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SUCCESS STORY

Mechanized Direct Seeded Rice and Fertilizer Deep Placement: A Game-Changer for High-Quality, Low-Emission Rice in Vietnam

Innovation Name
Precision Mechanized Direct Seeding combined with Fertilizer Deep Placement (mDSR-FDP)

Location (Country/Region)
Vietnam



Lead centre
International Rice Research Institute

Contributing Initiative/s/ Bilateral project/s
CGIAR Sustainable Farming and Scaling for Impact programs, USDA-Fertilize Right project, and Taiwan ICDF Capacity Building for Sustainable and Low-Carbon Rice Innovations in Southeast Asia (CABIN) project

Innovation Type
Product

Current Innovation Readiness Level
9
Proven Innovation

Current Innovation Use Level
8
End-Users/Beneficiaries (I)

Scaling Dimensions Achieved
Scaling Out Scaling Up

Challenge Addressed
Policy & Regulatory Framework
- *Lack of supportive legal frameworks*
Infrastructure & Services
- *Limited access to physical infrastructure*
Knowledge & Information Systems
- *Weak research-to-practice linkages*
Others
- *Weak PPP for scaling innovations*

Enabling Environment Methods
Baseline survey, Data-Driven and Machine Learning-Assisted Mapping, Writeshops, Large-Scale Field Demonstrations, Institutional Value Chain Networking and Digital Verification

SDG Targets

CGIAR Impact Areas

For generations, rice farmers in Vietnam's Mekong River Delta have relied on wasteful broadcast seeding, but climate change is driving a shift toward sustainable agriculture under the government's Sustainable Development of One Million Hectares of High-Quality and Low-Emission Rice Associated with Green Growth in the Mekong Delta by 2030 (1Mha) program. At the heart of this transformation is an innovative technical package by the International Rice Research Institute (IRRI) combining Mechanized Direct Seeded Rice with Fertilizer Deep Placement (mDSR-FDP).The system employs advanced dynamic air-assisted seeding to accurately position seeds 1-2 mm below the soil surface while simultaneously placing fertilizer 3-4 cm deep, creating an integrated solution for high-productivity and low-emission rice production. Regional trials have yielded striking results, cutting seed rates by up to 65% and reducing nitrogen fertilizer by up to 37% and pesticide by up to 30% while boosting crop yields up to 10%. Consequently, overall input costs have plummeted, driving a remarkable 26% to 79% surge in net profits for participating cooperatives. Through close collaboration with local stakeholders and the government, IRRI successfully embedded sustainable farming practices into formal policy frameworks, culminating in the official recognition of mDSR-FDP as a certified national technical advance. This institutional momentum enabled IRRI to scale the innovation across 8 of the 11 pilot models, covering more than 450 hectares in 8 provinces. Through June 2026, a total of 512 local farmers—comprising 459 men and 53 women—completed intensive training, transforming high-level policy into tangible, field-level results.

The Context and Ambition

The scalability of mDSR in Vietnam's delta regions is primarily hindered by technical and infrastructural limitations. A major bottleneck is the high capital cost of specialized machinery, which remains scarce and requires substantial upfront investment from farmers. Additionally, due to a lack of targeted training and awareness, most farmers still rely on traditional manual broadcasting or blower seeding, resulting in inefficiently high seeding rates, high fertilizer and pesticide uses, and increased production costs.

Compounding these challenges is the absence of a supportive policy framework. National and local policymakers require rigorous, science-based evidence of the technology's long-term agronomic and economic benefits before committing to regional initiatives. Without this integrated data, there are currently no



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active policies, subsidies, or institutional frameworks promoting the transition to mDSR in major rice-producing regions.

Objectives and Goals

The main goal of this intervention is to enhance rice productivity, input-use efficiency, and environmental sustainability by integrating mDSR-FDP, thereby reducing labor requirements, minimizing nutrient losses, and lowering greenhouse gas (GHG) emissions.

Specifically, it aims to deploy mDSR-FDP to achieve the following targets:

- Ensure precise agronomic placement by calibrating machinery to deposit seeds at a depth of 1–2 mm and fertilizer at 3–4 cm.
- Enhance resource use efficiency to significantly reduce baseline seeding and fertilizer rates.
- Wide-narrow row spacing seeding increase photosynthetic efficiency, improves aeration, reduces fungal incidence, and increases oxygen availability in the soil, thereby promoting better plant health.
- Minimize crop lodging to drastically lower harvesting and postharvest losses.

