INTRODUCTION

Rice is the most important crop in India occupying the largest area of 41.85 million hectares (Directorate of Economics and Statistics Ministry of Agriculture, Government of India, 1988-89) with a total production of 70.67 million tonnes. Though in India rice cultivation is the age old practice, possibly dates back to more than 2000 BC (Patnaik, 1986), the hectare yield of rice is only 1,689 kg ha$^{-1}$. This figure is miserably lower compared to other rice growing countries like Australia, Korea, U.S.A., Japan, Egypt, China, U.S.S.R. which are located at sub-tropicals of temperate regions (FAI, 1989).

It is estimated by the National Commission Agriculture that by the turn of the century, to match with the growing population, the country would need about two hundred twenty five million tonnes of food grain of which the requirement of rice would be 97 million tonnes. Though in the last year, India had a record rice production of about 72 million tonnes, by 2000 AD she had to produce an additional quantity of 25 million tonnes within a span of 10 years to come. This throws an open challenge not only to the agricultural scientists but also to the farmers and to the nation as a whole. This target has to be achieved through suitable management of rice varieties, soils, fertilizer, water and plant protection measures since there is no scope of increasing the area under rice production. Rather the planners are of the opinion for a crop diversification
particularly in upland areas comprising of about 7.09 million hectares, where the per hectare yield is even less than one tonne and rice is stated to be a non-remunerative crop. Under these circumstances only choice is left to increase the production per unit area which is only 1.689 kg ha$^{-1}$ at present.

Several modern rice varieties with high yield potentials have been developed and are also in the pipe lines. Fertilizer is the king pin for maximizing the production potential of these high yielding rice varieties. With the spread of high yielding varieties there is also increasing trend in the use of nutrient consumption (FAI, Fertilizer Statistics, 1989). The role of fertilizer nitrogen in this respect needs no emphasis because it is the most limiting nutrient for rice production in Indian soils (Mohanty and Patnaik, 1974). Brady (1979) stated that nitrogen, along with water management, is the key to the realization of the yield potential of modern rice varieties and in absence of nitrogen input, modern rice varieties yield little more than their traditional counterparts.

Manickam (1988) stated that the current use of modern high yielding, fertilizer responsive crop varieties had greatly increased the need for more fertilizer. However, the production of more fertilizer will soon exhaust the cheap source of raw materials and thereby increase the cost and limit fertilizer use.

The energy requirement for production of fertilizer nitrogen is high, thus making it an expensive input, especially
during the present days of energy crisis. Hence much emphasis is being laid for increasing the efficiency of fertilizer nitrogen. Unfortunately the efficiency of fertilizer nitrogen for rice crop is much lower than other crops and rarely exceeds 35 per cent (Prasad and De Datta, 1979). It is because of the fact, that cultivation of rice is taken under diverse soil–water situations like in upland, alternate wetting and drying, shallow submergence, intermediate deep water and deep water where applied fertilizers undergo many transformations. During the process of transformation of this applied nitrogen a good amount is lost from the soil–water ecosystem and feeding zones of rice through various loss pathways. The different loss mechanisms of nitrogen which have been identified so far include surface runoff, $\text{NH}_3$ volatilization, leaching, denitrification, immobilization and $\text{NH}_4^+$ fixation. The nature of transformation as well as their losses vary greatly depending upon soil type, climate, time, source and method of application of fertilizer nitrogen and the hydrological situations under which the crop is grown.

It was, therefore, thought essential to study the transformation of fertilizer nitrogen into different fractions in the soil and estimate losses particularly leaching of $\text{NH}_4^+$-N and $\text{NO}_3^-$-N and volatilization loss of $\text{NH}_3$ directly in the field under four typical situations of rice growing viz. upland, alternate wetting and drying, shallow submergence and intermediate deep water situation with different nitrogen management.
practices. It is expected that the results obtained from these investigations would throw some light for devising ways and means to schedule nitrogen management which could be utilised for increasing the efficiency of applied nitrogen for growing rice in different hydrological situations as stated above.

The relevant review of the work carried out in India and abroad on transformation losses of nitrogen under different nitrogen management practices and N nutrition of rice in relation to growth; the experimental techniques followed in the present investigations; the results obtained from different field experiments carried out for achieving the objectives with a discussion of important results and summary and conclusions from the data obtained are presented in this dissertation.