
| Madagascar | Spiny Forest | 20,000 | 23 | Early | 7 |
| Mozambique | Coastal East Africa | 125,000 | 130 | Early | 7 |
| Kenya | Coastal East Africa | 21,000 | 11 | Early-Middle | 4 |
| CAR | Congo Basin | 12,000 | 7 | Early | 8 |
| Cameroon | Congo Basin | 12,000 | 20 | Early | 6 |
| ***Totals/Mean*** | | ***280,800*** | ***230*** | | *4.9375* |

Consonant with their remote locations, the development and demographic stage of the regions are low. However, there is some notable heterogeneity. For example, populations of Roxas District in the Philippines have clearly progressed through much of the early demographic and development stages. Fishing communities are integrated into local government policies and health care, desired family size is below three births per woman, and mortality has fallen dramatically. Conversely, the people inhabiting the Dzanga-Sangha forest of the CAR and the Spiny Forest of Madagascar remain at the earliest stages of these key transitions. Desired family size is very high, life expectancy remains below 40 years of age, infant mortality in some cases exceeds 50 percent, and communities survive largely without any reliable government presence. In some instances, different development stages were evident within the same PHE site. For instance, the Ba'Aka forest people of the CAR, who had recently settled on the forest edge, and the Boni people, living as hunters and gatherers and incipient agriculturalists on the Kenyan and Somali border, were at the very early stages of the development and demographic transitions, notably lagging behind their Bantu and coastal Muslim neighbors respectively.

Each site received between $30,000 and $139,437 annually (2007 figures) for their program and was in the third, fourth, or fifth year of funding at the time of data collection (Table 3)[1].

**Table 3.** Investment per Intervention Site.

| Country | Priority place | 2007 funding | USAID | Johnson & Johnson | Years of funding | Funding per capita |
|---|---|---|---|---|---|---|
| Philippines | Coral Triangle | $70,000 | $70,000 | n/a | 3 | $3.11 |
| Nepal | Eastern Himalayas | $79,993 | $38,231 | $41,762 | 4 | $4.37 |
| India | Eastern Himalayas | $30,000 | n/a | $30,000 | 4 | $1.66 |
| Madagascar | Spiny Forest | $107,725 | $107,725 | n/a | 4 | $5.39 |
| Mozambique | Coastal East Africa | $46,000 | n/a | $46,000 | 4 | $0.37 |
| Kenya | Coastal East Africa | $139,437 | $85,000 | $54,437 | 4 | $6.64 |
| CAR | Congo Basin | $49,000 | n/a | $49,000 | 4 | $4.08 |

[1] All figures are net of WWF-US overhead, i.e. they are the amounts that WWF-US sent to the field. USAID funds are for October 2006–September 2007. J & J funds are for calendar year 2007. All USAID funds are from the Office of Population and Reproductive Health, Global Bureau, except for Nepal, which was funded by the USAID Nepal Mission.

| | | | | | | |
|---|---|---|---|---|---|---|
| Cameroon | Congo Basin | $45,400 | n/a | $45,400 | 5 | $3.78 |
| ***Total/Mean*** | | ***$567,555*** | ***$300,956*** | ***$266,599*** | ***4*** | ***$2.02*** |

Budgets often varied from year to year. Some of the PHE interventions we evaluated built capacity or infrastructure. Others were aimed at direct outcomes. Among these were direct interventions, such as directly saving individual turtles from fishing, while other interventions were preventive, such as preventing human impacts on turtles by seizing illegal fishing gear.

Similarly, some population and health outcomes were indirect and others direct. In Central Africa, poaching was a primary conservation challenge while in other terrestrial regions, agricultural expansion and fuelwood collection were primary environmental concerns. Marine sites, conversely, were combatting overfishing (Table 4).