Creating Enabling Environment for Scaling

As early as 2020, IRRI began conducting experiments in the Mekong River Delta to test the performance of a novel mechanized row seeding technology for wet mDSR in comparison to traditional broadcast seeding using a blower. The results of these early trials demonstrated clear benefits in farming efficiency, higher income, and lower GHG emissions, proving that mDSR could serve as a technology package to strongly support the sustainable transformation of rice cultivation in the Mekong River Delta of Vietnam. Armed with this empirical evidence, IRRI began formally establishing local partnerships in 2024 to mainstream the technology. These efforts included signing a Letter of Agreement (LoA) with the Cuu Long Delta Rice Research Institute (CLRRI) to evaluate mDSR-FDP to increase productivity and reduce carbon footprints, as well as an LoA with the Can Tho Sub-Department of Plant Production and Protection to support local field trials. To ensure broad cooperation, IRRI initially tapped 13 public organizations, mostly provincial Plant Production and Protection Departments, alongside 21 private sector groups, including agricultural machinery companies, fertilizer manufacturers, and local cooperatives.

Under the CGIAR Initiative on Excellence in Agronomy (EiA), IRRI also developed a comprehensive Vietnam mDSR use case. This framework covered tailored direct-seeded rice practices and equipment, a digital DSR service provision platform, and evidence-based scaling strategies. It also established viable business cases tailored specifically for machinery manufacturers, service providers, and individual farmers. To better understand the landscape, IRRI conducted a large-scale survey in 2023 to collect rice cultivation data and assess the current adaptation levels of improved farming practices across the region. This baseline survey engaged 10,000 farmers across 12 Mekong River Delta provinces to provide foundational data for the larger implementation of the government's 1Mha Program. The results revealed that while the majority of farmers in the delta still rely on broadcast seeding, there is an exceptionally high willingness among them to adopt new technologies such as drones and mDSR.

Complementing these foundational efforts, EiA and the CGIAR Initiative on Asian Mega-Deltas, in cooperation with the Department of Crop Production (DCP) and CLRRI, conducted a major field demonstration on mDSR in Can Tho City to promote new technology for increasing farming efficiency and reducing the carbon footprint in rice production. More than 300 farmers from the Mekong River Delta attended the event to observe a diverse array of agricultural machinery and direct-seeded rice technologies. These innovations included dynamic air-assisted seeders, tractor-mounted dynamic air-assisted seeders, hill

seeders, tractor-mounted hill seeders, self-propelled hill seeders combined with fertilizer placement, and drone seeding. These advanced tools were presented by a mix of local and international companies and institutions, including IRRI, CLRRI, APV, YANMAR, Tu Sang, and Sai Gon Kim Hong.

Building on these insights, IRRI conducted its first major pilot field in 2024 in Can Tho City to illustrate the benefits of rice cultivation according to the criteria of the 1Mha Program. IRRI introduced a suite of low-emission innovations, including mDSR, across more than 40 hectares of rice fields managed by the Tien Thuan Cooperative. This implementation spanned the Summer-Autumn 2024 season, which began in April, as well as the subsequent Autumn-Winter 2024 and Winter-Spring 2024–2025 seasons. The trials proved that the adoption of precision mDSR is essential to reduce the use of seeds, fertilizers, and pesticides, while simultaneously cutting labor costs and post-harvest losses. Recent studies by IRRI and its partners demonstrated that precision mechanized seeding can increase rice-related income by over 20% and reduce carbon emissions by at least 10% through input reduction, all while generating added value through higher-quality rice products.

Alongside pilot testing and partnership building, IRRI collaborated closely with academic institutes and private agro-machinery companies to refine the equipment for local conditions. Specifically, IRRI worked with Tien Giang University, CLRRI, and the Tu Sang Company to adapt existing machinery for wet Vietnamese field conditions, focusing on a 16-row dynamic air seeder. Through these collaborations, the team developed and successfully tested a new design for an improved land leveling blade suited for wet-seeding. Furthermore, they enhanced the overall performance of the 16-row dynamic air seeder by implementing an automatic control system for its land leveling blade, ensuring the machinery operates efficiently in local environments.

