Title of the Thesis: Drip irrigation and mulching management for rice-potato system in subtropical India Name: Poonam Biswal Roll no: 18AG90J04 Supervisors: Prof. Dillip Kumar Swain and Prof. Madan Kumar Jha

ABSTRACT

Climate change and excessive groundwater extraction are reducing global freshwater availability for irrigation, posing a substantial threat to agricultural production and food security at regional and global levels. Water-saving production technologies are essential for increasing agricultural yields under limited water resources in future periods. Rice, a high water-consuming crop, and potato, highly sensitive to drought stress, are two major crops cultivated in subtropical India within a cereal-based cropping system. However, sustainable rice-potato production faces numerous challenges, with one of the primary factors being irrigation water deficits, significantly affecting large-scale production. In this study, field experiments and simulation analyses were conducted to assess the effect of varying irrigation, nutrient management, and mulching on growth and yield of rice and potato in the cropping system, changes in soil fertility, and adaptation options for future climate scenarios. The field experiments to study the effect of drip irrigation and straw mulching in rice-potato cropping system were conducted during wet season (July-October) of 2018 and 2019 for the rice crop and during dry season (November-February) of 2018-19 and 2019-20 for the potato crop at the Research Farm of Indian Institute of Technology Kharagpur. Results stated that irrigation at a soil water potential of -0.6 bar in rice can save around 30% water without yield loss as compared to saturation, while higher stress at -0.8 bar can lead to >50% yield loss. The use of rice straw mulch in potato brought significantly (p < 0.05) higher tuber yield (14% in 2018-19 and 11% in 2019-20) and led to increased super grade potato over non-mulch treatment. Through drip system, limiting the irrigation amount up to 90% Field capacity (FC) gave comparable potato tuber yield as 100%FC, but further limiting to 80%FC resulted in significant yield reduction. Straw mulching with drip irrigation (100 or 90%FC) increased soil temperature (+0.5°C) and moisture content (+3%), improved soil fertility, saved irrigation water (42-58%), and increased potato water productivity & economic return in the rice-potato system as compared to conventional irrigation without mulch. The crop simulation analyses using DSSAT sated 8-11% yield reduction of rainfed rice and 15-25% yield reduction of potato in future periods (2021-2050) under RCPs 4.5 and 8.5 scenarios as compared to current period (2015-2020) yield. The agro-adaptations like right planting time with increasing N fertilizer dose can minimize the adverse effect of climate change on ricepotato production in subtropical India. This research stated the importance of water-efficient and resource conservation technologies for minimizing the adverse effect of climate induced challenges and ensuring food security in subtropical India.

Keywords: Agro-adaptations, Climate change, Drip irrigation, DSSAT model, Rice-potato system, Straw mulching, Water productivity