

# ONE BILLION HUNGRY: CAN WE FEED THE WORLD?

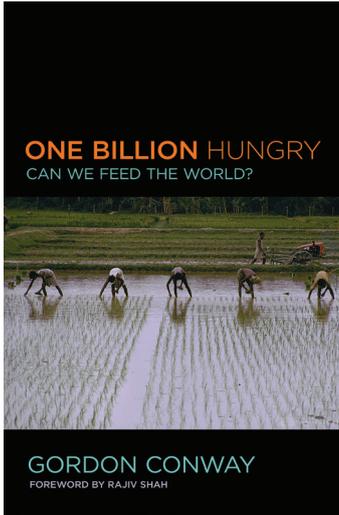
## A POLICY BRIEFING



THE HUNGRY EARTH

GORDON CONWAY AND KATY WILSON

# ONE BILLION HUNGRY: CAN WE FEED THE WORLD?



*One Billion Hungry*, explains the many interrelated issues critical to our global food supply from the science of agricultural advances to the politics of food security. It expands the discussion begun in his influential *The Doubly Green Revolution: Food for All in the Twenty-First Century*, emphasizing the essential combination of increased food production, environmental stability, and poverty reduction necessary to end endemic hunger on our planet.

*One Billion Hungry* addresses a series of urgent questions about global hunger:

- How we will feed a growing global population in the face of a wide range of adverse factors, including climate change?
- What contributions can the social and natural sciences make in finding solutions?
- And how can we engage both government and the private sector to apply these solutions and achieve significant impact in the lives of the poor?

It succeeds in sharing informed optimism about our collective ability to address these fundamental challenges if we use technology paired with sustainable practices and strategic planning.

"In *One Billion Hungry*, Gordon Conway lays out the formidable challenges we face in feeding the world by 2050 and reminds us why we have reason to be optimistic. History shows that we can reduce hunger and poverty, but to make a lasting difference we will need to help smallholder farmers sustainably increase their productivity."

**Bill Gates, Co- Chair of the Bill & Melinda Gates Foundation**

"We will not have a fair and secure world until we overcome the global challenge of feeding our ever-increasing population. Gordon Conway's insightful book addresses the complex issues of achieving global food and nutrition security."

**Kofi Annan, Former Secretary-General of the United Nations (1996–2007)**

"Gordon Conway has set out a bold, but doable agenda for meeting the food challenges the world faces. The brilliant and practical insights expounded in this book will help drive a sustainable green revolution in Africa."

**Akinwumi Adesina, Minister of Agriculture and Rural Development, Nigeria**

"*One Billion Hungry* is an excellent source of evidence-based proposals on how to feed the world in a sustainable manner. It is an antidote for pessimism and will go a long way in inspiring the global community to act in time. The book is as inspirational as it is pragmatic."

**Calestous Juma, Harvard Kennedy School**

"Sadly, the majority of the one billion hungry are smallholder farmers faced with limited opportunities to improve their livelihoods. This book promotes access to technology and, in partnership with the hungry, links evidence to policy and action."

**Lindiwe Majele Sibanda, CEO and Head of Diplomatic Mission, FANRPAN**

## About the Author



Gordon Conway is Professor of International Development at Imperial College London and Director of Agriculture for Impact. From 2005-2009 he was Chief Scientific Adviser to the UK's Department for International Development. Previously he was President of The Rockefeller Foundation and Vice-Chancellor of the University of Sussex.

He was educated at the Universities of Wales (Bangor), Cambridge, West Indies (Trinidad) and California (Davis). His discipline is agricultural ecology. In the early 1960's, working in Sabah, North Borneo, he became one of the pioneers of sustainable agriculture.

He was elected a Fellow of the Royal Society in 2004 and an Honorary Fellow of the Royal Academy of Engineering in 2007. He was made a Knight Commander of the Order of Saint Michael and Saint George in 2005. He is a Deputy Lieutenant for East Sussex. He was recently President of the Royal Geographical Society.



