



QUESTIONS & ANSWERS

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Golden Rice



Table of contents

About Golden Rice	1
What is Golden Rice?	1
How was Golden Rice developed?	1
Who developed Golden Rice?	1
As GMO, is it safe for humans?	2
How is Golden Rice better than regular rice?	2
Is vitamin A that big of a problem?	3
Why do we need Golden Rice?	3
Deployment	4
When will Golden Rice seed be available?	4
What will be the next step now that Golden Rice has been approved for cultivation?	4
Who will distribute Golden Rice? Will it be given for free?	5
How will Golden Rice be deployed?	5
What changes will be needed before Golden Rice can be commercialized on a large scale?	5
Is Golden Rice meant for commercial sale and export?	6
Who will buy the milled Golden Rice from farmers?	6
What are the priority provinces for Golden Rice deployment?	6
How do we ensure purity and quality of Golden Rice across the value chain?	6
Who will be in charge of monitoring the impacts of Golden Rice?	7
Is Golden Rice only available in the Philippines?	7
Production	8
Will farmers need additional training to be able to plant Golden Rice?	8
Will planting Golden Rice have any harmful effects on other rice varieties through cross pollination or out-crossing?	8
Is the farming method of Golden Rice the same as inbred or hybrid?	8
Will I have to spend more on pest control if I plant Golden Rice?	9
Will it result in stronger pests or new crop diseases?	
Can Golden Rice make weeds a bigger problem?	9
Is there any difference in the availability of pollen from Golden Rice to live, grow, or develop?	9
Does Golden Rice's beta carotene content have an effect on yield?	10
How many cavans could be produced per hectare? Production cost per hectare?	10
Will farmers make money from planting it?	10
Would DA require or enforce farmers to exclusively plant Golden Rice?	10
Consumption	11
When can I eat Golden Rice?	11
Is Golden Rice effective as a complementary supplement for VAD?	11
How much Golden Rice will I have to eat to have enough vitamin A in the body?	11
Can I overdose if I eat too much?	
Will Golden Rice taste differently from regular rice? What is its texture?	12
How much will Golden Rice cost to consumers?	12
What evidence do you have that Golden Rice will be beneficial?	13
What are the strategies to make sure that consumers and farmers will eat and plant Golden Rice?	13
Should I eat Golden Rice everyday to have sufficient vitamin A in the body?	13
How should I cook Golden Rice?	14
Who will benefit most from the nutritional benefits of Golden Rice?	14
Doesn't the beta carotene of Golden Rice get reduced when stored for some time and as you cook it? How will you ensure its efficiency in providing enough vitamin A?	14
References	15



I. About Golden Rice

What is Golden Rice?

Golden Rice is a type of rice that contains beta carotene (a source of vitamin A), and gives the grain its golden color. When people eat food containing beta carotene, it is converted to vitamin A as needed by the body. According to research published in the American Journal of Clinical Nutrition, about one cup of Golden Rice may provide up to 30-50% of the vitamin A needs of preschool age children and pregnant or lactating mothers.

Because rice is widely produced and consumed, Golden Rice has the potential to reach many people, including those who do not have reliable access to or cannot afford other sources of vitamin A. Golden Rice is intended to be used in combination with existing approaches to reduce vitamin A deficiency (VAD).

How was Golden Rice developed?

Golden Rice was developed using genetic modification, with genes from corn and a common soil microorganism that together produce beta carotene in the rice grain. The beta carotene in Golden Rice is the same as the beta carotene found in green leafy and yellow-colored vegetables, orange-colored fruit, and even in many vitamin supplements and food ingredients.

Who developed Golden Rice?

Golden Rice was first developed by Professor Ingo Potrykus, then of the Institute for Plant Sciences, Swiss Federal Institute of Technology and Professor Peter Beyer of the University of Freiburg, Germany. The co-inventors have donated the technology for Golden Rice to resource-poor farmers in developing countries. The Department of Agriculture Philippines - Rice Research Institute (DA-PhilRice) is leading the development and deployment of Golden Rice in the Philippines, in collaboration with the International Rice Research Institute (IRRI).



