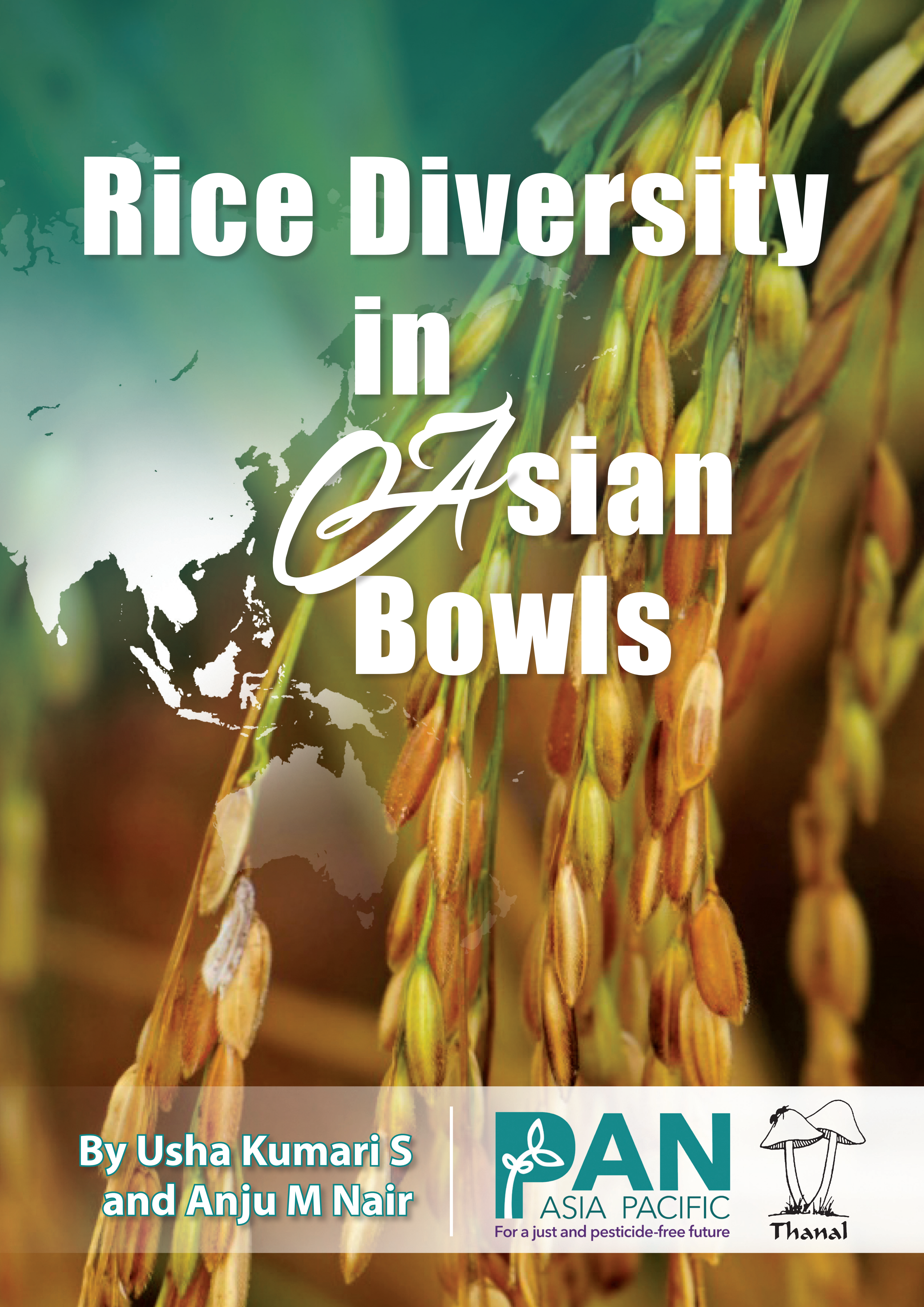
Rice Diversity in Asian Bowls



By Usha Kumari S
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Introduction

