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OPTIMIZING THE RICE HARVEST-TO-GROUNDNUT SOWING INTERVAL FOR RESIDUAL MOISTURE UTILIZATION AND ENHANCED PRODUCTIVITY OF RABI GROUNDNUT (ARACHIS HYPOGAEA L.) IN RICE-FALLOW SYSTEMS: A REVIEW

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ABSTRACT

Rice-fallow lands of eastern and southern India retain considerable residual soil moisture after the kharif rice harvest, offering an opportunity to intensify cropping with short-duration oilseeds such as groundnut (Arachis hypogaea L.). The success of rabi groundnut in these systems, however, depends largely on how quickly the crop is established after rice harvest, because stored soil water declines rapidly through evaporation once the rice crop is removed. This review synthesizes recent evidence on the rice–groundnut transition window, covering constraints to timely sowing, soil moisture and soil physical conditions after rice, the influence of sowing date on phenology, growth and yield, irrigation requirement, water-use efficiency, system profitability, climate variability and decision-support tools. Field studies in Odisha show that groundnut sown in the first week of December produced the highest pod yield (2,032 kg ha^{-1}), whereas sowing in the last week of January reduced yield by about 28%. Mechanized drill sowing raised groundnut pod yield by 45% over farmers' practice, and deficit irrigation scheduling saved up to 25.6% of irrigation water without lowering pod yield. Conservation tillage, residue retention, relay (utera) sowing, short-duration rice cultivars and protective irrigation further improve the use of residual moisture. Despite this progress, no study has yet quantified groundnut response to defined harvest-to-sowing intervals. Future research should treat this interval as an independent management variable and evaluate it together with soil moisture dynamics, crop establishment, yield and water productivity, supported by crop models, remote sensing and weather-based advisories, to develop location-specific sowing recommendations for rice-fallow systems.

KEYWORDS: Groundnut; Rice fallow; Residual soil moisture; Sowing window; Harvest-to-sowing interval; Water-use efficiency

INTRODUCTION

Rice-based cropping systems are predominant across eastern and southern India, where rice is largely cultivated during the monsoon season under rainfed or partially irrigated conditions (Gautam et al., 2021; Nandi et al., 2021; Naik et al., 2023). A substantial proportion of the land remains fallow after rice harvest because of inadequate irrigation facilities, delayed harvesting of long-duration rice cultivars, declining soil moisture, and limited opportunities for timely establishment of a succeeding crop (Srivastava et al., 2023; Kumar et al., 2024; Peramaiyan et al., 2023). Recent studies have demonstrated that many lowland rice-fallow areas retain sufficient residual soil moisture after rice harvest to support a short-duration post-rainy-season crop (Gautam et al., 2021; Nandi et al., 2021). Nandi et al. (2021) demonstrated that residual soil water remaining after rice harvest can support the establishment and production of a succeeding crop under Lower Gangetic Plain conditions. Similarly, Gautam et al. (2021) reported that appropriate agronomic interventions can

facilitate the utilization of residual moisture in rice fallows for short-duration crops and improve overall system productivity. Appropriate management of residual soil moisture, together with timely sowing, suitable crop establishment methods, conservation-oriented tillage, and appropriate crop selection, can facilitate the intensification of rice-based systems without requiring full irrigation (Gautam et al., 2021; Naik et al., 2023; Peramaiyan et al., 2023). Naik et al. (2023) showed that intensification of rice-fallow systems with oilseeds and pulses, combined with improved crop and soil management, can enhance system productivity and resource-use efficiency. Peramaiyan et al. (2023) further demonstrated the potential for crop diversification and intensification in rice-fallow areas of Odisha.

