

Win-Win Solutions from a New Green Revolution

By Johan Rockström, Executive Director Stockholm Environment Institute & Stockholm Resilience Centre

Question Seven: How can we meet both today's development challenges and tomorrow's climate risks?

In seeking answers to the question of how to investing in solutions to pressing issues, while at the same time contributing to building long-term societal resilience, the author focuses on agriculture. He emphasizes the need for a new green revolution in agriculture that would increase food production by 40% by 2050, and address poverty and food insecurity while also turning agriculture from a carbon source into a carbon sink, using proven technologies and practices. He also discusses how governments can start to implement such approaches and the barriers that need to be overcome.

Pressing Issues versus Long Term Risks: A False Trade-off

Twenty years ago one could argue that, if you ranked the most pressing issues for human development, poverty, corruption, democracy and infrastructure would come out on top, and climate change, protecting biodiversity and ocean acidification would fall far down the agenda. But we have turned a corner, scientifically, over the past six or seven years. In that period, earth system science

and empirical observations of negative climate change have been documented fully at a global scale. The result is that you cannot separate these development issues any longer in terms of those that are pressing and non-pressing, because all science disciplines are showing the same accelerated, negative trends. Abrupt and irreversible change may be right around the corner, and even the poorest, most vulnerable nations need today to invest in both short- and long-term solutions.

So then the challenge is, of course, how do we provide an agenda that allows for investing in solutions to pressing issues, while at the same time contributing to building long-term resilience? How do we find those win-win solutions with as few as possible tradeoffs?

Pressing Issues: Food and Water Supplies

Encouragingly, I think you can today find very many examples of big agenda items where such win-win solutions are possible. Perhaps the best place to start is in world food production – which occupies 40% of the world's land surface - and in water resources. These are policy areas where you can invest in addressing pressing issues for today, but in a way that builds resilience for the long-term.

There is a lot of logic to the statement, regarding climate change, that “if mitigation is about gases, adaptation is about water.” There is ample empirical evidence and evidence from modeling on expected impacts of climate change to show that the most immediate impacts are water related, with either too much water or too little water, occurring at the wrong time. This is what we are seeing with the landslides in Taiwan, with seven years of drought in Australia, with heat waves in southern Europe causing water scarcity in Spain, and with agricultural systems in northern Africa, Iraq and Syria collapsing under years of drought, not to mention increasing extreme rainfall events and the late onset of rainy seasons in other regions.

Agriculture is the logical starting point for addressing pressing poverty as well as climate adaptation. Some 70% of the world's absolute poor remain rural farmers, despite rapid urbanization, and they live in tropical regions. Tropical regions are most affected by climate change, and agriculture in tropical regions is governed predominantly by water. This means that, in terms of addressing the most pressing needs of adapting to climate change, poverty alleviation and development, agriculture in tropical regions is a good region to start. There is also a tremendous social dimension to focusing on agriculture and water supply. If we are serious about alleviating hunger, Africa needs a green revolution. The challenge here is tremendous. We need to see a doubling of agricultural production in 40 years, in an agricultural revolution that not only produces more food, but that also contributes

to climate mitigation, reduces impacts on biodiversity and other planetary boundaries, and at the same time is more resilient to unavoidable impacts of already committed climate change. Asia needs to ensure its existing green revolution doesn't become too vulnerable to climate change. And we also need a massive increase in food production in China, due to changing diets.

Moreover, the right investments in sustainable land management can also have the additional benefit of turning agriculture from being a source of carbon (responsible today for one third of emissions) to a sink of carbon, using a whole battery of proven technologies, methods and practices.

Win-Win Solutions from a Green Revolution in Agriculture

So, if you connect the global climate change challenge and the social challenge it all boils down to enormous expectations on agriculture. Then the question becomes "what can one do to achieve this green revolution?"

For water supply, there is a lot of evidence to suggest that if the solution in the past has been irrigated agriculture, the solutions of the future should focus on investments in small-scale rainfed agriculture and water harvesting. In Africa, 95 percent of agriculture is rainfed; in India 60 percent; in China, over 70 percent. Worldwide, 80 percent of agricultural land is rainfed, and this is where we have the largest untapped potential because productivity so far has been very low, due to the typically vast levels of water losses in rainfed agriculture.

There is much research to show that we can massively improve the productivity of rainfall, for example by rainwater harvesting, and thereby exponentially increase biomass production. I'm talking about doubling, tripling, even quadrupling, levels of maize, millet, sorghum, wheat – the basic cereals in savannah systems around the world. And at the same time farmers will potentially be consuming *less* fresh water because rainfed agriculture reduces water loss due to evaporation. So you are losing less in runoff losses in the river and groundwater downstream, while at the same time boosting productivity, generating more livelihoods, and sequestering more carbon in the soil.

Research in Africa, India, China, and Latin America shows that small-scale external water harvesting systems, also known as supplementary irrigation systems, may be the most promising investment to deal with climate adaptation in the short term, since the world's rain-fed agricultural system is tremendously vulnerable already to extremely variable rainfall. There is ample evidence in Kenya, Burkina Faso, India and parts of China showing that once you invest in supplementary irrigation, you build resilient systems not only ecologically but also socially because farmers then

invest in their land. These systems consist of multiple technologies, which have the same common base of collecting local runoff from small catchment areas and storing the water in micro-dams used for supplementary irrigation of rainfed cultivation. The reduction in risk means that they can dare to put the investment in hybrid seed or some commercial fertilizer, and the whole system gets a trigger to move in the right direction. So that's a very down-to-earth example of how you can act on a short-term risk which is there already today, namely the risk of dry spells and droughts, by building more resilient systems that are also hopefully able to address the longer-term challenge of both sequestering carbon and meeting even higher frequencies of dry spells.