In Asia, rice (*Oryza sativa* L.) farming has been closely linked to the rise of civilisation. Although significant food crops such as millet in rain-fed fields, sago palm in coastal lowlands, and taro in irrigated areas were all grown before rice in the Pacific Rim, it is believed that rice was domesticated for the first time in northern Southeast Asia or southern China around 8,000 years ago. Sago palm, taro, and millet were some of the first plants produced in Asia as crops; all three were staple foods in the early Neolithic period before rice. Wild grains collected in marshy locations are thought to have been domesticated to become rice. The development of settled populations, the articulation of social classes, and the emergence of state structures were all aided by the cultivation of rice (Eric Crystal and Peter Whittlesey, 2004). Geographically, West and East Asia account for the majority of global rice production. To this day, over 90% of the world's rice is produced and consumed in the Asia Pacific Region. There are several varieties of rice in existence today, including both wild and farmed varieties (Gopi Divya., 2021). In India, there are more than 280 significant rice types known to exist.

Cultural importance of rice in Asia

Rice is closely "associated with women and fertility" in Asian cultures, and religious rituals have historically been done primarily for "assurance of rice, fecundity of domestic animals, and propagation of human species." People harvest rice using tiny finger knives all around Southeast Asia, but especially in Indonesia, "so that the rice goddess doesn't get upset." Senior skilled women have long used delicate hand knives to carefully choose the seed rice for future harvests in both Indonesia and the Philippines. Many Southeast Asian societies still perform ceremonies and offer tributes to a female rice deity, in whose honor they hold sacred in many of their traditions. (Rashaan Meneses, 2004)

Political importance of rice in Asia

With a contribution of 40%–80% of total caloric intake, rice continues to be the most significant food staple throughout Asia. In this region, where at least two-thirds of the fertile land is used to grow rice, it is also the main source of income for households that depend on agriculture and small-scale farming. At least half out of the total area of fertile land is rain-fed, making it susceptible to both drought and flooding. Higher cropping intensity has led to more pest problems even in irrigated areas, adding to the output instability that characterises monsoon Asia's rice economy (M.K. Papademetriou, 2023). As rice is so significant to Asia's economy and politics, no government has allowed for the local rice market to be unfettered by forces of supply and demand. Offering low rice prices to consumers and financial incentives to farmers are two competing goals that Asian governments always find a way to reconcile. A distinct and significant challenge is maintaining stable domestic rice pricing for both consumers and producers (David et. al,1996).

Rice continues to be the most significant food staple throughout Asia.

With more than half of the world's population and one-third of the world's impoverished and starving populations, Asia is the center of global food security (Monika BD, 2013). In many Asian countries, the words for food and rice, or for rice and agriculture, are the same, signifying that rice is a staple food for many people. About 87% of the world's rice is produced in eleven

Asian nations. About 35% of the world's rice exports come from eight of these nations. The production of rice in Asia, namely in India and China, has a significant impact on world food security. Together, China and India, the two largest economies in Asia, produce 49% of the world's rice and have 37% of the world's population (Nirmala Bandumula, 2017).

Economic importance of rice in Asia

More than two billion people get nourishment from rice as a staple food, the most significant food crop in the developing world. The rich heritage of rice diversity presents a great opportunity for additional development to achieve environmentally- and economically-viable agriculture now. Rice is one of the most important food crops and feeds more than 60% of the population of India. The area for rice crop was 30.81 million hectares in 1950-51, which has increased to 43.86 million hectares during 2014-15 which is nearly 142% higher.

Panicle bearing rice spikelet
Photo credit: Anju Babu, Programme Coordinator, Thanal

Rice has been a necessity for people for a longer period of time than has any other grain. Rice lands in Asia are so diverse that it allowed for diverse kinds of cropping patterns in rotation with pulses, oil seeds and vegetables, fishes, ducks and poultry. This helped communities to develop complex and diverse systems of production, value addition, trade and consumption. Rice is exceptional in that it can thrive in wet conditions in which other crops cannot. These wet conditions are prevalent throughout Asia. There are many flood-resistant varieties of rice developed by farmers in the coastal wetland regions of Asian countries.

