

Zero Tillage Potato Cultivation (ZTPC): A Sustainable Approach for Coastal Farming System

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One of the main challenges of Sustainable Intensification (SI) is to raise the productivity of existing lands while minimising environmental effects. It calls for proper legislation, conservation agriculture, integrated pest management, agroforestry, etc. Future agricultural productivity is threatened by the sharp rise in agricultural production per person, severe rural poverty and environmental degradation, as well as the rise in extreme climatic events linked to water risk, particularly in Asia, where SI will be essential. In fallow regions between rice cultivation or rice and other crops (wheat), potato has been regarded a crucial alternative for increasing rice-based systems (Ramirez et al., 2022). In places where rice is the main crop, intensification with potatoes could diversify diets and generate additional income. Potato cultivation has been a significant contributor to global food security, but traditional farming practices often lead to soil degradation, increased water consumption, and reduced yields. In recent years, Zero Tillage Potato Cultivation (ZTPC) has emerged as a sustainable approach to address these challenges, especially in coastal farming systems. ZTPC involves minimal soil disturbance and promotes sustainable soil health management, leading to increased crop productivity and enhanced environmental preservation.

About ZTPC

Zero-tillage potato cultivation involves timely sowing of potatoes immediately after harvesting the preceding monsoon or kharif rice in

wet fields. This practice efficiently utilizes residual soil moisture and protects tubers with paddy straw, serving as a thick mulch to conserve irrigation water and prevent soil salinity. The early sowing and harvesting facilitate the subsequent cultivation of another rabi pulse crop, such as green gram. By adopting this method, farmers can significantly enhance cropping intensity, yield, and profitability. This practice aims to preserve soil structure, moisture, and microbial diversity, promoting natural nutrient cycling and reducing soil erosion.

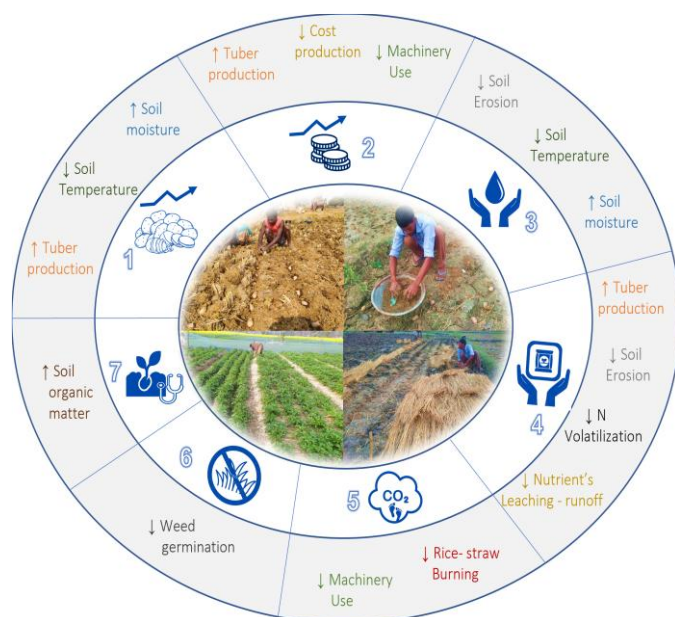


Fig 1. - The main processes triggered by zero/minimum-tillage and/or mulching under potato cultivation reported by the literature that improve crop yield (1), profitability (2), nutrient-use efficiency (3), water productivity (4), C footprint (5), weed control (6) and soil organic carbon (soil health) (7). (Source - Ramirez et al., 2022)

Advantages

- **Increasing Crop Productivity:** ZTPC has shown promising results in increasing crop productivity. The undisturbed soil allows for better water retention and nutrient availability, leading to healthier potato plants with higher yields.
- **Environmental Benefits:** By reducing the need for ploughing, ZTPC minimizes greenhouse gas emissions and fuel consumption, contributing to lower carbon footprints. This environmentally-friendly approach supports sustainable agriculture and mitigates climate change impacts.
- **Time Efficiency:** Early sowing and harvesting reduce the time between cropping cycles, allowing farmers to utilize their land more efficiently and potentially generate more income within a given agricultural season.
- **Soil Moisture Conservation:** By sowing potatoes immediately after the harvest of the preceding crop, residual soil moisture is effectively utilized, reducing the need for excessive irrigation and conserving water resources.
- **Reduced Soil Erosion:** Zero tillage minimizes soil disturbance, which helps in preserving the soil structure and reducing erosion, thereby promoting better soil health and fertility.
- **Weed Suppression:** The use of thick mulch, such as paddy straw, helps in suppressing weed growth, reducing the competition for nutrients and sunlight with the potato plants.
- **Cost Savings:** Zero tillage reduces the need for conventional tillage operations, leading to

cost savings in terms of labour, fuel, and machinery.

- **Soil Health Improvement:** The practice of zero tillage encourages the build-up of organic matter in the soil, enhancing microbial activity and overall soil health.
- **Sustainable Farming:** Zero tillage promotes sustainable agricultural practices by reducing the negative impacts on the environment, promoting soil conservation, and conserving water resources.

Fig 2. Zero Tillage Potato Cultivation (Source: AI -



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Adoption and Challenges

Despite the numerous benefits offered by Zero Tillage Potato Cultivation (ZTPC), its widespread adoption faces several challenges:

- **Pest Attacks:** Pest attacks, such as those caused by rats, can lead to severe damage to potato production. The resulting yield losses impose significant economic burdens on farmers.