Pulses and oilseeds have considerable potential for rice-fallow environments (Kumar et al., 2024; Kumar et al., 2025). Kumar et al. (2025) emphasized the potential of integrating pulses and oilseeds into rice-fallow areas of eastern India as a strategy for improving land-use efficiency and sustainability. In southern India, Swathi et al. (2024) demonstrated the feasibility of rice–groundnut and other sequential cropping systems under appropriate establishment and nutrient-management practices. Efficient utilization of residual soil moisture can therefore contribute to increased cropping intensity, system productivity, resource-use efficiency, and farm profitability while reducing the extent of post-rice fallow land (Gautam et al., 2021; Naik et al., 2023; Peramaiyan et al., 2023; Kumar et al., 2025). Recent research on groundnut has reinforced the importance of timely sowing for optimizing crop growth and productivity. Sowing date influences the environmental conditions prevailing during different phenological stages of groundnut and consequently affects growth, yield attributes and final pod yield. In a field experiment conducted in the South Eastern Ghat Zone of Odisha during 2020–21 to 2022–23, Das et al. (2025) evaluated eight sowing windows and reported that groundnut sown during the first week of December recorded the highest pod yield (2,032 kg ha^{-1}), while delayed sowing progressively reduced growth and yield attributes. Similarly, Vinu et al. (2023) observed that early sowing on 1 November produced superior growth and yield performance of groundnut under Kerala conditions, with adequate irrigation further improving yield and yield-related traits. These findings demonstrate that synchronization of sowing time with favourable environmental and moisture conditions is essential for achieving higher groundnut productivity. Water availability is particularly important for groundnut because moisture deficits during critical reproductive stages can adversely affect pod formation and yield. Sivarasan et al. (2022), in field experiments conducted in Tamil Nadu, demonstrated that appropriate deficit-irrigation scheduling could save up to 25.6% irrigation water while maintaining pod yield and improving water-use efficiency. The study identified medium-frequency deficit irrigation as an effective strategy for improving irrigation water-use efficiency in groundnut. More recently, Radha Kumari et al. (2026) reported that sowing window significantly influenced groundnut yield and rainwater-use efficiency under rainfed Alfisols, with early sowing producing the highest groundnut yield. Collectively, these findings indicate that timely sowing combined with appropriate water management is critical for maximizing groundnut productivity and water-use efficiency under rainfed and moisture-limited environments

2. Importance of timely groundnut establishment in Rice- Groundnut cropping system

Rice–groundnut is a potential sequential cropping system for suitable rice-fallow areas where sufficient residual soil moisture remains after rice harvest. Recent research in Odisha has demonstrated that a substantial proportion of rice-fallow areas can support short-duration post-rainy-season crops using residual soil moisture, with crop suitability strongly influenced by the duration and availability of soil moisture after rice harvest (Peramaiyan et al., 2023). Groundnut has also been identified as a suitable option for intensifying rice fallows, particularly where residual moisture and appropriate crop-establishment conditions are available (Variar et al.,2024). Recent field experiments in Odisha further showed that sowing time significantly affects rabi groundnut performance, with sowing during the first week of December producing the highest growth and pod yield, while delayed sowing reduced productivity (Das et al., 2025). These findings indicate that timely establishment of groundnut after rice harvest is important for effectively utilizing residual soil moisture and achieving higher productivity.

Recent studies have confirmed the importance of water management and improved crop establishment for enhancing groundnut productivity in rice-based systems. Sivarasan et al.(2022) demonstrated that appropriate deficit-irrigation scheduling improved groundnut water-use efficiency while maintaining pod yield, with medium-frequency deficit irrigation providing efficient utilization of irrigation water. In Odisha, mechanized sowing of groundnut under the CSISA intervention substantially improved crop performance; field-level evidence from Ganjam reported a 45% increase in yield, reaching 3.63 t ha^{-1}, along with higher profitability compared with conventional farmer practice. More recently, Panda et al. (2026) demonstrated that mechanized rice establishment combined with integrated nutrient management improved productivity, profitability and energy efficiency of rice–groundnut systems in coastal Odisha. These findings indicate that efficient water management and timely, mechanized establishment can substantially improve the productivity and profitability of rice–groundnut systems. The sequence of rice harvest, transition window and groundnut sowing in relation to residual soil moisture is illustrated in Fig. 1.

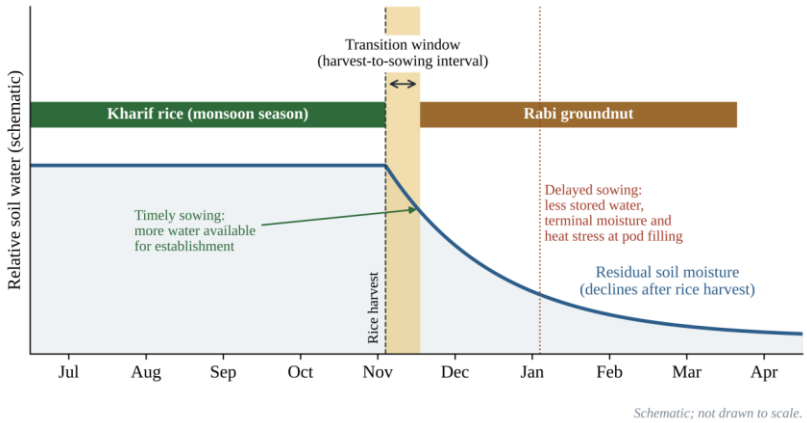


Fig. 1. Schematic representation of the rice–groundnut transition window showing the decline of residual soil moisture after rice harvest and the consequences of timely versus delayed groundnut sowing