Rice trade is quite an old trade and economic practice across Asia. Many Asian countries are rice exporters. This includes not only rice, but other value-added products from rice which are also traded. From seed to rice, a very big value chain works and all are benefited economically. In the recent years in India, many self-help groups of women farmers, farmer producer organisations, co-operatives and so on have started to work on the full value chain, trying to make rice cultivation more sustainable. This is helping farmers to shift to organic and sustainable cultivation practices and the results are encouraging. Even some well-known food industries have started to procure organic rice and thus creating more consumer demand for organic and traditional rice.

Traditionally, one of the preferred products from rice is flaked rice. This is utilised to make a variety of dishes. One of Japan's most popular alcoholic beverages is sake, which is produced after rice is fermented. The rice milling industry generates an important by-product called bran. In villages, it is utilised as cow feed. Bran oil is used as a cooking oil. Bran is also used in leather and textile industries. Bran wax, a by-product of the extraction of bran oil, is used to make lipstick and in the chocolate business. Paddy husk is used as fuel, and also utilised in brick-making. Straw is used to make strawboards, feed animals, and make hats, ropes, mats, and other items. Thus, rice becomes very economically important in the Asian context.

Threat of Climate Change on Rice Cultivation

Rice production is both affected by and a contributor to climate change. Climate change impacts and alters the production of rice. Each growing season, over 144 million smallholder rice farmers risk their livelihoods due to drought, flood, seawater, and excessive temperatures that destroy harvests. Methane, a powerful greenhouse gas, is produced by traditional farming practices like flooding paddy fields, and thus contributes around 10% of all man-made methane emissions in the atmosphere. (International Rice Research Institute, 2023). The rice producing system is one of the most vulnerable agro-ecosystems to climate change (Saud S., et al, 2022). Rice yield will be reduced when temperatures rise and rainfall variability increases. Each growing season, drought, flood, saltwater, and extreme temperatures destroy rice production systems and endanger rice farmers' livelihoods. About 60%of India's rice-harvesting area is irrigated, leaving the rest dependent on rainfall and hence vulnerable to drought (AlJazeera, 2022). According to some projections, climate change might result in the loss of more than a quarter of all rice output in the bulk of India's river basins (Palanisami., et al, 2017). According to a study conducted by National Innovations in Climate Resilient Agriculture (NICRA), rainfed rice yields in India are projected to reduce marginally (<2.5%) in 2050 and 2080 and irrigated rice yields by 7% in 2050 and 10% in 2080 (PIB,2021).

Warm temperatures (ideal range 20°C-30°C) and substantial rainfall (optimal range 1500 mm-2000 mm) often boost rice plant growth rates and thus production. Extremely high temperatures (> 35°C) cause heat stress and disrupt plant physiological processes, resulting in spikelet sterility, non-viable pollen, and decreased grain quality. Drought, on the other hand, affects plant transpiration rates and may result in leaf rolling and drying, decreased leaf expansion rates and plant biomass, solute immobilization, and increased heat stress of leaves. (Singh, K, et al., 2017). According to projections, the global temperature would rise by 2-3°C 2030 and 2050, with temperature increases of up to 2°C or greater projected to lower yields of global primary crops such as rice. Furthermore, climate change has resulted in significant changes in planting and harvesting schedules, which has resulted in changes in the growing season, altering food supply (Ansari A., 2017).

A study by the Potsdam Institute for Climate Impact Research found that climate change raises the risk of brown planthopper infestation in rice fields, one of India's most concerning pests. Temperature increases, in particular, have a critical role in the spread, potentially doubling the overall area under high pest risk from 7% to more than 15%. In many parts of India, the brown planthopper, often in conjunction with a virus, can cause wilting and even death of rice plants. This might result in massive economic losses of 70 to 100%of commercial rice production per season. If unabated, climate change could contribute to the pest's increase in the future, perhaps putting more than half of Indian rice production areas under severe threat from the brown planthopper (Govindharaj, et al., 2021)

To ensure rice sustainability and food security in the face of climate change, practices that promote resilience in rice-farming systems, such as the use of tolerant cultivars, locally-precise agricultural techniques, sustainable water management, and improving soil health must be implemented. These

> **To ensure rice sustainability and food security in the face of climate change, practices that promote resilience in rice-farming systems must be implemented.**

would increase crop productivity in the country, necessitating a greater emphasis on addressing climate change challenges in Indian agriculture. For proactive adaptation, methods should incorporate long-term decision-making and create incentives to adjust behaviour in response to climate change (Arivelarasan, T, et al., 2023).