**Table 4.** Human Threats to the Environment

| **Country** | **Priority place** | **Main Eco-threat** |
|---|---|---|
| Philippines | Coral Triangle | Illegal & over-fishing |
| Nepal | Eastern Himalayas | Fuelwood collection/cattle |
| India | Eastern Himalayas | Fuelwood collection/cattle |
| Madagascar | Spiny Forest | Agriculture/fuelwood collection |
| Mozambique | Coastal East Africa | Agriculture/illegal fishing |
| Kenya | Coastal East Africa | Fuelwood/illegal & over-fishing |
| CAR | Congo Basin | Poaching |
| Cameroon | Congo Basin | Poaching |

Interventions were prioritized according to the distinct conservation challenges facing each area (Table 5).

**Table 5.** Interventions

| **Area of Program** | **Main environmental intervention** | **Main health intervention(s)** | **Reserve Established** | **Clean Water Provided** | **Livelihood Intervention** | **Food security intervention** |
|---|---|---|---|---|---|---|
| Coral Triangle, Philippines | Sanctuaries/fishing regulations | FP/MCH | Yes | | Yes | Yes |
| Eastern Himalayas, Nepal | Fuel-efficiency | FP/MCH/HIV/Infectious Diseases | | Yes | Yes | |
| Eastern Himalayas, India | Fuel-efficiency | Infectious Diseases | | | Yes | Yes |
| Spiny Forest, Madagascar | Forest protection | FP/MCH/Infectious Diseases | | | | |
| Coastal East Africa, Mozambique | Sanctuaries/fishing regulations | Nutrition | Yes | | | Yes |
| Coastal East Africa, Kenya | Sanctuaries/fishing regulations | FP/MCH/HIV | Yes | Yes | Yes | Yes |
| Congo Basin, CAR | Hunting regulations | FP/MCH/HIV/ Infectious Diseases | | Yes | Yes | Yes |
| Congo Basin, Cameroon | Hunting regulations | FP/MCH/HIV Infectious Diseases | | Yes | | |

How successful were the WWF PHE programs in improving population, health and environmental outcomes in target sites?

## 2.2 Data Collection Methods

The lead author conducted individual and focus-group interviews with 754 individuals: WWF staff, staff from partner health and environment organizations, and local men and women in the program service areas (Table 1). Key informants were interviewed, including village leaders and local NGO and ministry representatives, health workers, and agricultural extension agents. At least three villagers were selected at random for interviews at each program site. A brainstorming and conceptual linking activity was conducted with a selection of local villagers, NGO, and government staff, to record and prioritize PHE synergies and to illustrate the synergistic pathways. Conversely, barriers to beneficial PHE linkages were also identified. Lastly, focus groups were conducted to capture diverse observations among locals regarding potential PHE synergies.

## 3. RESULTS

### 3.1 Population

The projects demonstrated mixed success regarding population outcomes. Capacity building for FP remains as diverse as the levels in the demographic transition in the target areas—from rudimentary or absent at one end of the spectrum to well advanced and sustainable at the other end. Several problems have limited success. First, the poorest sites, such as the Ba'Aka in the CAR, and Madagascar, had relatively low demand for FP. Relatively great demand exists for basic health care and nutrition, to prevent deaths, largely among infants, and to combat easily controllable infectious diseases. In these places, little progress in FP indicators was observed in the first several years of the projects. This result is unsurprising for populations in the early stages of the demographic transition. In these areas, mortality must fall and livelihoods must become more secure in order to generate demand for FP. Working first on mortality and subsistence is almost certainly a more sustainable path to ultimately reducing family size through FP adoption.

Despite these restrictions, the Contraceptive Prevalence Rate (CPR) among women of reproductive age resulted in varying but notable changes (Table 6).

