***Review Article***

**Golden and Silver Treasures of Agriculture: A Comparative Review of Valued Innovations**

**ABSTRACT**

In agriculture, many important crops, technologies and movements are described using terms like "gold" and "silver" to highlight their value. These symbolic names reflect not just their colour, but their impact on health, farming, income and sustainability. To understand the precious products of agriculture termed as golds and silver, it is important to glance in agriculture and allied sciences and compare various products. Therefore, various sectors were reviewed and major products titled as golden or silver were identified. The study of these products enhances our information and also to increase value of more such products to be known to the world. Through simple language and examples, the article compares their contributions, challenges and importance in today’s world.

1. **INTRODUCTION**

Agriculture is the foundation of our survival. It not only gives us food, fibre and shelter but also provides employment to 46.1 per cent in 2023-2024 (Bhagirath, 2025). With the growing population and changing climate, agriculture is undergoing a transformation. New technologies like genetic engineering, precision farming, biofortification and improved crop varieties are helping farmers produce more, use fewer resources and meet modern-day challenges (Sandhu *et al.*, 2023; Patil *et al.*, 2024). In this process, some crops, products, or ideas have become so valuable that people have started calling them “gold” or “silver.” These words aren’t just about the actual colour but they highlight how precious and powerful these innovations are in improving our health, income and environment. For example, Golden Rice, developed using genetic engineering, was created to fight vitamin A deficiency, especially in poor communities (Dubey and Petruzzello, 2023). Golden Banana is another biofortified crop rich in iron and vitamin A (Harding *et al*., 2018). Golden Silk refers to the lustrous Muga silk of Assam, a cultural and economic treasure (Das,2022). The Golden Revolution transformed the production of fruits, vegetables and honey, boosting farmer incomes (Siddiqui, 2014). Other terms like Golden Beans (soybean), Golden Fibre (jute) and Golden Urea (coated fertilizer) reflect how modern farming techniques and sustainable practices are helping improve both productivity and soil health. On the other hand, Silver Revolution and Silver Fibre stand for the success of poultry and cotton, which continue to support the rural economy.

In this article, we shall explore these golden and silver names in agriculture, where they came from, how will they help and what problems they aim to solve. From genetically modified crops to eco-friendly fibres, these “golds” and “silvers” show us how science, tradition and innovation are shaping the future of farming.

1. **AGRICULTURAL SILVERS**
	1. **Golden Rice (GR)**

Golden Rice is a specially developed variety of rice that has been genetically modified to produce β-carotene, a substance that the body converts into vitamin A. It contains about 20-35*μ*g *β*-carotene per gram of rice (Palmer, 2025). GR was developed by Prof. Ingo Potrykus and Prof. Peter Beyer in 1999 by addition of two genes, the phytoene synthetase gene (*psy*) from maize and the carotene desaturase gene (*crtl*) from *Erwinia uredovora* (Potrykus, 2012). It was created to help reduce vitamin A deficiency (VAD), a serious health issue in many developing countries. VAD can cause blindness, xerosis, xeropthalmia and even death in millions of children (Dastagiri *et al*., 2014). These genes enable the rice to produce the yellow-orange pigment β-carotene in the grain. In 2021 [Philippines](https://www.britannica.com/place/Philippines) became the first country to approve the commercial cultivation of golden rice (Wesseler and Zilberman, 2014).

While the rice holds great potential to improve nutrition, especially in poorer regions, it has faced regulatory hurdles, claiming that the crop had the potential to contaminate regular rice and thus disrupt food and financial security for rural farmers (Fuchs and Glaab, 2011). However, in 2016 more than 100 Nobel [laureates](https://www.britannica.com/dictionary/laureates) signed statement worldwide in support of GMOs and golden rice in particular, arguing that because golden rice may reduce avoidable deaths, restricting that is a [crime against humanity](https://www.britannica.com/topic/crime-against-humanity). In 2021, in India, Department of Biotechnology (DBT) made a significant announcement with regard to the approval of Golden Rice for consumption (Rama, 2024). One must think about biotechnology and genetic modification are the emerging field to combat various diseases, which would otherwise lead to millions of deaths. Being in 21st century, where everything in possible with technology, proven results of every technology need to be made public so that people become themselves aware about measures to follow.