3. Constraints in groundnut sowing after rice harvesting

The timing of rice harvest is critical for establishing a succeeding rabi crop because delayed harvest shortens the available growing period and limits the utilization of residual soil moisture. Recent research in Odisha has identified delayed Kharif harvest, particularly the cultivation of long-duration rice varieties, as an important constraint to rice-fallow intensification (Peramaiyan et al., 2023). Earlier rice establishment and harvest can therefore facilitate timely sowing and better utilization of residual moisture. For groundnut, timely establishment is particularly important as delayed sowing reduces crop growth and yield; Das et al. (2025) reported the highest pod yield with early-December sowing in the South Eastern Ghat Zone of Odisha. Supporting this, Panda et al. (2026) demonstrated under coastal Odisha conditions that appropriate rice establishment methods followed by timely groundnut establishment improved productivity, profitability and energy efficiency of the rice–groundnut system. Thus, minimizing the interval between rice harvest and groundnut establishment is essential for effectively utilizing the available growing period and maximizing system productivity.

The field condition at rice harvest strongly influences the establishment of the succeeding crop. In rice-fallow systems, excess moisture can delay post-rice planting, whereas declining residual soil moisture can rapidly increase establishment stress. Recent research has emphasized the importance of suitable crop-establishment practices for conserving residual moisture and improving productivity in rice fallows (Kumar et al., 2020; Behera et al., 2021). Relay or utera sowing, in which the succeeding crop is broadcast into standing rice before harvest, enables early establishment and effective utilization of residual soil moisture. Recent studies have demonstrated that utera cropping can improve early crop growth and water-use efficiency, although crop response depends on soil moisture and nutrient management (Saha et al., 2024; Baskey et al., 2025). The major constraints to timely groundnut establishment after rice and the corresponding management options are summarized in Fig. 2.

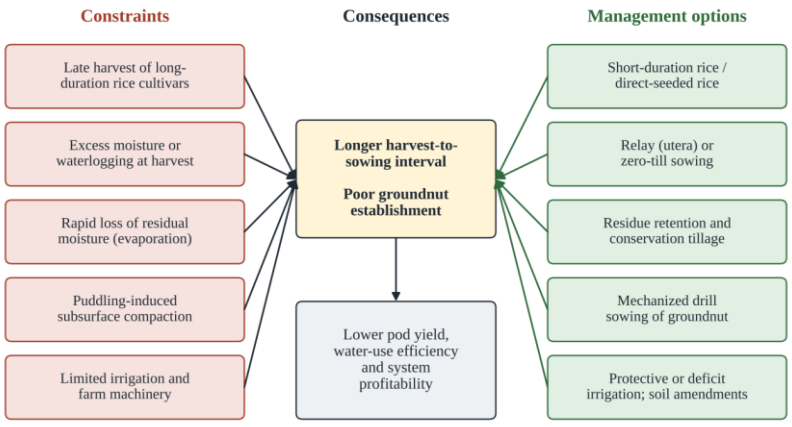


Fig. 2. Major constraints to timely groundnut establishment after rice harvest, their consequences and management options (compiled from Kumar et al., 2020; Behera et al., 2021; Peramaiyan et al., 2023; Saha et al., 2024; Baskey et al., 2025)

4. Soil moisture and soil physical conditions during the rice- groundnut transition

Residual soil moisture is a critical determinant of crop establishment and productivity in rice fallows. Its availability after rice harvest varies with soil properties, water-holding capacity, drainage and seasonal weather conditions, and declining moisture can constrain the establishment of succeeding crops. In Odisha, declining residual soil moisture has been identified as a major constraint to growing short-duration pulses and oilseeds in rice-fallow areas (Peramaiyan et al., 2023). Behera et al. (2021) further reported that rice-fallow crops depend largely on residual soil moisture, post-monsoon rainfall and supplemental irrigation, with one or two protective irrigations improving crop productivity. Similarly, recent

research in rice–groundnut systems showed that improving soil-water storage can enhance crop growth, yield and water productivity (Pradhan et al., 2025). Thus, efficient conservation and utilization of residual soil moisture, supplemented by irrigation where available, are essential for successful intensification of rice–groundnut systems.