Contributor: Katy Wilson has been working at Agriculture for Impact since August 2010. She has previously worked at the Institute for International Research in New York and volunteered at Harnas Foundation in Namibia. She has a MSc in Environmental Technology from Imperial College London.



# Executive Summary

Hunger is a daily reality for nearly a billion people. More than six decades after the technological discoveries that led to the Green Revolution aimed at ending world hunger, regular food shortages, malnutrition, and poverty still plague vast parts of the world. *One billion hungry can we feed the world?* lays out the many interrelated issues and solutions critical to securing our global food supply. It concludes that we can feed the world but only if we:

- Tackle the interconnected challenges the world faces
  1. The probability of repeated food price spikes and a continuing upward trend in food prices
  2. The persistence of a billion or more people suffering from chronic hunger
  3. Feeding a growing population in the face of a wide range of adverse factors, including climate change
- Accept that agricultural development is the best route to achieving sustainable economic growth in developing countries
- Aim to achieve an agriculture that is highly productive, stable, resilient and equitable.

The four routes to achieving a food secure world are:

- Innovation, including a wide variety of technologies, where appropriate
- Markets, that are fair and efficient
- People, who are central to driving and delivering agricultural development
- Political leadership, that supports and coordinates these routes

This paper lays out the critical steps that need to be taken along these four routes, which in combination result in a truly transformative and, most importantly, achievable action plan aimed at ending world hunger.

A 1% gain in GDP originating from agriculture will generate a 6% increase in overall expenditure of the poorest 10% of the population; in contrast a 1% gain in GDP originating from non-agricultural sectors creates zero growth.

## Background to the book

The theory of change central to this book was first documented in Gordon Conway's *The Doubly Green Revolution: food for all in the 21st century* first published in 1997. The conception of the Doubly Green Revolution was an outcome of the deliberations of a small panel, chaired by Gordon Conway, commissioned to develop a vision statement for the Consultative Group on International Agricultural Research. The vision was presented and adopted at a meeting of ministers of overseas development from the developed countries and of agriculture and natural resources from the developing countries.

What began as a second edition of *The Doubly Green Revolution* quickly developed into a largely new book reflecting what has happened globally in the intervening years: the growing number of people who are chronically hungry, the devastating impact of the food price spikes and the challenges we face if we are to feed a world subject to climate change. Alongside these challenges there have been enormous strides in technical achievements: revolutionary improvements in crop and livestock breeding, successes in application of ecological principles to agricultural production and real examples of exciting farmer innovation. While most of the concepts and arguments remain as relevant today as then, and in some cases more so, the book has many new elements and material to take into account these changes, resulting in a roadmap for urgent global action to tackle hunger.

# Innovation

## The Vision

- Appropriate technologies adopted, whether conventional, traditional, intermediate or new platform;
- Greater public and private investment in agricultural research and extension;
- Higher yields produced with fewer resources, known as sustainable intensification.

## Why?

The Green Revolution successfully used new technologies to increase the yields and production of staple crops at a rate that exceeded population growth, and also brought down their prices. Yet it had important limitations. Its impact on the poor was less than expected; it did not reduce, and in some cases it encouraged, natural resource degradation and environmental problems; its geographic impact was localised; and there were eventually signs of diminishing returns.

Given the nature of the current food security crisis we need another revolution, one that should not simply reflect the strategies and outcomes of the first. It must not only increase food production and benefit the poor more directly, but must be applicable under highly diverse conditions. It must be more environmentally sustainable in terms of conserving natural resources and the environment and more effective in reducing hunger and poverty.