**Table 6.** Changes in Contraceptive Prevalence among Women of Reproductive Age.

| Area of Program | Pre-intervention | At time of evaluation | Percent Change |
|---|---|---|---|
| Kiunga District , Kenya | 7% | 68% | 871 |
| Mad Spiny Forest, Madagascar | 6% | 11% | 83 |
| Roxas District, Philippines | 32% | 33% | 3 |
| Khata Corridor, Nepal | 43% | 50% | 16 |

*Source: WWF PMP 2007 and Tal Nepal Annual Report 2007.*

For example, CPR increased dramatically in the Kiunga district of Kenya, nearly doubled in Madagascar's Spiny Forest, increased by nearly 20 percent from 2006 to 2007 in Nepal's Khata region and increased slightly in Roxas district, Philippines. Adequate data on CPR are unavailable for other sites due to nonexistent or unreliable collection methods. This is unfortunate because CPR—a more immediate proxy for fertility reduction, as opposed to the longer duration needed to properly measure fertility rate change - may be the most appropriate short-term indicator for progress within the population component of PHE projects.

## 3.2 Health

The positive results of the PHE projects on health outcomes were substantial and rapid (Table 7).

**Table 7.** Changes in Health Outcomes.

| **Area of Program** | | **Pre-intervention** | **At time of evaluation** | **Percent Change** |
|---|---|---|---|---|
| Kiunga District , Kenya | Children under 5 immunized | <30% | 100% | >330% |
| | Community Based Distributors (CBDs) trained | 17 | 46 | 171 |
| | No. of persons trained in health service delivery | 47 | 81 | 72 |
| Roxas District, Philippines | No. of persons trained in health service delivery | 29 | 50 | 72 |
| Mad Spiny Forest, Madagascar | No. of persons trained in health service delivery | 91 | 96 | 5 |
| Congo Basin, Cameroon | Pit latrines built | 0 | 800 | NA |
| | Percent of children under 5 with diarrhea | 7% | 1.40% | -80 |

*Source: WWF PMP 2007 and data collected in the field by Carr and Oglethorpe, 2007.*

Infant mortality rates dropped dramatically within months in several sites. Improved water and sanitation efforts, basic health care provision and anti-malarial treatment and mosquito nets reduced infant mortality. Estimates from the WWF director and health partners in Kenya's Kiunga National Reserve suggest that vaccination campaigns resulted in complete coverage for children under five. Prior to these campaigns, coverage was about one-third of this age group. Although there is evidence that similarly impressive results were achieved elsewhere, these results are not supported by standardized data. In India, although seven core villages are the sites of the camps, a total of 25 villages are reached since villagers from nearby communities travel to the health camps. In Cameroon, following the buildup of pit latrines, the number of new childhood diarrhea cases plummeted from 7% to under 2%.

Key to project success—and antecedent to any sustainable outcomes that can be attributable to the project—was the successful development of local health infrastructure and capacity building. Capacity-building results varied according to the number of years the projects were funded, existing infrastructure, and the education level of locals. Where some infrastructure existed and where there was some level of literacy, training developed rapidly. For example, from 2005 to 2007 the number of community-based health volunteers trained in Kenya expanded from an initial group of 47 to more than 80. In the Philippines, trained health volunteers swelled from 29 to 50 during the same period. Conversely, the CAR has had difficulty training local volunteers (Table 7), due at least in part to low literacy levels: Among the Ba'Aka, one of several local groups, it is rare to find even one literate person among many clans. This makes it very difficult to establish the need for health volunteers in the first place and further hampers the effective communication of skills and knowledge necessary for the position. Nevertheless, two Ba'Aka play important roles in the CAR PHE project and are fundamental reasons the Ba'Aka attend the clinic. Two exceptions here are India and Madagascar. The locals in India's Terai are largely literate and enjoy at least elementary education. Yet, despite excellent relations between WWF and locals and their desire and ability to become more involved with improving health in their communities, local capacity remained

undeveloped. Conversely, in Madagascar, despite low literacy and education among locals and less flexible USAID funding, nearly 100 people were trained.

### 3.3 Environment

In the Philippines, Kenya and Mozambique, "no-take" marine sanctuaries were established. In the older sanctuaries, locals reported that in the less than two years since the marine conservation zones were implemented, fish volume had at least doubled while fish diversity also increased (Table 8).