Residual soil moisture declines rapidly after rice harvest due to high evaporative demand, limiting the establishment of succeeding crops. Kumar et al. (2020) reported that higher evaporative losses during the dry season rapidly depleted residual soil moisture in rice fallows, while conservation tillage and residue retention reduced evaporation and maintained higher soil moisture for longer. They also found that conventional puddling created compacted subsurface layers and greater soil resistance, which restricted root growth and water extraction by succeeding crops. Thus, appropriate tillage and residue management are important for conserving residual moisture and maintaining favourable soil physical conditions for post-rice crop establishment. Management practices that help conserve residual moisture and shorten the transition period are compiled in Table 1.

Table 1. Management practices for conserving residual soil moisture and enabling timely groundnut establishment after rice

Management practice	Role in the transition	Reported effect	Reference
Short-duration or direct-seeded rice	Advances rice harvest and frees the field earlier	Earlier sowing of post-rice crops; direct-seeded rice increased rice–groundnut system yield by 6.8%	Peramaiyan et al. (2023); Samant et al. (2023)
Conservation tillage and residue retention	Reduces evaporation and avoids puddling-induced compaction	Higher soil moisture retained for longer; better root growth and water extraction	Kumar et al. (2020)
Relay (utera) sowing	Sows the next crop into standing rice before harvest	Earlier establishment; improved early growth and water-use efficiency	Saha et al. (2024); Baskey et al. (2025)
Mechanized drill sowing	Shortens turnaround time and ensures uniform seed placement	Groundnut pod yield 3.63 vs. 2.50 t ha^{-1} (+45%) over farmers' practice	Mohapatra et al. (2023)
Super absorbent polymer	Increases soil-water storage in the root zone	Improved growth, yield and water productivity of rice–groundnut system	Pradhan et al. (2025)
Protective or deficit irrigation	Supplements depleting residual moisture at critical stages	One or two protective irrigations raised productivity; deficit irrigation saved up to 25.6% water without yield loss	Behera et al. (2021); Sivarasan et al. (2022)

Source: Compiled from the cited studies.

5. Influence of rice harvest-to-sowing interval on establishment of groundnut

The harvest-to-sowing interval is critical for utilizing residual soil moisture in rice fallows. Delayed sowing after rice harvest accelerates moisture depletion and increases moisture and temperature stress on the succeeding crop. Recent studies have emphasized that earlier rice maturity and timely sowing of the succeeding crop improve the utilization of residual soil moisture and facilitate rice-fallow intensification (Kumar et al., 2021; Peramaiyan et al., 2023). In Odisha, Peramaiyan et al. (2023) further reported that earlier rice harvest can facilitate earlier sowing of dry-season crops before residual soil moisture declines substantially.

Timely establishment after rice harvest is important for achieving good crop establishment and productivity in rice-fallow systems. Peramaiyan et al. (2023) showed that earlier rice harvest facilitates earlier sowing of succeeding crops while residual soil moisture is still available. In Odisha, Das et al. (2025) found that early-December sowing of groundnut produced higher growth and pod yield than delayed sowing. Similarly, Panda et al. (2026) demonstrated that improved mechanized establishment enhanced productivity and profitability of rice–groundnut systems. However, recent studies have not systematically quantified groundnut response to specific harvest-to-sowing intervals, indicating a need for further research on the optimum transition period. Recent studies on the effect of sowing time on groundnut are summarized in Table 2.

Table 2. Summary of recent studies on the effect of sowing time on groundnut growth and yield

Location / approach	Treatments	Key findings	Reference
South Eastern Ghat Zone, Odisha (2020–21 to 2022–23)	Eight weekly sowing windows, December–January	1st week of December gave the highest pod yield (2,032 kg ha^{-1}) and B:C ratio (1.90); 4th week of January gave 1,470 kg ha^{-1} and B:C ratio 1.37	Das et al. (2025)
Kerala	Sowing dates × IW/CPE-based irrigation	1 November sowing with adequate irrigation gave the best growth, yield attributes and harvest index	Vinu et al. (2023)

Location / approach	Treatments	Key findings	Reference
Western Maharashtra	Varieties × sowing windows	Sowing window significantly influenced growth, development and yield	Yadavrao et al. (2023)
Rainfed Alfisols	Sowing windows of oilseed crops	Early sowing recorded the highest groundnut yield and rainwater-use efficiency	Radha Kumari et al. (2026)
India (crop simulation)	Climate change scenarios with adaptation options	Adjusting sowing dates reduced projected climate-induced yield losses	Singh et al. (2021)

Source: Compiled from the cited studies.