Rice Cultivation Contributes to Climate Change

Rice cultivation is both adversely impacted by, and a contributor to climate change. Some traditional rice cultivation practices, such as flooding paddy fields and burning rice straw in open fields produce methane and carbon, strong greenhouse gases in large quantities. Methane is more than 25 times more powerful as a greenhouse gas than carbon dioxide (CO_2). Rice accounts for 10% of worldwide methane emissions, and in Southeast Asia, one of the world's largest rice bowls, rice farming accounts for 25-33% of the region's methane emissions.

According to the Environmental Defense Fund (EDF), global rice cultivation emits harmful greenhouse gases into the environment, equivalent to 1,200 average-sized coal power plants.

Flooding is a practice that helps in reducing weeds in the rice ecosystem. However, it has certain negative impacts on the environment. Rice when farmed in flooded fields will create excellent anaerobic conditions for bacteria to flourish on decomposing organic waste (mostly rice straw residue) and emit methane. Nitrous oxide emissions are caused by the rice plant's inability to absorb nitrogen-based fertilisers, which are frequently overused by farmers. Burning of residues will also result in increased emissions (Dina Umali Deininger, 2022).

Methane generation is aided by an abundance of water. One of the most common alternatives to flooding is to alternate between wet and dry fields. This method is referred to as Alternate Wetting and Drying (AWD). Alternate wetting and drying (AWD) is a management technique that preserves yields while conserving water and lowers greenhouse gas (GHG) emissions in irrigated lowland rice, The regular drying and re-flooding of the rice field characterizes AWD practice (Meryl Richards et. al, 2014). According to CGIAR, this practice can reduce Methane emissions up to 48%.

Non-chemical reduced tillage or zero tillage practices can also help in reducing emissions. Depending on the management practices used, tillage operations have a significant impact on energy consumption and production, carbon footprints and carbon use efficiency, soil health, and grain yield. The soil health significantly changes as a result of zero-tillage systems that maintain surface soil coverage, particularly in the higher soil layers (Anikwe and Ubochi, 2007). According to Van Kessel et al. (2013), Zero Tillage could minimise N_2O emission under dry climatic conditions. In addition, reducing the application of nitrogen fertilisers as suggested by experts is also important to adopt. Intensive application of chemical fertilisers and pesticides could lead to the emission of nitrous oxide to the atmosphere, another greenhouse gas, that could lead to an even greater issue. Nitrous oxide will remain in the atmosphere for around 100 years and may be up to 300 times more powerful than carbon dioxide. Many scientists and agroecology experts now recommend crop rotation with

> "The straw should either be incorporated in the soil or used as animal feed to reduce emissions."

pulses as a means to at least halve nitrogen fertiliser application. Organic rice farmers generally follow such crop rotation with pulses and oil seeds in different agroclimatic zones of India and completely stop using chemical fertilisers in a short period.

Avoiding burning of residues in the field could also help to reduce the emissions. The straw should either be incorporated in the soil or used as animal feed to reduce emissions.

Rice Conservation – Drought and Flood Resistant Varieties

In countries like Philippines, India, and Bangladesh, farmers, CSOs, NGOs and scientists are working together to revive many traditional varieties of rice which are resilient to abiotic stresses. India had around one hundred thousand varieties or accessions of rice in the 1960s and many of them were lost in the last fifty years. Dr Richharia, a well-known scientist and rice diversity expert who headed the Central Rice Research Institute made a collection of 19,000 accessions of rice from east India then. The National Bureau of Plant Genetic Resources also has a collection of around 30,000 accessions of rice from India. Unfortunately, all these are not in regular cultivation any more. In the last 2-3 decades in India around 1,500 such varieties have been collected and conserved and are getting tested in different agroecological regions by various groups and scientists. Many state governments have also in the recent years started to support policies that encourage production of selected varieties suitable for saline conditions, are drought tolerant, nutritious, medicinal and so on. A market is being developed for such varieties by raising consumer awareness through workshops, food festivals, social media campaigns and so on.