* 1. **Golden Silk**

The naturally golden-yellow silk is produced by Muga silkworm, *Antheraea assamensis*. It is semi-domesticated silkworm endemic to Assam, cultivated mostly in the Garo hills of Assam (Phukan, 2012). The silk got the geographic indication (GI) tag in 2007 and also received the Muga Silk of Assam (Logo) in 2013 (Gogoi *et al*., 2017). The silk is renowned for its natural golden sheen and is highly valued for its durability and rich texture. Muga silkworms are reared on Som and Soalu host plants. The famous Mekhala cheddar is obtained from muga silk (GeeksforGeeks, 2022). Muga silkworms are highly sensitive to pollution. Therefore, rearing must be undertaken in pollution free naturally best rearing conditions (Devi *et al*., 2011). Muga silkworms thrive well in specific temperature ranges, ideally being between 24°C and 25°C and relative humidity 75-85 percentage (Tikader *et al*., 2013).

* 1. **Golden Revolution**

The important milestone in agriculture growth is Golden Revolution (1991–2003). It transformed India’s horticulture and honey production, boosting economy and the rural employment. The revolution was led by Nirpakh Tutej, the *Father of the Golden Revolution* (Sharma, 2025)*.* It introduced modern farming, irrigation and market reforms, helping India become a global leader in fruits and vegetables. It raised rural wages, created more jobs, ensured food security and strengthened India’s exporting of goods, crop diversification, enhanced honey yield and horticultural growth to uplift agricultural incomes. Nirpakh Tutej, played a key role by introducing innovative farming technologies. Promoting beekeeping activity, popularly known as apiculture, proliferation of horticulture, introduced high-value crops such as fruits, vegetables, spices and flowers (Tuteja, 2011). The lack of facilities for cold chains and poor means of transportation resulted in post-harvest losses, price fluctuations and low returns (Butler and Officer, 2012). Inspired by this, the Government of India launched the National Horticulture Mission in the year 2005-2006 with a mandate to increase the production in the horticulture sector (Sinha and Sharma, 2022).

* 1. **Golden Mahseer**

Mahseer (mahi – fish and sher – tiger) is also called as tiger among fish (Gupta *et al*., 2014). It is known to be the toughest and a large cyprinid among all the fresh water sport fishes. The name golden mahseer is due to the body colour of adult which is golden on dorsal side and the fins are reddish-yellow. Large scales and powerful thick lips, with relatively longer barbels which are the sensory hair-like organs in front of the mouth (Bhatt and Pandit, 2016). These fishes generally breed during the floods and spawn over the rocky, gravel substrates, usually in ephemeral headwaters. The fecundity or sexual productivity is 6,000 – 10,000 eggs per kilogram (Dhawan *et al*., 1960). The average growth rate in individuals of population is 10 cm annually which is comparatively slower than the cultured carps, *viz*. the common carp (*Cyprinus carpio*), mrigal (*Cirrhinus mrigala*) and rohu (*Labeo rohita*). They are omnivorous, feeding on green filamentous algae, insect larvae, small molluscs and algal coatings on rocks (Langer *et al*., 2013). During migration, fish of all ages remain carni-omnivorous and the fish <46 cm size become piscivorous (fish feeding). The maximum size recorded- is 2.74 m and weight of 50 kg. The status of Golder mahseer has been listed in IUCN red list as it among the endangered species (Joshi *et al*., 2018).

* 1. **Golden Leaf (Tobacco)**

Tobacco is referred as the "Golden Leaf" due to its rich golden colour when cured, particularly with the flue-curing process. Also because of its historical and economic significance, especially in the context of the American colonies (Killebrew and Glasson, 1904). Flue-curing involves drying the leaves in a barn with heat from the flues, which helps preserve their sugars and results in a lighter, milder flavor and the distinctive golden hue. To create the smoking tobacco, leaves need to be cured or dried out. The wet and green tobacco leaves initially contain high much moisture which can catch fire (Curry-Machado, 2016). They also have a more chlorophyll content. By releasing certain amount of chlorophyll from leaves during drying out process, all the natural tannins come out, giving the smoked tobacco the flavour and scent (Shuwei *et al*., 2022). The curing process make the leaf dry enough to smoke while increasing the sugar and natural tannins found in each leaf to create the sweetly aromatic and mild taste the tobacco known for (Barcia, 2016).

* 1. **Golden Beans**

Soybeans are called the "Golden Beans" due to their high nutritional value, particularly their rich protein and oil content. They are also known as the "miracle bean" for their diversified uses in food and other industries (Sahana *et al*., 2007). Soybean, the nutritional powerhouse are packed with high-quality protein (38-45 %), almost double the protein content compared to other pulses. They also offer dietary fiber, vitamins (A, C, E, K), minerals [iron (Fe), magnesium (Mg), zinc (Zn), selenium (Se), calcium (Ca)] and antioxidants (Singh *et al*., 2020). The lower glycemic index, low saturated fat and cholesterol-free nature contribute to its health benefits. They are also known to provide therapeutic benefits and are a good source of essential amino acids. Soybeans are also used in a wide array of food products, including soy milk, soy sauce, tofu and even meat substitutes calling it as the poor mans’ meat. Their oil is extracted and used in cooking and various industrial applications. Soybean cultivation is economically significant, providing good returns for farmers. The versatility of the crop and its various by-products contribute to its importance in both food and industrial sectors (Dela *et al*., 2007; Lokuruka, 2010).