As a GMO product, is Golden Rice safe for humans?

Golden Rice is safe to eat, just like other genetically engineered foods developed under strict regulation by experts. Before any GM foods become available in the market, they must pass rigorous safety assessments and must not demonstrate a high likelihood of putting human health at risk. In the countries where GM foods have been approved, there have been no scientifically proven negative effects on human health due to consumption of GM foods.

Golden Rice received positive food safety evaluations from Food Standards Australia New Zealand, Health Canada, and the United States Food and Drug Administration in 2018. In December 2019, Golden Rice passed a rigorous biosafety assessment in the Philippines, and was declared “as safe as conventional rice” by the country’s Department of Agriculture – Bureau of Plant Industry.

How is Golden Rice better than regular rice?

Golden Rice is an enhanced version of ordinary rice designed to handle a specific nutrition issue, without any additional cost or difference in taste.

While Golden Rice is expected to cost and taste the same as regular rice, its beta carotene content makes it a valuable asset in the battle against VAD. Vitamin A is an essential micronutrient for growth, development, and keeping the body’s visual and immune systems healthy. VAD weakens the body’s resistance to diseases and infections, causes blindness, and may even result in death if left untreated.

In the Philippines where rice is a staple of nearly every meal, beta carotene-enriched Golden Rice can supply up to 30-50 percent of the estimated average vitamin A requirement (EAR), particularly for sectors that are most vulnerable to VAD: preschool age children and pregnant or lactating mothers.

Is vitamin A deficiency that big of a problem?

Many people in the developing world do not get enough vitamin A or beta carotene from the food they eat, contributing to the serious public health problem of VAD.

VAD remains a major public health problem across the world, with women and children being the most vulnerable to it. According to the World Health Organization (WHO), VAD afflicts 250 million people worldwide, most of which are preschool children (190 million) and pregnant women (19 million).

VAD is the leading cause of preventable blindness in children, and increases the risk of disease and death from severe infections. Each year, up to 500,000 children go blind as a result of VAD. Half of them die within 12 months of losing their sight.

In the Philippines, VAD incidence continues to be a significant public health issue affecting nearly 17 percent, or 2 million Filipino children under the age of 5. This is based on the 2018 Expanded National Nutrition Survey of the Department of Science and Technology – Food and Nutrition Research Institute.

Why do we need Golden Rice?

Current approaches (such as vitamin A supplementation, food fortification, diet diversification, and promotion of optimal breastfeeding), have made some successes in combating VAD. However, more work is necessary to address the needs of certain target populations, especially those in remote areas. Additionally, millions continue to suffer from VAD to this day.

Studies have shown that the addition of vitamin A (or some form of vitamin A) to the diets of children below the age of 5 could reduce all mortality by 24–30 percent. Meanwhile, vitamin A availability could prevent 1.3–2.5 million of the nearly 8 million late-infancy and preschool-age child deaths annually in developing countries with the highest risk.

With rice being a staple food in many vitamin A-deficient communities, Golden Rice presents a unique opportunity for meeting the nutritional needs of these populations, in combination with other existing interventions.





II. Deployment

When will Golden Rice seeds be available?

With the release of the biosafety permit for the commercial propagation of Golden Rice in July 2021, DA-PhilRice, in collaboration with IRRI and other partners, are taking the step towards bringing the vitamin A-enhanced rice to farmers through the production of seeds. It will require 3-4 cropping seasons to produce sufficient supply of seeds for commercial farm cultivation.

Limited amount of seeds may be made available next year for the pilot-scale deployment of Golden Rice in 2022. The produced seeds will then be deployed and made available in other target areas with high prevalence of vitamin A deficiency by the last quarter of 2023. Seed production work led by DA-PhilRice will continue to ensure that enough seeds are available for farm cultivation.

What will be the next step now that Golden Rice has been approved for cultivation?

Like any other new rice variety, the next step for Golden Rice would be to apply for varietal registration from the National Seed Industry Council. Production of seed planting materials will be carried out in tandem with the registration. Moving forward, Golden Rice research will focus on measuring impact on nutrient intake and expanding partnerships in countries where it may provide significant public health benefit.