> The National Bureau of Plant Genetic Resources also has a collection of around 30,000 accessions of rice from India.

The productivity of rice (*Oryza sativa* L.) is being progressively harmed by the increasing frequency and intensity of diverse abiotic stresses including flood and drought in the period of climate change. Sometimes, these pressures alone might cause a total yield loss. Therefore, it is crucial to create rice that is climate resilient and resistant to abiotic stressors (Mottaleb, K. et al.,2016).

The term "landraces" refers to native variants. They contain a lot of genetic potential for enhancing crops. These have a high degree of genetic variability because they have not been the focus of subtle selection over many years. This heterozygosity helps landraces adapt to a variety of agro-ecological contexts and also endows them with exceptional qualitative features and therapeutic properties. This wealth of complicated quantitative trait variability is still underutilised. Rice cultivation in Kerala, an Indian state in the southern Western Ghats, dates back to 3000 BC (Manilal, 1990). Both wild and domesticated rice germplasm exhibit enormous genetic diversity. The names of the state's landraces are based on morphological characteristics, seed colour, intended applications, growing circumstances, and so on.

In India, the risk of river flooding might affect as many as 4.8 million people annually. Since many potential planting locations have been submerged by floods in India, environmental constraints have had a particularly detrimental impact on rice production. Low-income farmers have been disproportionately impacted by this disaster. These farmers frequently operate on pieces of land that are less stable and more prone to flooding. Without the creation of methods to help combat extreme weather, both the broader Indian economy and the livelihoods of low-income Indians will suffer serious socioeconomic effects (The Borgen Project, 2021).

Swarna Sub-1 Rice: Swarna Sub1, developed by the Indian Council of Agricultural Research and the Manila-based International Rice Research Institute since 2009**.** A strain of flood-tolerant rice called Swarna Sub-1 has been a major development that addresses crop damage due to flooding in India. As a mixture of two different rice varieties, this scientifically-developed plant is able to withstand intense flooding. This type of rice has been on the market for use since around 2009; however, many farmers have not had access to the rice strain until recently. This is largely due to the lack of information about the existence of Swarna Sub-1 and a lack of accessibility to it (The Borgen project, 2021). Recently, farmers from Golaghat district in Assam have cultivated new flood resistant paddy varieties to shift away from the traditional ones. The varieties called **Ranjit Sub1, Swarna Sub1 and Bahadur Sub1** have been used by about 60% farmers of the West Brahmaputra area. The Bangladesh Rice Research Institute (BRRI) and the Bangladesh Institute of Nuclear Agriculture (BINA) developed and promoted five submergence-tolerant (Sub1) rice varieties, **BRRI dhan51, BRRI dhan52, BRRI dhan79, BINA Dhan 11, and BINA Dhan 12,** which are suitable for farming in the Aman season (July-November). Aman rice is highly prone to monsoon and flash floods (Bairagi, et al., 2021).

Agriculture gets badly affected by the floods in the coastal regions of Kerala with bunds being broken and floodwaters inundating low lying fields. **Pokkali** is one of the oldest rice varieties in Kerala. It became prominent for its salt-tolerant and flood-resistant properties and is now being pitched as a climate-adaptive crop (Sreelekha et al., 2023). Through various schemes and policies, the Kerala government is encouraging a number of traditional rice cultivars that are climate-smart such as **Pokkali, Kaipad** etc. In other states also such traditional varieties are recognised by state governments and getting promoted for their special qualities.

Table 01: List of climate-resilient rice varieties in Kerala, India

Serial Number	Drought-resistant rice varieties	Flood-resistant rice varieties
1	*Kalladiyaryan*	*Thulunadan*
2	*Veliyan*	*Karingon*
3	*Thondi*	*Vayilathure*
4	*Mundon*	*Orppandi*
5	*Kallele*	*Swarnapandi*
6	*Eravapandi*	*Pokkali*
7	*Karuthapandi*	*Kuruka*
8	*Pookulathari*	*Kattamodan*
9	*Kochuvithu*	*Kodiyan*
10	*Vellathan*	*Aryan*
11	*Vykatharayan*	*Kozhivalan*
12	*Karavala*	*Karimala*
13	*Champavu*	*Orkazhama*
14	*Parapilarppan*	*Kuttanadan*
15	*Kettamodan*	*Thavalakannan*
16	*Karuthamodan*	*Karuthaallikkannan*
17	*Parambuvattan*	*Adukkan*
18	*Karnellu*	*Veliyan*
19	*Chuvannamodan*	*Thulunadan*
20	*Vykatharyan*	*Chenthadi*