* 1. **Golden Fibre**

Jute is called as the "golden fibre" primarily due to its lustrous appearance, golden-brown colour and its high monetary value. It is a natural fibre extracted from the stem of the jute plant and its unique lustre and profitability have earned it this descriptive name (Gangwar *et al*., 2011). Jute is the second most widely used natural fiber after cotton, but cotton requires five times as much water, five times as many areas and a staggering amount of chemicals to grow, further highlighting significance of jute (Prakash *et al*., 2024). It can be used for countless industrial and domestic applications due to its high tensile strength, breathability, low extensibility, ease of blending with both synthetic and natural fibres, acoustic and thermal insulation and antistatic properties (Aurora and Haider, 2024). Examples includes the insulation (replacing glass wool), geotextiles, carpet backings, activated carbon powder, gunny bags, wall coverings, flooring, garments, rugs, ropes, handicrafts, curtains, paper, furniture and sandals. In India and Bangladesh there was even a period focusing on jute production called as the "Golden Fibre Revolution," emphasizing its importance in the agricultural sector and to overcome jute related challenges. Further, overcoming issues like new processing technology and product diversity beyond packaging and handcraft will cherish the industry (Islam, 2019).

* 1. **Golden banana**

The Banana21 project began in 2005 to address vitamin A and iron deficiencies in Uganda, where East African Highland bananas are a staple food but naturally low in these nutrients, due to poor fertility and lack of high-nutrient varieties, researchers used genetic modification to boost levels of pro‑vitamin A in banana fruit (Paul *et al*., 2018). Initial trials in Australia proved that fruit could exceed the target of 20 µg/g dry weight β‑carotene, enough to meet 50% of daily vitamin A needs (Paul *et al*., 2017). The technique and infrastructure were then transferred to Uganda, where field trials led to promising local lines. The final phase (since late 2017) focuses on generating safety and composition data, genome sequencing and preparing regulatory submissions to achieve the world’s first approved GM "golden banana" from Africa. Main challenges include navigating Uganda’s biotech regulation and meeting biosafety standards before these nutrient-rich bananas can reach farmers and children (Waltz, 2014).

* 1. **Golden snail**

*Pomacea canaliculata*, often referred to as the golden apple snail or channeled apple snail, is a large freshwater mollusk belonging to the Ampullariidae family. It is native to South America. This snail is characterised with gills and a protective operculum, which allow it to thrive in aquatic environmental conditions (Halwart, 1994). Due to its highly invasive nature and destructive impact on the ecosystems and agriculture particularly in the rice fields, it has earned a place among the world’s top 100 most invasive alien species. In Europe, it holds the title of being the most damaging gastropod invader and is ranked 40th among the continent's worst alien species. *Pomacea canaliculata* exhibits a highly diverse diet, making it a polyphagous species. It primarily consumes aquatic vegetation plant materials (macrophytes), especially the floating and submerged macrophytes, but also feeds on organic detritus and even animal matter, showcasing its adaptability in various ecosystems (Serra, 1997).

* 1. **Golden Urea**

Urea Gold, also known as Sulphur Coated Urea (SCU), is a newly introduced slow-release fertilizer approved by the Government of India to promote sustainable agriculture and reduce excessive urea use. Unlike conventional urea, which contains only 46% nitrogen, Urea Gold combines 37% nitrogen (N) with 17% sulphur (S) addressing both nitrogen efficiency and sulphur deficiency in soils. It is coated with the molten sulphur to ensure a gradual release of nutrients, enhancing uptake by plants and minimizing nutrient loss. Enriched with humic acid, it improves soil health and extends the effectiveness of fertilization. Studies by Indian Council of Agricultural Research (ICAR) showed that it can reduce urea consumption by up to 25 per cent and 15 kg of Urea Gold can deliver the same effect as 20 kg of regular urea. Priced similarly to neem-coated urea, it offers an eco-friendly and cost-effective solution for Indian farmers (Golden *et al*., 2009).