Other products in the pipeline is the High Iron and Zinc Rice (HIZR) which is developed to address the problem of micronutrient deficiency, especially iron deficiency anemia (IDA) and zinc deficiency. In the Philippines, these nutritional amounts will be stacked with the Golden Rice traits providing 3-in-1 rice that contains vitamin A, iron, and zinc. Currently, HIZR is undergoing another round of confined testing to determine the best variety to undergo field trials.



Who will distribute Golden Rice? Will it be given for free?

DA-PhilRice is the lead organization for developing a deployment plan that includes seed distribution of Golden Rice in the Philippines. DA-PhilRice will work with relevant agencies and organizations to ensure a targeted and well-coordinated distribution system and will make the necessary announcements once there are enough seeds to be distributed to the farmers. Golden Rice seeds will be given for free in the target provinces as part of pilot scale deployment.

How will Golden Rice be deployed?

As Golden Rice is developed for humanitarian purposes to help address VAD, it will be deployed through market- and program-based approaches in partnership with relevant agencies that implement nutrition and public health programs. DA-PhilRice and its partners will seek the necessary policy support to make this vitamin A-infused rice available, accessible, and affordable to Filipinos, especially in areas where malnutrition is a high concern.

What changes will be needed before Golden Rice can be commercialized on a large scale?

To ensure the highest quality of seed for farmers and a safe and nutritious food supply for all Filipinos, DA-PhilRice will be putting in place a comprehensive quality assurance and stewardship program that covers all steps in the chain from seed production, to post-harvest processing, to marketing.

Is Golden Rice meant for commercial sale and export?

Golden Rice has been donated by its inventors for humanitarian use to help address VAD in countries where it is approved for cultivation. DA-PhilRice hopes that Golden Rice farming can generate additional income to local farmers while providing nutritional benefit of additional vitamin A to Filipino consumers. Golden Rice is meant to be consumed locally to provide an additional and sustainable source of vitamin A in the Filipino diet.

Who will buy the milled Golden Rice from farmers?

DA-PhilRice is currently conducting studies to determine the most effective way of purchasing Golden Rice where the first beneficiaries will be our farmers and communities who are most in need of the additional vitamin A available in Golden Rice.

What are the priority provinces for Golden Rice deployment?

Golden Rice will be planted first in provinces with a high prevalence of stunting, which is an indicator of VAD. Data used is derived from the most recent National Nutrition Survey conducted by DOST-FNRI and the Philippine Plan of Action Priority Areas 2017-2022.

How do we ensure purity and quality of Golden Rice across the value chain?

A comprehensive quality assurance and stewardship program that covers all steps in the chain from seed production, to post-harvest processing, to marketing is being developed by DA-PhilRice to ensure the quality and purity of the Golden Rice that will reach farmers' fields and consumers' tables.





Who will be in charge of monitoring the impacts of Golden Rice?

An efficacy study will be conducted by an independent organization with expertise in public health to determine whether Golden Rice improves vitamin A status of individuals. DA-PhilRice will lead the monitoring and evaluation of Golden Rice as it moves through the distribution system.

Is Golden Rice only available in the Philippines?

Bangladesh scientists are also developing Golden Rice using their popular inbred local varieties. It is currently undergoing regulatory review.

III. Production

Will farmers need additional training to be able to plant Golden Rice?

Golden Rice is not expected to require any changes in farm management or cultivation practices. Everything about local cultivation practices currently followed for conventional rice varieties, including the application of fertilizer, crop protection products, and labor, are directly applicable to the cultivation of Golden Rice.

Will planting Golden Rice have any harmful effects on other rice varieties through cross pollination or out-crossing?

Cross-pollination in rice is rare if plants are separated by a short distance of a few feet or meters. It is also uncommon in rice, unless all the rice plants are flowering at the same time. Rice pollen is normally viable for only a few minutes after flowering.

In other words, organically-grown rice will not cross-pollinate naturally with other cultivated rice, unless they are growing close together and flowering at the same time. Additionally, the beta carotene-producing trait in Golden Rice is not intended to affect the growth-related characteristics of rice. It will also not make it any more or less viable than conventional varieties.