To produce this revolution we need to develop and implement new technologies and production processes that provide farmers with productive, stable, resilient and equitable farming systems; in essence minimising the trade-offs between these goals. The fields of modern ecology and molecular and cellular biology hold great promise for finding these win-win-wins. But most important these technologies must be appropriate. They must be effective, readily accessible and affordable, easy to use, environmentally friendly and serve a real need. Beyond appropriateness we must eschew assertions that one form of intervention or technology is best whatever the circumstances. In other words, we will need a variety of innovations to work in a wide diversity of environments i.e. both small and large farms, both organic and GM farming systems, both free-range and stall-fed livestock rearing, and both micro-finance and macro-investment.

The importance of technology is apparent in the need to achieve greater food production using fewer resources, particularly land, or in other words sustainable intensification. We need multidisciplinary approaches that combine science and technology, environmental considerations and economic factors. To achieve this we need investment in research and extension to ensure the rapid development of new technology and the delivery of it into the hands of smallholder farmers. In areas where the Green Revolution was considered successful in transforming agriculture and reducing poverty, local research and extension almost always took place. Indeed farmer experimentation and innovation needs to be recognised as one of the keys to sustainable intensification.

Biotechnology is not a magic bullet but has much to offer where appropriate. In particular its strengths lie

in addressing the practical limitations of conventional breeding techniques. But there are hazards: some are apparent, others perceived. Techniques of biotechnology are already having an impact on plant and animal breeding and further research should be supported. Where appropriate and well regulated, there exists the potential for the benefits of biotechnology to reach poor people as well as those who are better off, particularly where new varieties are arising from research in developing country government laboratories.

## Submergence-tolerant rices

So-called 'deepwater rice' is known for its ability to elongate its internodes. These have hollow structures and function as snorkels to allow gas exchange with the atmosphere, and thus prevent drowning. In 2009, a pair of genes responsible was identified at Nagoya University in Japan. The genes, via a pathway of plant hormones, cause the rice plant to grow by up to eight metres in the presence of rising water levels.

A second discovery was made in 2006 by a team at the International Rice Research Institute (IRRI) in the Philippines. The team identified a stretch of DNA in rice linked to genes enabling submerged plants to survive for more than two weeks. The rice becomes dormant during the flooding then continues growing once floodwaters recede.

In effect these discoveries have provided two sets of genes, which respond to deep water in different ways, one lengthening its internodes and the other limiting the elongation. The potential is to utilise both sets of genes so that high yielding rice varieties plants can withstand either flooding that is deep and quick or floodwaters that climb in a progressive and prolonged fashion.

Breeding is already underway and the resulting crosses when grown in the field in the Philippines exhibit submergence tolerance while the yields, plant height, harvest index and grain quality remain the same. New submergence tolerant varieties are now being produced in Laos, Bangladesh and India, and in Thailand. In one farmer's fields during IRRI's Indian field trials 95 to 98% of the, so-called, scuba rice plants recovered while only 10 to 12% of the traditional variety survived. Within one year of its release it has been adopted by over 100,000 Indian farmers.

## Making it happen

- Incorporate, within projects to develop and distribute technologies, an examination of their appropriateness to both the environment in which they will be used and the end users;
- Increase investment in research and development of new technologies at global, regional and national levels, partnering with a range of institutions to ensure maximum impact;
- For all programmes and projects, assess the trade-offs between productivity, stability, resilience and equitability, aiming to minimise these trade-offs as much as possible;
- Ensure efficient use of natural resources while aiming to increase productivity i.e. pursue a path towards sustainable intensification.

Doubling investment in public agricultural research in Sub-Saharan Africa would increase growth in agricultural output by between 0.5 to 1% and reduce poverty by 282 million.

# Markets

## The Vision

- Enabling environments built for smallholder farmers;
- Smallholder farmers linked to input and output markets both physically and virtually;
- Increased benefits within value chain captured by smallholder farmers while risks minimised.

## Why?

An enabling environment is the sum total of the macroeconomic policies that favour markets and trade; the provision of inputs and related physical infrastructure (such as roads and irrigation) and social infrastructure (education and research etc) together with the accompanying institutions and regulations.