The Intervention and Actions

IRRI has been highly strategic in aligning itself with Vietnam's flagship 1Mha Program. Seizing this initiative as the primary vehicle for scaling low-emission rice production, including mDSR, IRRI anchored its regional strategy to this program following its approval by the Prime Minister of Vietnam in late 2023. To mark the official launch of the project in Hau Giang Province in December 2023, the Ministry of Agriculture and Environment (MAE), in collaboration with IRRI, organized a joint program launch and a major live field demonstration of mDSR technology. Aimed at achieving a synchronous mechanization rate of over 70% across the project area, the field demonstration served as a massive "learning by seeing" opportunity. It welcomed a core group of 95 local farmers alongside over 100 international agricultural experts invited directly by IRRI. The event drew massive attention from global organizations, universities, and local officials from all 13 Mekong River Delta provinces, bringing total estimated attendance to over 1,000 participants, including 300 international delegates from 41 countries.

Following this successful launch, MAE developed a comprehensive implementation plan and mobilized significant resources, including funding from the World Bank, to upgrade regional infrastructure. Recognizing the highly effective coordination provided by IRRI during the initial pilot at the Tien Thuan Cooperative in Can Tho City, the ministry requested that IRRI expand its support to five additional pilot demonstrations. These new sites were strategically selected to represent five distinct natural and ecological zones within the project area across the provinces of Can Tho, Dong Thap, Kien Giang, Tra Vinh, and Soc Trang. Throughout these participating provinces, hands-on mDSR training sessions were conducted for nearly 500 registered farmers. These pilots actively involved agricultural cooperatives across the sites, each averaging around 100 members. Utilizing the cooperative system made



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"Planting the seeds of prosperity is about more than rice; it's about empowering farmers. Mechanized direct-seeding is transforming fields in the Mekong River Delta, ensuring not just a harvest today, but a bounty for generations to come."

- **Nguyen Van Hung,** senior scientist at IRRI



Photo by Author: Trương Hoàng Thám of Tạp chí Nhiếp ảnh và Đời sống

the adoption of mDSR highly cost-effective, as it allowed members to share the capital and operational expenses of the specialized machinery.

This testing was further scaled under the World Bank-funded "Making One-Million-Ha Transformation – Piloting Phase" (MOM-P) project. During the Summer–Autumn 2025 and Winter–Spring 2025–2026 seasons, IRRI partnered with the provincial Departments of Agriculture and Environment (DAE) in An Giang, Dong Thap, Ca Mau, and Tay Ninh to implement four large-scale pilot models. Covering approximately 50 hectares each, these pilots were established within the Go Gon Agricultural Cooperative in Tay Ninh, the My Thanh Bac Agricultural Cooperative in Dong Thap, the Hiep Xuan Phu Agricultural Cooperative in An Giang, and the Hong Phat Agricultural Cooperative in Ca Mau. By deploying different high-quality rice varieties—such as Dai Thom 8, OM5451, and OM18—across diverse soil, water, and climate conditions, this wide spatial distribution provided a robust dataset to assess the performance and adaptability of low-emission rice practices, establishing a strong foundation for full regional replication.

Beyond field-level implementation, IRRI simultaneously focused on building institutional policy frameworks to support mDSR adoption nationwide. As early as October 2023, IRRI convened a specialized writeshop to draft the Technical Guideline and Hands-on Manual for Mechanized Wet Direct Seeding for Increased Productivity, Quality, and Reduced Carbon Footprint in Rice Production in the Mekong River Delta. By tapping local partners led by DCP, IRRI established strong local ownership over the document, utilizing a 20-person editorial team to tailor the manual specifically for extension workers and farmers. This collaborative strategy was repeated the following year to develop the Technical Manual for High-Quality and Low-Emission Rice Production in the Mekong River Delta. This definitive manual serves as the operational baseline for all participating farms under the 1Mha Program, establishing standardized guidelines for sustainable cultivation, harvest, post-harvest management, and straw management.

Building on its success in the south, IRRI recently expanded the technology to the Red River Delta, another vital rice-producing region in Vietnam. In partnership with the Plant Production and Protection Department (PPPD), IRRI co-developed the Technical Guideline: Rice Cultivation Reduces Costs, Improves Efficiency, Adapts to Climate Change in the Red River Delta, focusing on input reduction, climate resilience, and mDSR adaptation for northern ecosystems. In the first quarter of 2026, IRRI launched three new pilot sites in the provinces of Hai Phong, Ninh Binh, and Thai Binh in collaboration with MAE's PPPD. Integrated into the PPPD's Low-emission Crop Production for 2025–2035 Program, these models aim to refine technical processes, develop localized guidelines for emission Measurement, Reporting, and Verification (MRV), and evaluate overall economic efficiency. Supported by the United States Department of Agriculture (USDA) through the Fertilize Right program, these northern pilots showcase mDSR-FDP and the 4R nutrient stewardship, significantly driving down labor requirements and GHG emissions while optimizing input efficiency.