- **Need for Proper Training:** Successful cultivation of zero tillage potatoes requires farmers to undergo comprehensive training in this technology. Insufficient training can lead to a significant decline in the adoption of ZTPC.

Market Access: Farmers need access to a proper market or appropriate marketing channels, such as Farmer Producer Organizations (FPOs) or others, to efficiently sell their produce. A lack of adequate market access can have adverse effects on the adoption of ZTPC.

High Initial Costing: The initial investment required for cultivating Zero Tillage Potatoes can be substantial, which may deter farmers from readily adopting this technology due to lower motivation.

Addressing these challenges is crucial to promote the widespread adoption of ZTPC and to fully harness its potential benefits in potato cultivation. Measures such as providing training and technical support, facilitating market linkages, and exploring avenues for cost reduction could play vital roles in overcoming these obstacles.

Prominent Example

A prominent example is included from an article by Bengali Newspaper named 'Anandabazar Patrika'. Which says,

Despite the unique challenges posed by its environment, characterized by unconventional irrigation patterns and distinct climatic conditions, the women of the Sundarbans have forged a pioneering path in agriculture. By embracing the concept of zero tillage, they have transformed potato cultivation into a sustainable and efficient practice. This innovative technique involves directly sowing

potato seeds into the soil without the traditional ploughing or tractor usage. Intriguingly, this approach is accompanied by strategic applications of organic fertilizers, ensuring optimal growth and yield. By sidestepping the need for mechanical tilling, these farmers not only conserve water and preserve soil structure but also mitigate the costs and labour associated with conventional methods. The result is a remarkable increase in potato production, even in the face of the region's unique challenges. The significance of their achievement resonates beyond local boundaries. Esteemed institutions like the Australian National Science Agency have taken note of their success, highlighting the Sundarbans' women farmers as a model for sustainable agriculture. This showcases the power of innovation to transcend geographical and cultural barriers, offering insights that can inspire agricultural practices around the world.

Ultimately, the story of zero tillage potato cultivation in the Sundarbans encapsulates the resilience, resourcefulness, and determination of these women farmers. Their ability to adapt and thrive under adverse conditions underscores the potential for sustainable practices to create meaningful change, paving the way for a more secure and prosperous future for communities worldwide.

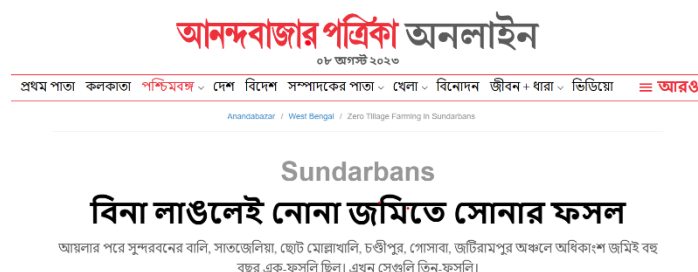


Fig 3. - Newspaper article of 'Anandabazar Patrika'. (Source - www.anandabazar.com)

Conclusion

Zero Tillage Potato Cultivation (ZTPC) is a viable approach for crop intensification in rainfed lowlands in coastal saline regions since it uses less irrigation water, requires less labour, and produces higher yields. In comparison to the traditional ridge and furrow style of potato production, this approach also produced better net returns and BCR. With the application of this technique, cropping intensity can be increased by 300% (Sarangi et al., 2018), and carryover soil moisture and rice crop residue can be used more effectively. As a result, this method is

sustainable and improves the standard of living for farming people in India's coastal regions.

References

- Sarangi, S. K., Maji, B., Digar, S., Mahanta, K. K., Sharma, P. C., & Mainuddin, M. (2018). Zero tillage potato cultivation. *Indian Farming*, 68(04), 23-26.
- Ramírez, D. A., Silva-Díaz, C., Ninanya, J., Carbajal, M., Rinza, J., Kakraliya, S. K., ... & Kreuze, J. (2022). Potato Zero-Tillage and Mulching Is Promising in Achieving Agronomic Gain in Asia. *Agronomy*, 12(7), 1494.

Table 1: Zero Tillage Potato Cultivation Vs Conventional Potato Cultivation:

Aspect	Zero Tillage Potato Cultivation	Conventional/Traditional Potato Cultivation
Soil disturbance	No soil disturbance by ploughing, harrowing, or ridging	Frequent soil disturbance by ploughing, harrowing, and ridging
Soil cover	Soil surface covered with paddy straw mulch	Soil surface exposed without mulch cover
Cost of cultivation	Reduced by about 27%	Higher due to more labour, fuel, and machinery requirements
Tuber yield	Tuber yield varies from 12.4 to 32.1 tonne/ha (mean: 20.17 tonne/ha) (Sarangi et al., 2018)	Tuber yield varied from 7.5 to 26.9 tonne/ha (mean: 19.02 tonne/ha) (Sarangi et al., 2018)
Tuber quality	Improved in terms of crude protein, fat, crude fibre, and carbohydrate content	Inferior in terms of nutritional value
Soil health	Enhanced by reducing soil salinity, improving soil bulk density, and increasing soil organic carbon	Degraded by causing soil erosion, runoff, and nutrient losses
Irrigation water	Saved by about 200 mm	Wasted due to higher evaporation and runoff