A key component of an enabling environment is the creation of markets. While often highly distorted, they remain key to reducing poverty: only through access to markets can poor farmers increase the income from their labour and lift themselves and their families out of poverty.



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Most poor farmers are not involved significantly in agricultural markets. Smallholders in particular often have little contact with the market and hence a poor understanding of, and ability to react to, market forces. Part of the answer lies in helping to create countrywide networks of small and large markets supported by commodity exchanges. Also needed are countrywide networks of village level agrodealers selling key inputs to farmers in small, affordable quantities, providing extension advice and, most significantly, reducing the distances farmers have to go to get inputs and advice.

Agricultural produce markets are highly differentiated offering new opportunities to smallholder farmers but also heightened risks and new barriers. Aggregation of smallholder farmers into producer association including contract farming and cooperatives may allow farmers to receive a greater proportion of the benefits while minimising the risks they face. Smallholders also need to be physically (roads) and virtually (ICT) connected to markets and information.

## AGRA, RUMARK and KASP

To date the Alliance for a Green Revolution in Africa (AGRA) has trained and supported over 5,000 agrodealers in eastern and western Africa. Although the stores are small (what Americans call 'Mom and Pop stores') they are collectively having a major impact, providing \$45 million worth of improved seeds, fertilizers and other inputs in 2008. They sell key inputs to farmers in small, affordable quantities and, most significantly, they reduce the distances farmers have to go to get inputs – in one area of Kenya from 17 kilometres in 2004 to 4 kilometres in 2007.

RUMARK, supported by the Bill and Melinda Gates Foundation, has so far educated around 1,100 agrodealers on seed and chemical storage and pesticide and fertiliser application and safety. Agrodealers are also trained in business management, product knowledge and crop husbandry and share their knowledge with farmers through 1,300 demonstration plots.

The Kenya Agrodealer Strengthening Program (KASP), funded by AGRA, has built a network of agrodealers that covers 85 districts in Kenya's agricultural areas, accessed by 1.4 million farmers. KASP has been instrumental in improving agrodealer's access to finance through local microfinance institutions and providing guarantee and matching investment facilities. It also advances agricultural policy advocacy through a Ministry of Agriculture think tank and by helping to create associations that advocate on behalf of small business agrodealers.

In many countries only between 1 and 2 fifths of the rural population are significant participants in agricultural markets.



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## Making it happen

- Support country-led plans to ensure an appropriate investment climate within which the private sector can engage and support programmes to ensure the provision of rural public goods;
- Invest in infrastructure both soft and hard, the creation of village level agrodealers and markets and aid the formation of producer associations;
- Invest in the provision of microcredit and microinsurance.

# People

## The Vision

Appropriate innovation and fair and efficient markets are essential but success depends on people to drive and embrace the changes:

- People are prioritised: at the core of the Douby Green Revolution are smallholder farmers;
- Strategies targeted to those typically marginalised from the formal food industry: women, youth, ethnic minorities and the landless;
- Interventions directed to ensure mothers and children receive adequate nutrition.

## Why?

There are three interconnected challenges to achieving a food secure world: 1) the threat of recurring food price spikes; 2) about one billion (one in six of the world's population) are chronically hungry; and 3) we have to increase food production by 70 to 100% to feed a growing population in the face of adverse factors such as climate change.

People are not only the victims of such challenges but lie at the heart of solutions. Smallholder farmers are a source of innovation but may find it difficult to respond quickly to market signals – they need labour, inputs, credit, insurance and access to a market that will purchase their harvest.

Women are a critical link between food production, consumption and future progress on food security: they are farmers, mothers, educators, and innovators. Equal access to productive resources, therefore, is essential. By ensuring female farmers have access to the same resources as their male counterparts, the number of undernourished people in the world could be reduced by 100 to 150 million.