Yet simple, effective approaches like this have not taken off around the world. In fact the trend has gone in the wrong direction. For example, a tremendous work called *Dying Wisdom* by Anil Agarwal of the Centre for Science and Environment (CSE) in New Delhi showed how India used to employ water harvesting as an integral part of its risk strategy in small-scale farming, on a continental scale. But that wisdom was lost with the Asian Green Revolution which introduced irrigation systems using diesel pumps. Now, encouragingly, that wisdom is coming back, from the bottom, up. In Gujarat, for example, you're starting to see large-scale community-based watershed management projects which are filling up watersheds with check dams, small-scale farm ponds, river diversions, and moisture conservation initiatives.

Barriers to Success

How do we scale up such solutions and overcome the barriers they face? There is much evidence to suggest that the two most promising investment areas of innovation to unlock the potential of both an agriculture revolution and climate adaptation are water harvesting and conservation agriculture, which involve moving from plow-based systems to minimum-till systems. What is preventing this from happening? The answer, of course, is complex and there are many factors at play, but one fundamental factor is that mainstream international policy to improve world food production remains fixated on irrigation.

The second critically important factor is that countries' governance systems are split. Water is governed primarily by Ministries of Water Resources, which are "wet" (i.e., they are responsible for policies related to exploitation and allocation of runoff resources), and agriculture is governed by Ministries of Agriculture, which are "dry" (i.e., despite governing the sector consuming the largest volume of freshwater in human societies, they are mainly responsible for policies related to crops and land). I think that Ministries of Agriculture need to become much more

“wet” in their governing approach and invest much more competence in how to promote, for example, small-scale water harvesting systems. Today large capacity building investments go to training engineers that get employed by Ministries of Water to design dams, while there is limited capacity to support the upgrading of rainfed agriculture with water harvesting systems. In other words, governments need to shift their mindset so that they start considering rainfall as a water resource. Eighty percent of world water production is not even considered water, in a legal manner, because it falls as rain, and yet this same ungoverned water resource produces most of the biomass, and thereby the biodiversity, in the world.

In some wealthier parts of the world this type of approach is now happening. The Cape Province in South Africa, for example, is littered with small-scale storage systems for supplementary irrigation. All the commercial grape farms have introduced supplementary water harvesting systems, because they could never achieve resilience to the variable local climate without it. If you go to the Murray-Darling basin in Australia, it's the same story, water harvesting systems everywhere. But when it comes to poor, small-scale farmers in Africa, those who need it more than anyone, they are not able to implement such systems. Why? Because they don't have the support functions to enable it, including access to infrastructure, credit and markets.

Implementation in Vulnerable Countries

Any nation in Africa which is dependent on agriculture, subject to water scarcity and has a large rural population could today launch a major national strategy on upgrading rain-fed agriculture, including not only water harvesting but also sustainable land management, and integrated nutrient management. It is only through integration of land, water and nutrient management that the full potential of agricultural development and resilience building can be achieved, even in water scarcity prone regions. This should be an integrated, cross-government initiative which should also include a component of credit and a big component of capacity building, since you basically need to build an army of extension engineers to support an effort like this.

And then the question for policymakers is, “How do you get this to scale?” The answer, I think, is that each country needs to carefully strategize over the legal changes and policy changes it needs to make and how it anchors the strategy across the government system. (Tanzania, for example, has adopted a special water harvesting strategy in its national plan.) However governments go about it, the goal must be to get the three key ministries of Agriculture, Environment and Water to join forces, either by being merged or closely integrated.

And then the final question is how to roll the strategy out? I don't exclude that you need a lot of both bottom-up and top-down strategies. I think the Millennium Development Project in Africa has shown that we've come to a point with the degradation of agricultural land in many nations on that continent at which the end of the road has been reached for bottom-up processes. For example, even though water resources are fundamentally the key limiting factor for food production in tropical regions (and the primary factor affected by climate change), soil nutrient limitations are often a key factor in the immediate term, particularly in order to tap the full potential of available water resources. Therefore, what is now urgently needed, apart from national water resource investments to build water resilience, is a national top-down soil fertilization injection initiative to kickstart a positive trajectory for food production.

For example, in Ethiopia a thousand years of degrading land use combined with unsustainable structural adjustment programs resulted in a situation where Ethiopian *teff* production is totally dependent on top-down subsidized small-scale fertilizer supply to sustain a national crop which in the long term could transform itself to a more technological and sustainable farming system.

Due to the complexity of the global drivers the world is facing, and the urgency of the social need, African nations may need some radical policy in these domains and to be willing to experiment and learn along the way. This imperative lends itself to a new constellation of partnerships, with civil society joining forces with scientists and policymakers to do things in a new way, to protect our planet's future.

10 G Street NE Suite 800, Washington, DC 20002, USA

Phone +1 (202) 729-7600

Fax +1 (202) 729-7610