Is the farming method of Golden Rice the same as inbred or hybrid?

Golden Rice is an inbred rice variety so the method of planting and caring for it is the same. Like other inbred varieties, its seed can be used in subsequent plantings.



Will I have to spend more on pest control if I plant Golden Rice? Will it result in stronger pests or new crop diseases?

Golden Rice does not have any modified or introduced resistance to insect pests or diseases. It is not expected to drive the evolution of resistant pest populations or require any changes in pest control practices. No occurrences of pest and beneficial insect species were observed during Golden Rice confined field tests. Golden Rice was not seen as a preferred host for pest insects, nor did it cause any harmful effects on the prevalence of beneficial species.

Can Golden Rice make weeds a bigger problem?

Confined field tests of Golden Rice at multiple locations in the Philippines have confirmed that there were no unintended or unexpected changes in the characteristics of rice concerning seedling germination and vigour, plant growth and morphology, reproductive characteristics, and susceptibility to pests and diseases resulting from genetic engineering. Golden Rice can co-exist with organic agriculture and other production systems, and will not make any other species more invasive or less viable.

Is there any difference in the availability of pollen from Golden Rice to live, grow, or develop?

There are no unintended effects on Golden Rice's pollen viability due to genetic engineering. Based on comparisons of pollen morphology and viability between GR2E Golden Rice and conventional rice, there are no significant differences in pollen viability or appearance.



Does Golden Rice's beta carotene content have an effect on yield?

Results of recently conducted tests have shown that Golden Rice has no unintended effects on yield or grain quality. Aside from the beta carotene content of the grain, Golden Rice is basically the same as conventional rice varieties.

Additionally, based on germination tests conducted under two different temperature regimes, genetic engineering did not result in any unintended changes that could affect Golden Rice's seedling development or environmental growth.

How many cavans could be produced per hectare? Production cost per hectare?

The yield of Golden Rice is estimated at 4,000kg or higher, depending on the area, per hectare per season. The production cost of Golden Rice may entail additional cost compared to normal inbred rice varieties, especially at start, since it requires dedicated labor, equipment, and supplies among other varieties.

Will farmers make money from planting it?

Due to the high yield nature of the popular inbred rice background of Golden Rice, there is also a high probability that farmers will earn from planting Golden Rice.

Would DA require or enforce farmers to exclusively plant Golden Rice?

The DA ensures that Filipino farmers are empowered to make decisions on what best serves them and their family based on the best-possible options to improve their crops, raise their farm productivity, and increase their income. Golden Rice is a nutrient-dense type of rice like brown rice, black rice, and red rice: an additional option for farmers to plant that can help in ensuring micronutrient sufficiency.

The Department promotes a range of technologies, interventions and safety nets to attain its vision of a food secure and resilient Philippines with prosperous farmers and fisherfolk.





IV. Consumption

When can I eat Golden Rice?

Considering the amount of time needed to produce enough seeds for farm cultivation, Golden Rice will be made available for consumption initially in areas with high prevalence of VAD by the last quarter of 2022.

Is Golden Rice effective as a complementary supplement for VAD?

Golden Rice is intended to be used in combination with existing approaches to overcome VAD including eating foods that are naturally high in beta carotene and processed foods fortified with vitamin A; oral supplementation, breastfeeding, and complementary feeding practices.

An independent bioefficacy study will be conducted by an organization with expertise in public health to determine the impact of Golden Rice on vitamin A intake.

How much Golden Rice will I have to eat to have enough vitamin A in the body? Can I overdose if I eat too much?

One cup of cooked Golden Rice can provide 30-50% EAR of vitamin A for preschool children and two cups for school children and adults. It will have to be eaten regularly replacing the existing white rice in order to have a long-lasting result.

Golden Rice can be eaten with other sources of beta carotene such as malunggay, carrots, squash, and other green and leafy vegetables--in other words, as part of a diversified and balanced-diet as illustrated in DOST-FNRI's Pinggang Pinoy. Beta carotene present in these foods can only be converted into vitamin A as the body needs it so any excess will only be excreted safely.



Will Golden Rice taste differently from regular rice? What is its texture?