Sources: Current Science, Vol. 114, No. 5, 10 March 2018

Agroecological Practices in Rice Cultivation

Maintaining and boosting agricultural productivity is the best way to guarantee food security in the current climate change scenario. Abiotic elements, such as rainfall, drought, flooding, temperature, and sun radiation are, nevertheless, adversely influencing the yield of rice at different growth stages as a result of rapid climate change. However, 10–14% of all global greenhouse gas emissions are attributed to agricultural activities, while paddy rice fields are responsible for 18% of all methane emissions, which together contribute to global warming. Thus, in order to prevent further environmental damage, mitigating and adaptation strategies through agroecological practices like zero or reduced tillage, intercropping, crop rotation, mulching, resource management, reliance on traditional knowledge, intercropping with short-term vegetation, organic farming, use of rice cultivars with low methane emission, recycling of farm waste into organic fertilisers, and creation of integrated rice farming systems need to be implemented (Sajid et. al, 2020).

> Maintaining and boosting agricultural productivity is the best way to guarantee food security ...

Agroecology Supports Agrobiodiversity

The term "agrobiodiversity" refers to the diversity of domesticated plant and animal species and their wild relatives, as well as the variety of wild species that influence or are influenced by agriculture and the variety of ecosystems formed by populations of species related to various types of land use, including intensively farmed agricultural lands and semi-natural agricultural habitats. Agrobiodiversity can be conserved by the use of agroecological methods like zero tillage and organic mixed-crop farming that are based on traditional ecological knowledge. It takes a deeper understanding of how agrobiodiversity contributes to improved nutrition, higher food security, and sustainability in order to use biodiversity for agroecological transition more successfully than simply going back to conventional methods. According to Fernando (1995, 1996), rice fields, along with the adjacent water habitats and dry land, form a mosaic of constantly shifting ecotones that support a rich biological diversity (flora and fauna) that is sustained by rapid colonisation as well as by rapid reproduction and expansion of organisms.

These organisms enter rice fields during their dormant stages and spread via irrigation water, air, and soil (Fernando 1993a). In the foliage, water, and soil sub-habitats of the rice fields, micro-, meso-, and macro-invertebrates, particularly arthropods, predominate, while vertebrates are also found there. In general, a wide variety of aquatic species can be found in wet rice fields. The majority of creatures that live in vegetation are arthropod insects and spiders. Additionally, numerous species of birds, animals, amphibians, and reptiles from the surrounding areas visit the rice fields for food and are typically regarded as transient or ephemeral residents (Bambaradeniya et al. 1998). The fauna and flora in rice fields include pests, their natural enemies (predators and parasitoids), and neutral forms in connection to the rice crop.

Case Study – Thanal Agroecology Center, Wayanad, Kerala

Thanal Agro Ecology Centre (TAEC) is a scenic lush green campus, spread across 6.5 acres, in Panavally with the river Kalindi flowing along one side. TAEC is one of the field learning sites (FLS) of the International People's Agroecology Multiversity (IPAM). TAEC conserves one of largest live Paddy collections in Kerala with 300+ indigenous rice varieties. TAEC also conserves 35 species of trees on its campus and varieties of tubers, spices and bananas, vegetables and medicinal plants, which are mostly collected from Kerala. TAEC also hosts different kinds of birds, butterflies, dragonflies and damselflies, spiders and have documented the same. Thanal has shown special interest in identifying, conserving and documenting edible leaf diversity in TAEC with the help of traditional knowledge of the local people in Wayanad.

