

Evolutionary tools improve prospects for sustainable development

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The pink bollworm, a global pest of cotton, has evolved resistance to genetically modified cotton in India, but not in Arizona where farmers have planted refuges of conventional cotton to reduce selection for resistance. Credit: Alex Yelich, University of Arizona

Solving societal challenges in food security, emerging diseases and

biodiversity loss will require evolutionary thinking in order to be effective in the long run. Inattention to this will only lead to greater challenges such as short-lived medicines and agricultural treatments, problems that may ultimately hinder sustainable development, argues a new study published online today in *Science Express*, led by University of California, Davis and the Center for Macroecology, Evolution and Climate at the University of Copenhagen.

For the first time, scientists have reviewed progress in addressing a broad set of challenges in agriculture, medicine and environmental management using evolutionary approaches, approaches that consider species' evolutionary histories and the likelihood of rapid evolutionary adaptation to human activities.

The study finds an urgent need for better implementation of these approaches, for example in managing the use of antibiotics and pesticides in order to reduce the escalating problem of resistance evolution. Furthermore, current efforts are found insufficient to reduce the accumulating costs from chronic disease and [biodiversity loss](#), two challenges ultimately caused by exposure to food and environments to which people and threatened wildlife are poorly adapted.

The study also assessed the potential for less commonly implemented strategies including gene therapies to treat human disease, the breeding of "climate change proof" crop varieties, such as flood tolerant rice, and translocating exotic strains for ecological restoration and forestry that will be better adapted to near-future conditions.

"Applying [evolutionary biology](#) has tremendous potential, because it takes into account how unwanted pests or pathogens may adapt rapidly to our interventions and how highly valued species including humans on the other hand are often very slow to adapt to changing environments through evolution. Not considering such aspects may result in outcomes

opposite of those desired, making the pests more resistant to our actions, humans more exposed to diseases and vulnerable species less able to cope with new conditions", says biologist Peter Sørensen, one of the lead-authors and PhD from the Center for Macroecology, Evolution and Climate at the University of Copenhagen.

"To succeed in avoiding such unwanted outcomes however, we need to learn from successes and progress in all fields using evolutionary biology as a tool. Currently there is no such coordination, says Scott P. Carroll, lead-author and biologist at the University of California Davis and Director of the Institute for Contemporary Evolution. He continues:

"A particular worry is that the unaddressed need for management of evolution that spans multiple sectors will lead to the spread of new infectious diseases and antimicrobial resistance genes between natural, [human health](#) and agricultural systems. It is clear that we need to strengthen evolutionary biology linkages across nature conservation, food production and human health and develop a shared strategy."

Many evolutionary solutions are already at hand

Whereas we might have to wait for new solutions from human gene therapy, genetic engineering of crops and development of new medicines to replace old ones, many innovative solutions based on applying evolutionary biology already exist.

For example, farmers in the United States and Australia have used planting of pest-friendly refuges to delay evolution of insect resistance to genetically engineered corn and cotton. These genetically modified crops kill certain pests, but without refuges the pests quickly adapt. Providing refuges of conventional plants has been especially effective for suppressing resistance in the pink bollworm, an invasive pest of cotton.

However, Peter Jørgensen also cautions:

"In many cases, decision makers must pay more attention to assuring that long-term benefits of applying these solutions do not come at a short-term cost for some individuals, for example from yield loss due to localised effects of pests in a particular year. By encouraging cost sharing, local communities and governments play a crucial role in ensuring that everybody gains from the benefits of using evolutionary biology to realise the long-term goals of [sustainable development](#) such as increasing [food security](#), protecting biodiversity and improving human health and well-being."

The article is published today in *Science Express*. Peter Jørgensen will also present the research at the upcoming Sustainability Science Congress in Copenhagen from October 22nd to 24th.

More information: "Applying evolutionary biology to address global challenges" *Science Express*, [www.sciencemag.org/lookup/doi/ ... 1126/science.1245993](http://www.sciencemag.org/lookup/doi/10.1126/science.1245993)

Provided by University of Copenhagen

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