* 1. **Black gold**

Petroleum, commonly known as crude oil, is a naturally occurring yellowish-black liquid composed mainly of hydrocarbons found in geological formations. It encompasses both the raw, unprocessed form and the refined products derived from it. Crude oil appears dark or jet black upon extraction, but after undergoing refining processes, it acquires a golden hue, hence the nickname black gold (Wateringen, 2005). This comparison to gold reflects its immense economic value, scarcity and the high costs associated with its extraction. Petroleum plays a critical role in modern life, with its derivatives used in fuels, transportation, plastics and synthetic materials. In the U.S. alone, annual oil consumption reaches nearly 7.5 billion barrels, almost half of which goes to motor gasoline. Despite its economic significance, the petroleum industry has been linked to serious human rights violations and environmental concerns, often involving the displacement of communities and suppression of dissent in fossil fuel-producing regions (Esrafili-Dizaji and Harchegani, 2011).

Another commodity, black pepper also widely referred to as "black gold" in agriculture and trade. Black pepper has been a highly sought-after spice for centuries, with its trade routes shaping historical events and cultural exchanges. Its high market value, particularly in the past, earned it the moniker "black gold". Black pepper is not just a flavouring agent; it's also used in traditional medicine and various food products. While traditionally grown in a few tropical regions, black pepper is a globally traded spice, making it a valuable commodity worldwide (Stommel and Griesbach, 2005).

* 1. **Red Gold**

Saffron, often referred to as "red gold" due to its high value among medicinal and culinary crops, has been used for over 4,000 years, primarily as a traditional remedy with antidepressant and tonic properties. Derived from the dried stigmas of *Crocus sativus L.*, saffron is prized for its unique flavor, aroma and colouring properties, commonly featured in signature dishes like Spanish paella and Italian risotto. With growing interest in functional foods for disease prevention, saffron's health benefits have boosted its global appeal. Economically, it offers farmers a means of income diversification, enhances agrotourism potential and supports sustainable farming. However, declining yields have led researchers to explore ways to improve stigma production through better agronomic practices and the use of bio stimulants. Additionally, there's increasing focus on utilizing saffron by-products such as stamens, leaves and corms for food (Shahi *et al*., 2016).

* 1. **White gold**

Camel milk, often called "white gold," of desert is valued for its rich nutritional content and health benefits, especially in arid and desert regions where camels thrive. Unlike cow milk, it contains higher levels of iron, vitamin C and unsaturated fatty acids, making it a vital source of nourishment for communities in harsh climates. Its medicinal properties such as anti-inflammatory, antioxidant and potential anti-diabetic effects have increased its popularity worldwide (Wernery, 2006). Camel milk is also easier to digest for people with lactose intolerance. Due to its growing demand and limited supply, especially in niche markets, it has earned the title "white gold" for its economic and therapeutic value (Chikha and Faye, 2025).

 Cotton earned its nickname “white gold” in the American South due to its profound economic significance and transformative power during the 19th and early 20th centuries. Before Eli Whitney’s invention of the cotton gin in 1794, separating cotton fibers from seeds was laborious and slow. The gin revolutionized this process—boosting productivity by around fiftyfold—and turned cotton into a major export crop that dominated Southern economies. Much like precious metal, this soft, shining white fiber generated immense wealth, underpinning plantation prosperity, regional trade and even financing the growth of infrastructure and cities. The term "white gold" came to capture both its physical appearance and its pivotal role in shaping history, while also carrying a complex legacy tied to slavery and environmental impacts (Shahrajabian *et al*., 2020).

**Table 1 : Comparative Analysis of agricultural golds**

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| **Golden Term** | **Domain / Sector** | **Focus / Impact** | **Key Challenges / Concerns** |
| Golden Rice | Biofortification / GM Crops | Vitamin A deficiency reduction | Regulatory hurdles, GMO opposition, acceptance by farmers |
| Golden Silk | Sericulture / Rural Economy | Natural golden sheen, GI tag, high-value textile | Climate sensitivity, limited regional cultivation |
| Golden Revolution | Horticulture / Apiculture | Boosted fruit, vegetable and honey production | Post-harvest losses, cold chain gaps, price fluctuations |
| Golden Mahseer | Fisheries / Biodiversity | Endangered sport fish, ecological significance | Habitat degradation, slow growth, IUCN Red List species |
| Golden Leaf | Commercial Crops (Tobacco) | High-value export crop, golden hue when cured | Health concerns, ethical issues, regulation of tobacco industries |
| Golden Beans | Pulses / Food Industry | Nutritional powerhouse, soy-based products | GM concerns, dependency on imports, monoculture risks |
| Golden Fibre (Jute) | Natural Fibre / Sustainability | Eco-friendly fibre, industrial use | Modern processing tech, product diversification, price instability |
| Golden Banana | Biofortified Fruit / Nutrition | Provitamin A-rich GM banana, malnutrition reduction | Regulatory approval in Africa, biosafety, public perception |
| Golden Snail | Invasive Species / Environment | Invasive pest, major threat to rice fields | Ecosystem damage, crop loss, difficult to control once established |
| Golden Urea | Fertilizer / Input Efficiency | Slow-release N + S fertilizer, eco-friendly | Adoption rate, awareness, supply logistics |
| Black Gold |  Energy / Spices / Trade | Petroleum / Black Pepper | Valuable cash commodity |
| White Gold | Agrarian economy / Dairy | Cotton / Milk | Cotton in one context, milk in another |
| Red Gold | Medicinal plants / Horticulture | Saffron / Tomato | Valuable spices or crop |

