Conceptualization of community-based integrated farming system model design with multi-objective optimization management

day Mandal[1,*], Rabindra K. Panda[2], Prasanta K. Mishra[1], . M. Alam[1] and Gouranga Kar[2]

drology and Engineering Division, ICAR-Indian Institute of Soil and Water Conservation, 218-Kaulagarh Road, Dehradun 248 195, India
AR-Indian Institute of Water Management, Bhubaneswar 751 023, India

fective utilization of land and water resources is empted in the present study through an integrated rming system and multi-objective optimization man- ement framework model using goal programming gorithm in a coastal waterlogged paddy area in lisha, India. A methodology is developed to identify e water harvesting structure locations in the study ea using spatial science tool. Due to the uncertainty parameters and control variables, development of anagement framework was considered with 85% d 75% probability of rainfall occurrence and run- generation. To incorporate the uncertainties, a lti-objective linear goal programming optimization del is developed considering the objective of maxi- zing the net annual return and production subject optimal allocation of land. While evaluating the del for different water resources scenarios, the net nual return is found to be Rs 4,343,474 and maxi- m production is 10,424 q from scenario I, whereas ximum production of 10,980 q is obtained in sce- rio II. Tomato and rice cultivation area increased m 11.47 to 21.43 ha and 8.82 to 10.48 ha respec- ely in scenario II. The developed methodology ows the potential applicability in similar farming uations in other areas.

The Indian population is projected to become 1.53 and 1.69 billion respectively, in 2030 and 2050 from the present population of 1.27 billion[2]. The challenges on natural resources conservation need to be addressed judiciously due to decline in per capita availability of land from 0.5 ha in 1950–51 to less than 0.1 ha by 2020. Agricultural production will have to increase by at least 70% for the developed countries and 100% in the developing countries to cope with a 40% increase in the world population[3]. On an average, about 2035 farmers in our country are losing 'main cultivator' status per day for the last 20 years[4]. In India, 14.29 m ha is under coastal waterlogged area with Odisha's share of about 671 ha[5]. In this adverse condition, it is imperative to develop strategies and agricultural technologies to enable adequate employment, income generation and especially to develop interest of the small and marginal farmers.

Multi-criteria or multi-objective decision-making is becoming increasingly popular as a decision tool for managing natural resources at the microscale. There exist two key components, namely the biophysical 'production system' comprising crops, pastures, animals, soil and climate, together with certain physical inputs and outputs, and the 'management system', made up of people, values,