**Table 8.** Change in Environmental Outcomes.

| | **Indicator** | **Pre-intervention** | **At Time of Evaluation** | **Percent Change** |
|---|---|---|---|---|
| Kiunga District , Kenya | No. of turtle nests reported | 98 | 123 | 25 |
| | Percent of turtles nests reported by community | 50% | 72% | 22 |
| | Percent of registered fishermen in the KMNR using sustainable fishing gear* | 89% | 100% | 11 |
| Mad Spiny Forest, Madagascar | Percent of households using fuel-saving stoves | approx. 0** | 10% | NA |
| | Tree nurseries | 3 | 7% | 133 |
| | Trees planted | 2,160 | 106,250 | 4,819 |
| Roxas District, Philippines | No. of boat patrols conducted for illegal fishing | 0 | 70 | NA |
| | No. of apprehensions & cases filed in court for illegal fishing activities | 0 | 8 | NA |
| | KG fish caught per man-hour (CPUE) | 0.7 to 2.4 | 1 to 3 | NA |
| Eastern Himalayas, India | Percent households using gas | 20% | 45% | 125% |
| | Fuelwood collection decrease among households | NA | NA | 65% |

In Kenya, a 22 percent increase (from 50 to 72 percent) of marine turtle nests were reported by communities in Kiunga Reserve. These sanctuaries had immediate impacts not only on conservation outcomes but also on fisher family well-being and nutrition. In Mozambique, the increase in marine richness within the sanctuaries had the spillover effect of enhancing fish catches outside of the sanctuaries. Human population outcomes were also influenced by the increased fish catches. Perhaps contrary to conservation outcomes in the short term, the impact has been through an in-migration rate exceeding 5 percent yearly following the establishment of the sanctuary, according to local informants.

On the terrestrial side, in Madagascar's Spiny Forest, the project catalyzed the increase in tree nurseries from 3 to 7 and the number of tree plantings from 2,160 to 106,250, accompanied by government recognition of almost 98,000 ha. of new areas under community forestry management. In an effort to preserve these forests and increase food security, locals were trained in composting and in the creation of "curvas de nivel" (trench and dyke) agriculture. Both practices promise to reduce soil erosion and capture soil nutrients and water for reuse. Early adopters were demonstrably enthusiastic about increased yields observed in their first harvest year with the new techniques; several neighboring villages subsequently adopted the

approach. Lastly, in India, households in the project area changed their energy use from locally collected firewood to liquefied petroleum gas, from less than 20 percent of households using this cleaner energy source before the intervention to almost 50 percent. This change resulted in an estimated 60 to 70 percent reduction in fuelwood collection.

### 3.4 PHE Synergies?

Although we were unable to apply a standardized experimental design, results suggest that WWF's population and health work generated goodwill for environmental conservation outcomes. Indirectly, community commitment was fostered through an understanding of linkages between health and the environment. In other cases, the exchange is more direct, for example through an increased quantity and quality of working hours enabled by improved health. A potentially positive feedback loop exists where conservation efforts lead to increased resource availability, which leads to better nutrition, achieved in fewer hours of work, which ultimately gives people more time to spend on conservation efforts (Honzak and Lopez-Carr 2012).

## 4. CONCLUSION

Life expectancy in the developing world remains largely predicted by infant mortality. It is among children under age five where mortality is concentrated in the poorest countries. And it is here where FP, livelihood, sustainable and just food production and security investments provide the biggest yield. Results suggest progress in reducing childhood mortality across the PHE sites. Sometimes, as with latrine construction in Cameroon (reducing childhood deaths from gastrointestinal infections) and with malaria prevention efforts in Kenya, death is averted with trust, teaching, knowledge and the volition to change. However, without doubt, when planned with appropriate cultural sensitivity and local buy-in, even modest financing can make a dramatic impact. It appears that the distribution of malaria nets and antimalarial pills in most of the sites has notably lowered malaria rates. Although numerical data are not readily available for each country, interviews corroborate noticeable reductions in infections—in some cases, dramatically. This is especially salient where, for example in Kiunga Reserve, several methods are used in tandem to combat malaria, including using malaria nets, taking antimalarial drugs, covering wells and clearing stagnant water sources. Similarly, antibacterial drugs, vitamins and other basic medicines, although provided only sporadically in some instances (for example with monthly health camps), have apparently had important positive effects on childhood survival. Lastly, sanitation campaigns, including the construction of latrines and the development of clean water sources, have helped to lower several diseases, most notably childhood gastrointestinal infections, which are a leading cause of infant death.