6. Effects on phenology, growth and yield formation of Groundnut

Groundnut establishment date strongly influences crop growth, development and productivity by altering the environmental conditions during different growth stages. Early sowing generally promotes greater vegetative growth and branching, while delayed sowing can reduce growth and yield due to less favourable growing conditions. In Odisha, Das et al. (2025) reported that early-December sowing produced higher plant height, branching, pods plant^{-1} and pod yield, whereas delayed sowing progressively reduced these attributes. Similarly, Vinu et al. (2023) observed superior plant growth and dry-matter accumulation with early sowing, while Yadavrao et al. (2023) reported significant effects of sowing windows on growth and yield attributes. The progressive decline in pod yield and pods per plant with delayed sowing in Odisha is shown in Fig. 3, while the yield and water-use efficiency of groundnut relative to other dry-season crops are compared in Table 3.

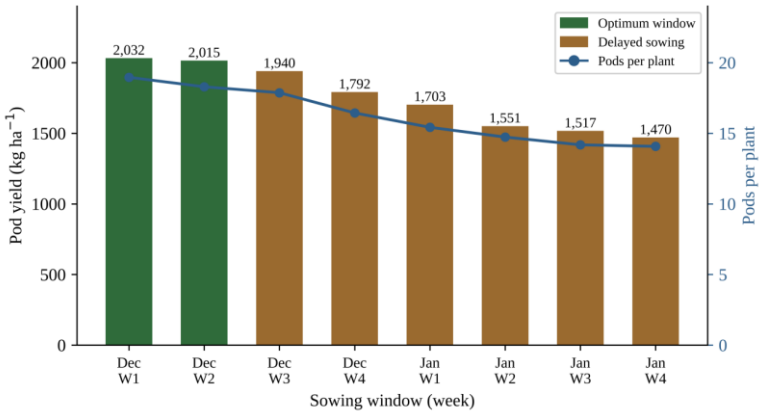


Fig. 3. Effect of sowing window on pod yield and pods per plant of rabi groundnut in the South Eastern Ghat Zone of Odisha (pooled data, 2020–21 to 2022–23; W = week). Data source: Das et al. (2025)

Table 3. Yield and water-use efficiency (WUE) of groundnut compared with other dry-season crops

Crop	Yield (kg ha^{-1})	WUE (kg ha^{-1} mm^{-1})
Potato	12,400	28.70
Maize (Grain)	5,805	13.80
Wheat	2,780	5.85
Sunflower	1,715	3.39
Groundnut	1,590	3.35

Source: Kar et al. (2006), Agricultural Water Management, 79, 280–292.

Groundnut sowing time influences crop growth and productivity by altering the environmental conditions experienced during different growth stages. Delayed sowing can expose the crop to moisture stress during critical reproductive stages, reducing growth, pod formation and yield. In Odisha, Das et al. (2025) reported that early-December sowing produced higher plant height, branches, pods plant^{-1} and pod yield, whereas delayed sowing progressively reduced these attributes. Similarly, Vinu et al. (2023) found that early-November sowing produced superior plant height, leaf production and dry-matter accumulation, while adequate irrigation further improved growth, yield attributes and harvest index. These findings highlight the importance of timely sowing and adequate moisture availability for optimizing groundnut growth and productivity.