A Fork-tailed drongo (natural predator of insect pests) in the paddy field.
Photo credit: Anju Babu, Programme Coordinator, Thanal

Background

Thanal bought the land at Panavally in 2009 with an aim to conserve rare and traditional Indian rice varieties when Thanal launched the Save Our Rice campaign. The national campaign involves six Indian states to preserve and propagate native rice varieties and maintain Rice Diversity Blocks (RDBS) and live seed banks across India. It was started in 2004 to ensure food sovereignty, protect traditional wisdom, prevent GMOs and toxics and ensure safe and nutritious food for the people. Over the years Thanal managed to secure and revive around 300 traditional rice seeds which were almost lost during the green revolution. Later on, TAEC also started biodiversity conservation and agroecology research and training.

Rice Diversity Block

In 2010, Thanal started an indigenous rice diversity conservation programme as part of the Save Our Rice campaign in TAEC, with 64 rice varieties. Today, Thanal conserves around 300+ traditional varieties of paddy. Along with the indigenous rice varieties, TAEC also aims to preserve age-old agrarian practices of Kerala by celebrating the agricultural traditions of Wayanad while co-creating and sharing knowledge among farmers, scientists, officials and the key holds of agroecology. Thanal, realizing the prerequisite of engaging the younger generation in organic farming, provides opportunities for students to explore, experience and learn directly from the field.

A Robber fly in the paddy leaf blade (Asilidae species) feeding on a stink bug (sap sucker).
Photo credit: Raju S, Director, Thanal

Farmer Support

More than 2000 farmers have been reached out to through the Mobile Organic Agri Clinic (MOAC), an innovative venture launched by Thanal and PAN India. Since 2014, MOAC has been extending their support and service to enthusiastic farmers, amateurs, beginners, and students in Wayanad. It is a

Bird's-eye view of Rice diversity Block in TAEC Panavally.
Photo credit: Thanal

fully equipped vehicle, which offers technical support and mentoring to the farmers in pest and disease management, farm design, conducts tests and also aids in PGS certification

Rice varieties in Thanal Agroecology Centre Panavally, Wayanad

- The short-term rice varieties number around 154, some of them are *Adansilpaar, Adukkan, AHU, Akkal, Allikkannan, Ambimohar, Anamodan, Arupathaam Kuruva, Assam black, Aswini Maharashtra, Baalbi, Badma, Banakelok, Basmathi, Black Jasmine, Bogthu Chebok*.

- The medium-term rice varieties number around 60 varieties, some of them are *Anakkomban, Bangarudi,Barma Black,Black Basmathi, Black Gouni, Bora, Bora Assam, Borajogthi Chebok, Chakau Maharashtra Chebok Karanellu, Chomala, Ekkarinetta, Gandhakashala AEC, Gandhakashala Meera.*

- The long-term rice varieties include 15 varieties and they are *Athiyan, Chenthadi, Chettuveliyan, Chitteni, Chuvanna Chitteni, Karutha Kodiyan, Karuvalicha/Mundon, Kurukkan Chitteni, Mannuveliyan, Maranellu Mullan Chenthadi, Mullan Mundon, Ottal Mundon, Vadakkan Chitteni.*

**Detailed list attached in Annex 1.*

Call for Action

There will be nine billion people on the planet by 2050, which means that food production must increase by more than 50% to feed this massive population (Alexandratos et al., 2016).

One of the most important staple foods, rice, is agronomically- and nutritionally-sound and provides the calories needed by around half the world's population. There is an urgent need to take all necessary actions to produce rice in a sustainable manner in order to fulfill the future demand for food that is anticipated from the projected growth in global population.

It is imperative to have a thorough understanding of how plants react to abiotic stress, as climate prediction models have shown that abiotic elements like drought, floods, salinity, and high temperatures occur more frequently when crops are developing (IPCC, 2008). Ninety percent of the 470 Mt of rice produced worldwide is produced by Asian nations. Hence it is imperative to conserve the rice varieties for the food and nutritional security of future generations.