A common denominator of success across sites was effective collaboration with health partners. Building capacity among locals and health partners is necessary for effective outcomes and their sustainability. Where partnerships are more developed, stakeholders yield benefits from the relationship as well. For example, in the Philippines and Kenya, the involvement of both NGOs (nongovernment organizations) and GOs (government organizations), particularly the MoH (Ministry of Health) with health and conservation NGOs, enabled the team to accomplish more than anyone could achieve, especially where NGOs filled geographic vacuums, especially conservation NGOs, where government institutes have little to no presence.

An important, perhaps underappreciated, aspect of a successful PHE program is the selection of an appropriate geographical target for integrated PHE interventions. With the exception of Mozambique, all PHE programs target between 5,000 and 50,000 people in 5 to

30 villages in priority biodiversity sites or landscapes where there are strong human-environment interactions. At the modest funding available to these efforts, larger scale projects may have diluted their impact had they expanded their geographic scope. Further related to scale, in addition to the internal synergistic effect of the PHE programs, external synergy has also been accomplished through leveraging PHE resources to acquire further funding.

The WWF PHE programs were run at $.37 to $6.64 per capita annually, thus seemingly challenging two dominant paradigms operating in development assistance. The first relates to the demographic transition and, more specifically, the urban transition. During the coming decades, all the world's several billion net additional people will live in the world's poorest cities. Yet this belies the fact that in many conservation priority areas the demographic transition has scarcely commenced. What will be the impact of progress, or lack of, through the demographic transition? This cost efficiency also challenges the notion that has dominated development assistance in recent years that agencies should invest their efforts in urban areas to achieve the greatest yield. Although certainly more people can be accessed at less cost per person in urban areas, the qualitatively distinct human-environment milieu of high-priority ecological priority demands a revisiting of this assumption.

The results of those WWF PHE programs also strongly point toward the importance of investing in livelihoods in tandem with PHE interventions. Invoking livelihoods is key for selling PHE: People think in terms of their livelihoods first and see their relationship with the environment through a livelihood lens. Involving livelihoods is also key for implementing PHE programs: People struggling to make ends meet do not enjoy the leisure time to practice conservation as a hobby; it must be integrated seamlessly into how people survive and thrive. Livelihoods are also important for stimulating demand for FP. Although human populations increase in the short term where environmental conservation and livelihood programs attract migrants, over the longer term, a successful PHE message could help to limit in-migration where it threatens livelihoods. Such a message could also support an increasing demand for FP as people wish to improve education for their children, and thereby increase investments in fewer children.

The PHE approach strives to combine the strengths of PE and HE solutions to maximize conservation efforts for some of the most biologically sensitive parts of the world. By recognizing potential linkages among these three dimensions, and simultaneously addressing them, practitioners of this approach hope to realize increased synergy and efficiency in conservation, health, and development outcomes. The underlying philosophy is that environmental conservation and human development need not be oppositional; rather, they can be complementary. The ethical contradiction of protecting animals but not people is a thorn that may be removed by earnest PHE and livelihood interventions. In order to compellingly demonstrate these synergies across different places, each with distinct human and environmental landscapes, challenges, interventions, and desired outcomes, future research can build upon lessons learned from case studies towards scaling up to test potential PHE synergies in replicable standardized before and after controlled experimental designs.

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