1. **AGRICULTURAL SILVERS**
	1. **Silver Revolution: Poultry Development in India**

The Silver Revolution refers to the significant growth in poultry farming and egg production in India during the 1960s–1980s. This transformation was largely credited to Dr. B.V. Rao, considered the father of the poultry industry in India (Gulati and Juneja, 2023). As part of India’s broader agricultural revolutions (like Green for food grains and White for milk), the Silver Revolution helped India evolve from an egg-scarce country to one of the world’s leading producers. It not only improved nutritional security but also generated employment, especially among rural women (Hellin *et al*., 2015). However, challenges like rising feed costs, disease outbreaks (e.g., bird flu) and market fluctuations still persist in the sector.

* 1. **Silver Fibre: The Cotton Economy**

Cotton, often referred to as the “Silver Fibre”, plays a pivotal role in India’s textile and agricultural economy (Ravindra *et al*., 2010). Known for its white, lustrous fiber, cotton is one of the most widely cultivated commercial crops, especially in states like Maharashtra, Gujarat and Telangana. It supports millions of farmers and textile workers across the country (Tausif *et al*., 2018). However, cotton farming faces major challenges such as pest infestations (like the pink bollworm), overuse of pesticides and market price volatility. The introduction of Bt cotton helped in initial pest resistance, but concerns around sustainability and GM crop dependency have emerged in recent years (Gordon and Hsieh, 2006).

* 1. **Silver Carp: Aquaculture and Invasive Risk**

The Silver Carp (*Hypophthalmichthys molitrix*) is a species of freshwater fish native to East Asia, but widely introduced across the world, including India, for aquaculture purposes. Known for its rapid growth and filter-feeding abilities, silver carp helps in controlling plankton in ponds and lakes, making it a valuable species for composite fish farming. However, in several countries like the United States, it has become an invasive species, disrupting native ecosystems by outcompeting local fish (Lübcker et al., 2014). In India, while not yet invasive, its cultivation requires careful monitoring to prevent ecological imbalance (Lu et al., 2020).

* 1. **Silver Oak: Shade Tree in Agroforestry**

The Silver Oak (*Grevillea robusta*) is a fast-growing tree species with silvery underside leaf commonly used in agroforestry systems, particularly in coffee and tea plantations in southern India. Farmers prefer silver oak as a shade tree for crops like coffee due to its light-filtering canopy and timber value. Its straight trunk and relatively low water demand make it suitable for integration into plantation ecosystems. However, it is also flammable and care must be taken during dry seasons to prevent fire hazards. Its widespread use demonstrates how tree integration supports both crop protection and timber economy (Riyaz *et al*., 2024).

**Table 2 : Comparative Analysis of Agricultural Silvers**

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| **Silver Term** | **Domain / Sector** | **Focus / Impact** |
| Silver Revolution | Animal Husbandry (Poultry) | Rapid increase in egg production in India |
| Silver Fibre | Cotton (textile crops) | Denotes cotton, valuable white fibre |
| Silver Carp | Fisheries | Freshwater fish used in aquaculture, fast-growing |
| Silver Oak | Agroforestry / Plantation | Tree used as shade plant (e.g., in coffee plantations) |

**Conclusion**

Agriculture is not just about growing crops—it is the lifeline of our country, feeding people, supporting livelihoods and strengthening the economy. As we face new challenges, the farming sector is being reshaped by innovation and technology. The use of terms like Golden Rice, Golden Silk, Golden Urea, Silver Revolution and others reflects how certain crops, products and practices have brought major benefits to health, income and the environment. These “golden” and “silver” names remind us that when science and farming go hand in hand, they can lead to a brighter, more sustainable future for all.

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