Climate change is hurting farmers – even seeds are under threat

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Credit: Markus Spiske from Pexels

Climate change is already affecting the amount of food that farmers can produce. For example, crop sowing in the UK was delayed in autumn 2019 and some emerging crops were damaged because of wet weather.

Meanwhile in Australia, considerable drought has been immensely damaging.

But climate change can also have a knock-on impact on farming by affecting the quality of seeds, making it harder to establish seedlings that then grow into mature, food-producing plants. My research group has recently published a study showing that even brief periods of high temperature or drought can reduce seed quality in rice, depending on exactly when they occur in the seed's development.

Nonetheless, it is possible to breed improved varieties to help crops adapt to the changing climate. And the resources needed to do this are being collected and conserved in "genebanks," libraries of seeds conserving crop plant diversity for future use.

In much of the developing world in particular, the supply of affordable, good-quality seed limits farmers' ability to establish crops. Seeds need to be stored between harvest and later sowing and poor-quality seeds don't survive very long in storage. Once planted, low-quality seeds are less likely to emerge as seedlings and more likely to fail later on, producing a lower plant density in the field and a lower crop yield as a result.

For this reason, investigating seed quality is an important way of assessing such effects of climate on cereal crop production. We already know that climate change can reduce the quality of cereal seeds used for food, food ingredients and for planting future crops.

The main factor that affects seed quality in this way tends to be temperature, but the amount and timing of rainfall is also important. This impact can come from changes in average weather patterns, but short periods of extreme temperature or rainfall are just as important when they coincide with sensitive stages in crop development. For example, research in the 1990s revealed that brief high temperature

periods during and immediately before a crop flowers reduces the number of seeds produced and therefore the resulting grain yield in many cereal crops.

Our research has now confirmed that seed quality in rice is damaged most when brief hot spells coincide with early seed development. It also revealed that drought during the early development of the seeds also reduces their quality at maturity. And, unsurprisingly, the damage is even greater when both these things happen together.

In contrast, warmer temperatures later in the maturation process can benefit rice seed quality as the seeds dry out. But flooding that submerges the seed can also cause damage, which gets worse the later it occurs during maturation. This shows why we have to include the effects of changing rainfall as well as temperature and the precise timing of extreme weather when looking at how seed quality is affected.

Future seeds

Our research has also shown that different seed varieties have different levels of resilience to these environmental stresses. This means that farming in the future will depend on selecting and breeding the right varieties to respond to the changing climate.

The world now has a global network of genebanks storing seeds from a wide variety of plants, which helps safeguard their genetic diversity. For example, the International Rice Genebank maintains more than 130,000 samples of cultivated species of rice, its wild relatives and closely-related species, while the AfricaRice genebank maintains 20,000 samples.

Our finding mean that, when scientists breed new crop varieties using genebank samples as "parents," they should include the ability to produce high-quality seed in stressful environments in the variety's

selected traits. In this way, we should be able to produce new varieties of seeds that can withstand the increasingly extreme pressures of climate change.

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