Results and Impact

In the Mekong River Delta, the pilot models implemented under the 1Mha Program have demonstrated substantial outcomes across input efficiency, cultivation practices, and economic performance. In terms of input cost reduction efficiency, seed rates were slashed by 30% to 65% compared to conventional practices, a feat enabled by row seeding combined with fertilizer deep placement. Additionally, fertilizer use declined by 11% to 43%, which significantly improved overall nutrient use efficiency, while the number of pesticide applications decreased by one to four sprays due to lower pest pressure. These advancements were underpinned by the application of full mechanization, particularly the integration of mDSR-FDP, together with 100% mechanized harvesting.

While grain yields increased by 2.6% to 15.8% compared to control plots, GHG emissions showed an increasing trend in certain models, ranging from an additional 0.28 to 7.81 tons of carbon dioxide equivalent per

"Ever since I started using mechanized direct seeding on my 4-hectare farm, the results have been remarkable. I am using 50% less seed than I did with traditional broadcasting, my grain harvest is up by 7%, and my profits have increased by 17%. These trials showed us that we can get much higher yields with just half the seed, while also cutting down on fertilizer, pesticides, and water. A win like this on my farm is truly a win for our entire community."

– Vo Van Than, farmer, Can Tho City

hectare. This variation indicates a clear need for further optimization of field-level water and straw management practices. The emission increases were partly attributed to prolonged pre-season flooding exceeding 30 days due to seasonal floods, during which farmers were unable to effectively control field water levels because of tidal intrusion and the absence of protective dike systems. Despite these hydrological challenges, the overall economic performance remained outstanding. Total input costs were reduced by 18% to 36%, while production costs per kilogram decreased by 4% to 32%, thereby enhancing market competitiveness. Consequently, net profits increased substantially by 26% to 79%, depending on market conditions, rice variety, and yield achieved.

To drive widespread impact, IRRI collaborated with local stakeholders and secured vital government support to embed these practices into formal policy frameworks. This joint effort led to the issuance of the Technical Guidelines on Mechanized Wet Direct-Seeding for Increased Productivity, Quality, and Reduced Carbon Footprint in Rice Production in the Mekong River Delta, pursuant to Decision No. 396/QD-TT-VPPN on October 31, 2023. This was followed by the Technical Guidelines on High-Quality and Low-Emission Rice Production in the Mekong River Delta, enacted under Decision No. 145/QD-TT-CLT on March 27, 2024. Crucially, on September 25, 2024, the DCP officially recognized mDSR-FDP as a certified technical advance for rice production in the Mekong River Delta. These policy milestones successfully mainstreamed the application of mDSR within the 1Mha Program, enabling IRRI to provide direct technical support to 8 of the 11 pilot models, covering more than 450 hectares across 8 provinces in the region. Building on this institutional momentum, a total of 512 local farmers—comprising 459 men and 53 women—successfully completed intensive mDSR training programs and actively implemented these low-emission pilot models on their lands through June 2026. This extensive training and hands-on participation have solidified grassroots adoption, transforming high-level policy frameworks into tangible field-level results.

Expanding these innovations to the Red River Delta yielded exceptional financial and agricultural returns across all three northern pilot locations. At the Lien Hiep Cooperative in Hung Yen, the model achieved a 30% yield increase, reaching 6.49 tons per hectare; while traditional farming methods yielded almost no profit in this area, the new model helped farmers earn a net income of 19.2 million VND (730 USD) per hectare. Meanwhile, the Nam Cuong Cooperative in Ninh Binh witnessed a 28% yield increase to 5.65 tons per hectare, effectively reversing a traditional financial loss of 3.1 million VND (118 USD) per hectare into a comfortable profit of 13.2 million VND (502 USD) per hectare. The most dramatic financial surge occurred at the Huu Chung Cooperative in Hai Phong, where yields hit 7.62 tons per hectare, representing a 25% increase over traditional machine planting. This exceptional harvest generated a staggering 24.4 million VND (928 USD) per hectare in net profit, which is more than six times the return generated by traditional local practices.