Poor participation of young people in farming and the agricultural economy directly threatens the future of Africa's agriculture and rural economic transformation. The prospects of those young people who live and work in rural areas now and in the future must be improved and we must ensure that the agricultural sector becomes a more productive and attractive profession. We need a clear policy strategy for engaging both women producers and the rising group of rural youth.

We must also not forget that indigenous ethnic groups are often isolated from mainstream society and in many countries are more likely to be poor than people in ethnic majorities. The poor are also typically landless or have very small farms and size of landholdings is falling. Better ownership of, or access to, land enables farm households to consciously examine the trade-offs between productivity, stability, resilience and equitability and make informed decisions. It is through minimising these trade-offs that we will reach a sustainable agriculture.

To ensure a productive and healthy population adequate nutrition is essential and critically important during the first 1000 days of a child's life (from pregnancy to two years old). Undernutrition in this window increases infant and child mortality and has largely irreversible long-term effects on health and on cognitive and physical development.

About 1 billion people hungry, 98% of which live in developing countries. 70% of people who are chronically hungry are smallholder farmers, 43% of total farmers worldwide are women and 38% of working youth in Africa are in agriculture.

## A one hectare farm in Kenya, Africa

Several years ago, Mrs Namarunda's husband died from HIV/AIDS. Her eldest son inherited the family farm, a single hectare running up one side of a hill, in the Siaya district near Lake Victoria. The soils are moderately deep and well drained, but they are acidic, highly weathered, and leached. Mrs Namurunda's first son married and moved to Nairobi, where he is a casual labourer and has children of his own.

Mrs Namarunda was left on the farm – still officially owned by her absent son – with four younger children and the responsibility to produce food, fetch water, gather fuel, educate the children and take care of the family. But shortages of almost everything – land, money, labour, and plant nutrients in soil exhausted from many years of continual crop production – mean that she is often unable to provide her family with adequate food. The two youngest children suffer from undernourishment and persistent illnesses.

Like many others in Africa, Mrs Namarunda's smallholding provides an "insecure" livelihood. Fertiliser is expensive and she can't get credit, so she starts each growing season with a maximum potential harvest of only about 2 tons from mixed cropping on her 1 hectare of land. To survive, her family requires a harvest of about 1 ton, so the maximum harvest is achieved, it would be sufficient to meet their needs and to generate a modest income. But, during the course of every growing season, she faces innumerable threats to her crops which reduce her yields.

Weeds are her most persistent and pervasive problem. It takes 40 to 50 days of weeding each crop to keep the weeds under control. Her staple crop, maize, is attacked by streak virus, the parasitic weed *Striga*, boring insects, and fungi.

Among other pests and diseases she also faces periodic drought that reduces yields. At the end of each season, what she actually harvests is usually less than one ton. She and her children are often hungry, and there is no money for schooling or for health care.

Although Mrs Namarunda lives at the end of a poorly maintained track, far from a town or markets, she is not immune to the events in the larger world. The high price of food affects her; the small sums her son irregularly sends her are insufficient to keep her family adequately fed.

## Making it happen

- Support smallholders through participatory research and extension that both investigates and caters to their needs;
- Ensure room in the market for small and large farms;
- Design programmes and projects with women, youth, and landless, minorities in mind through gender inclusion, targeted interventions and addressing inequality;
- Support developing country-led plans to increase maternal and child nutrition through the Scaling Up Nutrition framework as well through promoting a diversity of crops for market and household consumption.

# Political Leadership

## The Vision

- Political leadership must deliver on the above agenda at international, regional, national and local levels;
- Commitments honoured to increasing investments to agricultural development and end global hunger;
- Developing country-led plans supported.

## Why?

We need coordinated political action at national, regional and global levels, supporting country-led plans and agendas and political will and vision. Appropriate enabling environments require appropriate governance. Without good governance there can be no food security. The necessary macroeconomic policies, physical and social infrastructure together with the accompanying institutions and regulations will only be created if there is a supportive governance structure.