The beta carotene concentration present in Golden Rice is not expected to affect its taste. This will be confirmed before commercial release by sensory panels. Beta carotene is a nature-derived color additive; it affects the color, not the taste, of the foods it is added to. This is different from how colored rice dishes (such as paella and Java rice) don't taste like regular white rice; that's because of the ingredients used in preparing the dishes, and not the rice itself. Based on the result of the initial sensory evaluation, Golden Rice is indistinguishable from its conventional background variety in terms of aroma, texture, and taste.

How much will Golden Rice cost to consumers?

As Golden Rice is developed for humanitarian purposes to help address malnutrition, especially vitamin A deficiency, it will be deployed through market-based and programmatic approaches (e.g. feeding program) in partnership with appropriate agencies. The project will lobby for policy support to make this vitamin A-infused rice available, accessible, and affordable to Filipinos, especially in areas where malnutrition is high.

What evidence do you have that Golden Rice will be beneficial?

Based on computations made in consultation with nutrition experts, one cup of cooked Golden Rice can provide 30-50% of the estimated average requirement (EAR) of vitamin A for preschool children, and pregnant and lactating mothers. A simulated analysis study suggests that beta carotene-rich rice like Golden Rice could improve vitamin A intake and could reduce the prevalence of VAD among women and children. Furthermore, an impact study will be conducted to further show Golden Rice efficacy.

What are the strategies to make sure that consumers and farmers will eat and plant Golden Rice?

At each stage of the project, the Healthier Rice team has engaged with key stakeholders from our target communities. Talking to farmers, nutrition workers, local government officials, students, and other community leaders have helped us understand their concerns and assure us that we share similar aspirations of having safe, affordable and nutritious food available to all Filipinos.

Should I eat Golden Rice everyday to have sufficient vitamin A in the body?

It is better to eat Golden Rice daily, as a substitute for ordinary rice, to have a continuous supply of vitamin A in the body. It is recommended to consume Golden Rice regularly to make it effective. This means that in areas where the risk of vitamin A deficiency is high, households are recommended to replace the existing white rice with Golden Rice to have a long lasting result.





How should I cook Golden Rice

Like the planting method, the cooking method is no different from ordinary rice.

Who will benefit most from the nutritional benefits of Golden Rice?

Golden Rice is for all citizens who need extra nutrients, especially children aged five years and below as well as pregnant and breastfeeding mothers because they are the ones who have a higher chance of getting the vitamin A deficiency.

Doesn't the beta carotene of Golden Rice get reduced when stored for some time and as you cook it? How will you ensure its efficiency in providing enough vitamin A?

Because beta carotene has a natural tendency to degrade over time, the project team monitors beta carotene content at various stages of the project, from harvest to storage to cooking: estimating from 100 grams of milled Golden Rice stored for two months in normal conditions, with 30% cooking losses in its calculations. Measurements at this stage show that there is sufficient beta carotene in Golden Rice to meet the 30-50% EAR of vitamin A for young children and mothers or lactating women.

References:

Swamy et al, 2019. Compositional Analysis of Genetically Engineered GR2E "Golden Rice" in Comparison to That of Conventional Rice

Oliva et al, 2020. Molecular characterization and safety assessment of biofortified provitamin A rice

Swamy et al, 2021. Development and characterization of GR2E Golden rice introgression lines.

Biswas et al, 2021. Development and Field Evaluation of Near-Isogenic Lines of GR2-EBRRI dhan 29 Golden Rice.

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For more up-to-date information on Golden Rice, please refer to the links below:

<http://www.philrice.gov.ph/golden-rice/about-gr/>

<http://irri.org/golden-rice>



Quality Rice. Quality Life.



We are a government corporate entity (Classification E) under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding and cost-reducing technologies so farmers can produce enough rice for all Filipinos. With our "Rice-Secure Philippines" vision, we want the Filipino rice farmers and the Philippine rice industry to be competitive through research for development in our central and seven branch stations, including our satellites, coordinating with a network that comprises 60 agencies strategically located nationwide. We have the following certifications: ISO 9001:2015 (Quality Management), ISO 14001:2015 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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