An indigenous rice variety at Panavally.
Photo credit: Anju Babu, Programme Coordinator, Thanal

> **One of the most important staple foods, rice, is agronomically- and nutritionally-sound and provides the calories needed by around half the world's population.**

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Annex 1

RICE DIVERSITY AT TAEC PANAVALLY, WAYANAD

Table 02: List of Short-term, medium-term, long-term rice varieties at Thanal Agroecology Centre, Panavally, Wayanad

Short term rice varieties	Adansilpaar Adukkan AHU Akkal Allikkannan Ambimohar Anamodan Arupathaam Kuruva Assam black Aswini Maharashtra Baalbi Badma Banakelok Basmathi Black Jasmine Bogthu Chebok Bora black sticky rice Chadayan Chakkara Kazhama Chammara Muni Chembakasala Chenkazhama Chennallu UP Chennalthondi Chettu Chomala Chinnaponni Choman Chonnanellu Chotti Basmathi Rajasthan Chovveryan Chuvanna Allikkannan Chuvanna Chennallu Chuvanna kazhama Chuvanna Navara Dabarshala (dbt) Dhodda Baira Nellu Dhoothsaal Ekkannu Eraan	Gangabathi Garudan chamba Girishala HMT Indanoor Sanna Isaapu Samba Jagannath Jeeraka Chembaavu Jeerakasal Joodabatha Jugal Kaal Nooniya Kagga Kakishala Kalaacheera Kalamallifool Kalanamak Kalanoosiya Kalikamod Rajasthan Kalladiyaaryan Kallyani Violet Kamank Maharashtra Kannur Jeerakasala Karakayama Karikomal Karutha Navara Kashmiri Basmathi Kathi Chebok Kathiradakkan Kavuni Kazhama Kerala Sundhari Keshavan Kleero Kolakazhama Kottakkanni Kottathondi Koyyala Kullan Violet Kunju Kunju Kurayi	Kuruva Kuttivith Kuttiyathira Kuttoosan Lal Kolambo90d Lalgili Losayi Lottimach Chathigrah Madhushala Maguri Malayodumban Manipur Black Mappilachamba Marathondi Meeshabatha Mugajai Mukkan Ratnachoodi Mullaari Mullabatha Mullanpuncha, Mundodan Mysoremalligai Nahulai Naleepanka Nambyaramban Nanijeera Rajasthan 90d Nasarbath Navara Nepal Black Nimput Maharashtra Okkappuncha Orthadayan Ovuvattan Pajariya up75d Rajasthan Palkkazhama Palliyaaral Palthondi matta Paramban Navara	Ponni Poochemban Punnadan Thondi Pussa Basmathi Radhathilak Rajakazhama Rakthachoodi Rakthasaali MSSRF Rakthasaali OG Rakthasali AEC Ramigali Ranisal Rasakadam Red Jasmine Salem sanna Saraswathy Sarjan Shyamala Sidhasanna Sreena rice Sumfo Chebok STP Kuruva Surat Kalaan Surti kolam Maharashtra Tamil Tamil 1 Tamil 2 Tamil 3 Thavalakkannan Thonnooram Thondi Thulasi Bhog Thulasiya Timti up60d Rajasthan Vadakkan cheera Velutha Allikkannan Velutha Chennallu Vithavithu

Medium term rice varieties	Anakkomban Bangarudi Barma Black Black Basmathi Black Gouni Bora Bora Assam Borajogthi Chebok Chakau Maharashtra Chebok Karanellu Chomala Ekkarinettu Gandhakashala AEC Gandhakashala Meera Ittikkandappan Jeerakachanna	Jeerakasala Joha Kalabetti Kalabora Kalash Kamukin Poothala Kanali Kannichennallu Karibasmathi Karuvachi Kisni Koduveliyan Matta Kothandan Krishnakaumod Kudakuveliyan Kullan Valichoori Madad Mallikkuruva	Mullankazhama Nagabatha Nareekala Nouhali Soktharve Pal Veliyan Parimal Punaran Rajamudi Tamil Ranjith Ratnachoodi Rosapoochamba Tamil Rosmuth Sokelok Soktheppo Sunno Mosoni Goya Suresh Black	Tharveso Chebok Thengro Chebok Urunikkayama Vadansamba Tamil Valiya Chennallu Veliyan White Jasmine
Long term rice varieties	Athiyan Chenthadi Chettuveliyan Chitteni	Chuvanna Chitteni Karutha Kodiyan Karuvalicha/ Mundon	Kurukkan Chitteni Mannuveliyan Maranellu Mullan Chenthadi	Mullan Mundon Ottal Mundon Vadakkan Chitteni

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