In Sub-Saharan Africa average annual growth in agriculture has been over 3% in recent years (2000 to 2008), creating opportunities in domestic, regional and international agricultural markets especially where there are supportive, stable governments.



Good governance entails creating efficient institutions that promote rural development and attract private investment whether by farmers or the private sector as a whole. It means creating policies, laws and regulations that ensure markets and financial institutions function fairly, protecting women, minorities and the poor from discrimination and exploitation.

The key international and national policies needed include:

- Economic policies that do not discriminate against agriculture
- Liberalised private markets for farm inputs and outputs
- Efficient rural financial institutions, including adequate access by farmers to credit, inputs and marketing services
- Land tenure reform or redistribution as appropriate
- Adequate rural infrastructure
- Investments in rural education, clean water, health, nutrition and family planning
- Attention to satisfying the needs of women and of ethnic and other minority groups and securing their legal rights

If we are to achieve a Doubly Green Revolution, we need to find ways of replicating success rapidly. The challenge is to help take local systems, especially those that significantly

increase farmer and labourer incomes, and to scale them up so that the poor – both farmers and the landless – can benefit in a way that brings about a virtuous circle of rural development.

## John Kufuor

President of Ghana from 2001-09 and World Food Prize laureate in 2011, John Kufuor was instrumental in accelerating Ghana's growth, particularly in the agricultural sector. The country's Rural Development Plan consisted of strategies to educate farmers, increase investment in agricultural research, and economic incentives to farmers to boost yields. Between 2002 and 2005 cocoa production doubled from 350,000 to 734,000 tons. Government also invested in infrastructure such as feeder roads, warehouses, and cold stores for horticultural crops.

As a result of the strong and sustained political vision and will, Ghana's agricultural sector has grown by an average of 5% per year in the past 25 years; the percentage of the population living in poverty reduced from 51% in 1991-92 to 28.5% in 2005-06; the proportion of infants underweight fell from 30% in 1988 to 17% in 2008; and Ghana is the only country in Sub-Saharan Africa likely to meet the first Millennium

## Making it happen

- Provide support to countries in developing macroeconomic policies that support agriculture and rural economic growth;
- Invest in scaling up as a route to rapid success through public-private partnerships.



# Can We Feed the World?

## YES, if....

- There is a major focus on getting poor rural people out of poverty
- Technologies for agricultural development are developed and applied, providing they are appropriate, whatever the source
- We accept that biotechnology is an essential tool in attaining food security
- There is more funding for improving mixed livestock systems
- We recognise the role of farmers as innovators
- There is increased support for integrated pest management (IPM) systems building on pest and disease resistance utilising biotechnology
- There is widespread adoption, in appropriate environments, of systems of conservation farming
- We focus our investments on small scale water harvesting and community water
- There is significant investment in agricultural adaptation to climate change
- There is urgent attention to financing the reduction of greenhouse gas emissions from agriculture
- We invest in scaling up as a route to rapid success
- We recognise that crucial to success of going to scale are public-private-community partnerships
- We recognise food security affects us all and the time to act is now
- We acknowledge the challenges we face are unprecedented and require concerted action.
- The world's leading donors of aid implement their commitments to food security
- The Doha round is completed with satisfactory outcomes for developing countries
- There is explicit attention to the creation of enabling environments
- The appropriate governance for food security and agricultural development is in place
- Fair and efficient output and input markets are created on a countrywide basis
- Greater attention is paid to gaining increased value for farmers through producer associations and widespread availability of microinsurance and microcredit
- We acknowledge the key role of agriculture in development
- We recognise the need for a new Doubly Green Revolution
- There is explicit recognition of the critical role of smallholder agriculture
- More attention is paid to agroecological research and development

For more information and references, please visit:

[www.canwefeedtheworld.org](http://www.canwefeedtheworld.org)



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