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Food Biofortification—Reaping the Benefits of Science to Overcome Hidden Hunger

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Should variety release committees be required to take micronutrient levels into consideration alongside yield and stress resistance when deciding which new varieties are approved for release to farmers? Are any organizations actively advocating for such changes to variety release decision protocols?

> Yes, I believe this should be a key advocacy point when dealing with release committees. This is the only way we will get biofortified traits truly mainstreamed. The minimum levels will change over time for key micronutrients, as different countries are at different stages of their breeding programs. For invisible traits, like Fe and Zn, this could be across all varieties. For vitamin A enriched crops, there is likely to be two separate lines—and the mainstreaming process might be different. The African national breeders agreed that 50% of the clones submitted for release would be biofortified.

What is the implementation success? The flat break in India seems a very nice example indeed, how many people are reached by this kind of implementation, and what is the expectation for the future in numbers?

> In 2019 an estimated 240,000 farming households were growing iron pearl millet (flatbread in the picture was from pearl millet—consumed by an estimated 1.2 million people)—that is only 6% of all pearl millet farmers—there is significant room for scale up. India has recently included minimum iron and zinc standards in pearl millet varieties which means all future varieties released in this country in the future will be biofortified.

Conventional breeding cannot achieve nutritionally significant levels of Vitamin A or iron in rice. Can genetic engineering succeed in combining elevated Vitamin A, iron, and zinc in rice? What would be the impact of the adoption of rice engineered to have all three of these micronutrients?

> We did a meta-analysis to review the functional outcomes—Finkelstein 2019—a few studies have looked at certain cognitive domains—attention and memory for example and showed an efficacy of iron biofortified crops in improving these outcomes.
>
> We completely agree with you! One CGIAR reform has a big opportunity to mainstream biofortification as crop programs get modernized.

Are there ways to encourage more linkages between university researchers working on biofortification with CG centers and national research programs to help solve nutritional challenges in the developing world?

University professors often reach out to specific researchers within the CG that they know when they have a student looking for a topic, or a student with a topic looking for a co-supervisor. In the future, it would be good for departments with common interests to reach out to country and/or regional offices and set up memoranda of understanding to make this process more systematic, and hence more beneficial to both researchers and students.

What is the difference of GMOs and biofortification?

Biofortification could be done through (1) conventional breeding (2) transgenic engineering and (3) agronomic (fertilizers)—currently released biofortified varieties are NOT GMOs. They are all bred using conventional plant breeding methods.

Are there any special steps needed in food preparation to maintain the nutrients that are included?

Several vitamins are sensitive to heat and light, so that losses can occur when stored for long periods of time or cooked for a long time at high temperatures. Depending on how the vitamins are embedded into the plant tissue, losses can be reduced. During food preparation, overcooking should be avoided (which is not only true for biofortified crops, but for any foods that contain vitamins).

I see HarvestPlus programs in India and Bangladesh. I am wondering if we can start biofortification program in Nepal too. How is it possible?

There is a growing biofortification breeding in Nepal. Iron and zinc biofortified lentils are released, and other crops such as zinc wheat is under testing. Details are in the CAST issue paper Figure 3.

If farmers have excessively high, high, or optimum levels of nutrients in their soil, the plant naturally takes up those nutrients, therefore by planting a biofortified seed, would that just add to the increase of the nutrients in the harvested seed, thus making that product more valuable?

Healthy soils do contribute to heathier plants. In the OFSP, we do see higher levels of beta-carotene in the same variety planted on a fertile soil compared to a marginal one.

Is there any strategy to provide policy support at country level for biofortification legislation?

Yes, both HarvestPlus and CIP at different points in time have dedicated specific staff resources for this type of effort. A paper will be coming out soon describing how work was undertaken with the African Union. One key strategy was to identify influential individuals in the society and/or government that were trained as advocates for biofortification and provided with a toolkit of briefs, pull up materials, etc. to support their internal efforts.

Dedicated researchers and organizations have made a great deal of progress. Based on this webinar, many challenges remain. Is there a list of short-term goals you will try to achieve in the near future?

Key activities include 1) increased advocacy among governments to get resources dedicated to match the achievements we have made to integrate biofortification into country policies
2) Assuring true mainstreaming of biofortified traits in CGIAR population development programs, so this is not de-prioritized during the structural transition
3) Applying digital technologies to better link seed supply to demand
4) Conducting more impact surveys to continue building the evidence base that biofortified crops are being adopted.

How biofortified none staple crop can bring nutrition improvement in target communities if they are not consumed widely? How can we raise the acceptance of biofortified crops in target communities?

Biofortification primarily refers to staple foods that are widely consumed in target populations. Of course, one needs to work on those crops that are popular and commonly consumed in a particular context, otherwise the technology will have low impacts. In terms of acceptance, most micronutrients (such as iron and zinc) do not change the taste or color of the crops, so there are no acceptance problems, as long as the nutrition traits are included in high-yielding varieties with preferred agronomic properties. For provitamin A, there is a color change towards yellow/orange. First experience with orange-fleshed sweet potatoes (OFSP) shows that acceptance levels are high if the nutritional advantages are properly communicated. This needs to be ensured, otherwise, acceptance may become an issue with the color change.

If I'm not mistaken, biofortification seems to be done by public rather than private institutions. In other crops, it is the private sector that dominates. While it is positive that breeding happens in the public domain as it ensures access to the products of that breeding effort to those who have less economic resources, it may also be an indicator that the approach is not yet economic mature enough to attract private business. What is the view of the panel on the role of private business and the public sector in biofortification?

> There is a big role for the private seed sector especially for hybrid crops such as maize and pearl millet - there is also a big potential for the private food companies to integrate biofortified ingredients in their product lines for healthier processed foods.