7. Interaction between sowing interval and irrigation requirement

In rice-fallow systems, irrigation requirements increase as residual soil moisture becomes insufficient to meet crop water demand. In eastern India, low residual soil moisture and limited irrigation are major constraints to rabi crop production (Pradhan et al., 2025). Their rice–groundnut study demonstrated that improving soil-water storage increased groundnut growth, yield and water productivity, highlighting the importance of conserving residual moisture and improving its availability to the crop. Similarly, Behera et al. (2021) reported that protective irrigation can enhance the productivity of

rice-fallow crops when residual moisture is inadequate. Thus, timely establishment combined with supplemental irrigation, where required, can improve the productivity and water-use efficiency of rice–groundnut systems.
Sowing time and irrigation requirement are closely linked in groundnut because crop water availability varies with the growing environment and developmental stage. Vinu et al. (2023) found that both sowing date and irrigation level significantly influenced groundnut growth and yield, with early-November sowing and adequate irrigation producing superior performance. Sivarasan et al. (2022) further demonstrated that appropriately scheduled deficit irrigation improved water-use efficiency without significantly reducing pod yield. More recently, rainfall synchronized with pod initiation to maturity was shown to enhance dry-matter production and pod yield, whereas moisture deficits shortened the pod-filling period and reduced yield .Thus, timely sowing combined with need-based irrigation is important for protecting critical reproductive stages and improving groundnut productivity.

8. Effects on water-use efficiency and water productivity

Water-use efficiency (WUE) is an important indicator for assessing rice–groundnut systems under limited water availability, particularly where groundnut depends on residual soil moisture, rainfall and supplemental irrigation. In eastern India, low residual soil moisture and limited irrigation are major constraints to rabi groundnut production (Pradhan et al., 2025).Sivarasan et al. (2022) reported that appropriately scheduled deficit irrigation improved water-use efficiency and irrigation water-use efficiency in groundnut without significant reduction in pod yield. Similarly, Pradhan et al. (2025) evaluated soil-water storage, yield and WUE in a rice–groundnut system in Odisha, highlighting the importance of improving soil-water availability for enhancing crop water productivity. Thus, efficient irrigation scheduling and improved soil-water conservation are essential for increasing groundnut productivity per unit of water.

9. Implications for rice–groundnut system productivity and profitability

Conversion of rice fallows into productive post-rainy-season crops can substantially improve system productivity and farm profitability. Recent studies in Odisha have shown that improved rice establishment and nutrient management enhance the productivity and economic returns of rice–groundnut systems. Samant et al. (2023) reported that direct-seeded rice increased system yield by 6.8% over transplanted rice, while improved nutrient management enhanced system productivity and economic returns. More recently, Panda et al. (2026) demonstrated that mechanized rice establishment combined with integrated nutrient management improved productivity, profitability and energy efficiency in rice–groundnut systems in coastal Odisha, with PMTR recording a pooled rice-equivalent yield of 11.17 t ha^{-1} and integrated nutrient management achieving the highest B:C ratio (1.88). Thus, improved crop establishment, mechanization and efficient nutrient management can facilitate rice-fallow intensification and enhance overall system profitability. Field evidence on the yield and economic benefits of mechanized rice–groundnut intensification in Ganjam is presented in Table 4.

Table 4. Yield and economics of mechanized rice–groundnut intensification compared with farmers' practice in Ganjam, Odisha

Season	Crop & Establishment	Variety	Yield(t ha^{-1})	Yield Increase	Production Cost	Net Income (USD ha^{-1})	Income Increase
Kharif	Rice – M-DSR	Arize 6444 Gold	6.81 vs. 5.18	31%	17% lower	1,043	50%
Rabi	Groundnut – Drill-seeded	Dharani	3.63 vs. 2.50	45%	—	1,709	87%

Source: Mohapatra et al. (2023), CSISA field data from Ganjam, Odisha.

10. Climate variability and future sowing windows

Climate variability can increase uncertainty in crop calendars by altering temperature and rainfall patterns, thereby affecting sowing windows and the productivity of rice–groundnut systems. Dhanya et al. (2023), using DSSAT modelling under future climate scenarios in Tamil Nadu, demonstrated that adjusting groundnut sowing windows could partly offset climate-induced yield losses. Similarly, Singh et al. (2021) projected significant reductions in groundnut productivity under future climate scenarios across India and showed that adaptation measures, including adjustment of sowing dates, could help reduce these climate-induced losses. Thus, adjusting sowing dates to changing climatic conditions is an important adaptation strategy for sustaining groundnut productivity under future climate variability. Simulated yield gains from shifting groundnut sowing dates under projected climates in Tamil Nadu are given in Table 5.