Reflection and Learning

A primary lesson in creating an enabling environment for scaling mDSR and associated low-emission practices is that technological solutions must be paired with location-specific environmental and infrastructural



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adaptations. While pilot models demonstrate that combining mDSR-FDP, Alternate Wetting and Drying (AWD) water management, integrated pest management, and proactive rice straw management substantially enhances productivity and profitability, their environmental success is heavily dependent on site-specific hydrology. In flood-prone areas lacking adequate dike systems, prolonged pre-season inundation and tidal water fluctuations can severely offset GHG emission reduction efforts, regardless of the improved practices used. Therefore, an enabling environment cannot rely on a one-size-fits-all strategy; scaling must adopt a highly localized approach that actively strengthens field-level water control infrastructure, refines AWD protocols under flood conditions, and customizes rice straw management to guarantee both economic gains and consistent climate mitigation outcomes.

To effectively scale these innovations across the Mekong River Delta, a comprehensive, data-driven framework is essential to align local capacity with policy and market incentives. Creating this enabling environment requires starting with machine learning-assisted mapping and rigorous feasibility studies to match scale-appropriate solutions to specific farmer profiles and regional infrastructure. This must be followed by the continuous validation of context-specific technical packages that fit both the local ecology and the underlying value chain. Furthermore, scaling cannot occur without robust capacity-building initiatives—such as e-extension platforms, targeted training materials, and field demonstrations—alongside formal policy interventions that establish clear national regulations and criteria for high-quality, low-emission rice production.

Finally, a truly enabling environment requires institutional and market mechanisms that reward sustainable production and streamline stakeholder collaboration. Leveraging digital verification tools, such as the IRRI-developed ViRiCert platform, provides a crucial mechanism to certify and promote a distinct Vietnam Green and Low-emission Rice Brand, giving farmers a tangible market incentive to adopt new technologies. This brand equity must be supported by the establishment of a formal 1Mha Rice Value Chain Network. By actively connecting public institutions, private sector groups, and international partners, this network maximizes resource efficiency, prevents the overlap of developmental interventions, and secures the cross-sector buy-in necessary to sustain long-term technology transition across the region.

Affordability for Users

The initial high capital cost of mDSR machinery was made affordable for smallholder farmers by utilizing the local agricultural cooperative system, which allowed members to successfully share equipment and operational costs. This collective approach was further reinforced by field pilots demonstrating an immediate 18% to 36% reduction in total input costs for participating farmers.

Financial Sustainability

Economies of scale were initiated by expanding the technology across massive regional frameworks like the 1Mha Program, which significantly reduced per-kilogram production costs by 4% to 39%. This drastic cost reduction, combined with net profit surges of up to 79%, ensures that the innovation is highly profitable and financially sustainable for farmers to maintain without relying on continuous project subsidies.

Temporal & Environmental Sustainability

Temporal sustainability was achieved by institutionalizing mDSR-FDP into official government policy through formal technical guidelines and Ministry-approved "technical advances" across the Mekong and Red River Deltas. The primary environmental trade-off involved localized increases in GHG emissions in flood-prone areas lacking dike systems, a challenge that is being actively mitigated by refining site-specific water control infrastructure and AWD practices.

Inclusivity and Responsible Scaling (GenderUp Framework):

Stage 1 & 2: Exploring User Diversity: Beyond gender diversity—which included tracking male and female farmer participation at major field events—the strategy identified institutional structure, wealth, and geographic location as key dimensions of social diversity

Partners

- Ministry of Agriculture and Environment
- Plant Production and Protection Department
- Provincial Sub-Department of Agriculture and Environment
- Cuu Long Delta Rice Research Institute
- US Department of Agriculture
- Tu Sang Company

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by targeting over 10,000 farmers across twelve distinct provinces. To ensure equitable implementation, the strategy actively integrated smallholder producers through local cooperative networks, public extension workers, and private agro-machinery manufacturers into the localized co-design and decision-making processes.

Stage 3: Anticipating Differentiated Consequences: The strategy anticipated risks of financial exclusion and unequal access for resource-poor smallholders who could not individually afford expensive specialized machinery, which could lead to market consolidation favoring larger, wealthier producers. Conversely, scaling mDSR presented an opportunity to significantly empower local farming communities by drastically cutting production costs per kilogram by up to 36% and increasing net profits by up to 79%.

Stage 4: Mitigating Risks and Embracing Opportunities: To mitigate the risk of financial exclusion, IRRI leveraged the cooperative system to distribute capital costs, enabling nearly 500 registered smallholders across multiple provinces to share equipment expenses efficiently. Furthermore, opportunities for equitable scaling were secured by developing simplified Technical Manuals specifically tailored for local extension workers and farmers, coupled with extensive "learning by seeing" field demonstrations to ensure the technology remained accessible to all literacy and economic levels.

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