Table 5. Simulated yield gain of groundnut (cv. TMV 7) from adjusted sowing dates under future climate scenarios in Tamil Nadu

Crop	Variety	Climate Period	Recommended Sowing/Planting Date	Yield Improvement over Baseline
Groundnut	TMV 7	Near-century (2020–2040)	10 December	+7.51%

Groundnut	TMV 7	Near-century (2020–2040)	1 January	+7.50%
Groundnut	TMV 7	End-century (2070–2090)	20 December	+1.90%

Source: Dhanya et al. (2023), DSSAT-based climate-scenario simulation study in Tamil Nadu.

11. Decision-support tools for optimizing the rice-to-groundnut transition

Decision-support systems can integrate rice harvest timing, soil moisture, weather, soil characteristics and crop requirements to optimize the transition from rice to groundnut. Dhanya et al. (2023) demonstrated the usefulness of DSSAT for evaluating alternative groundnut sowing dates under historical and projected climate scenarios. In Odisha, Peramaiyan et al. (2023) combined satellite data and SMAP soil-moisture information to identify rice-fallow areas and suitable sowing windows based on residual soil moisture. Similarly, Medida et al. (2025) demonstrated that multi-source satellite remote sensing can identify crop sowing windows and sown areas in rice fallows, highlighting its potential for timely crop-establishment decisions. More recently, Singha et al. (2025) used Sentinel-2, Landsat-8 and climate data with machine-learning models to predict soil moisture in rice-fallow areas, supporting improved water-management decisions. Thus, integrating crop models, weather information, remote sensing and soil-moisture data can provide dynamic, location-specific sowing and irrigation recommendations rather than relying on a fixed calendar date. A conceptual framework for such a decision-support system is proposed in Fig. 4.

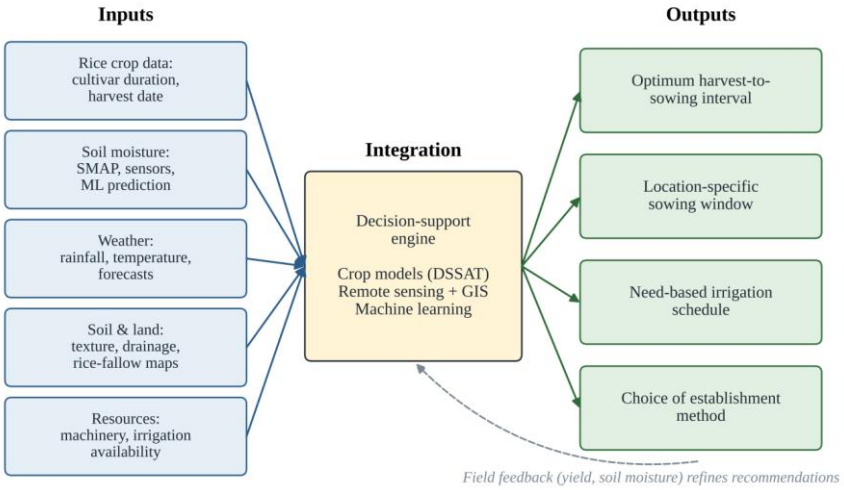


Fig. 4. Conceptual framework of a decision-support system for optimizing the rice-to-groundnut transition (based on approaches of Peramaiyan et al., 2023; Dhanya et al., 2023; Medida et al., 2025; Singha et al., 2025)

12. CONCLUSION

The interval between rice harvest and groundnut sowing is an important yet rarely quantified component of rice-based cropping systems. Residual soil moisture remaining after rice is the principal water source for rabi groundnut, particularly on lowland and heavy-textured soils, but it is depleted progressively as this interval lengthens. Available studies consistently show that early establishment, such as sowing in the first half of December in Odisha, gives higher pod yield, better yield attributes and greater economic returns than late sowing. Nevertheless, published work has examined calendar sowing dates rather than the number of days elapsed after rice harvest, so the optimum harvest-to-sowing interval remains undefined; this is the principal research gap identified in this review. Future experiments should treat the interval as an independent treatment and measure soil moisture, crop establishment, growth, yield, irrigation requirement, water-use efficiency and economic returns simultaneously. The optimum transition window should not be equated simply with the shortest possible interval; rather, it is the earliest point at which the soil is workable enough for good seeding while sufficient residual moisture is still retained and excessive soil disturbance is avoided. Combining timely rice harvest, appropriate tillage and residue management, mechanized sowing, supplemental irrigation and weather-based decision support offers a practical route to convert residual soil moisture from an underused resource into the basis of productive, water-efficient and profitable rabi groundnut cultivation.

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