INTRODUCTION

The burgeoning population of India will demand 260 to 264 million tonnes of food grains by 2030 (Paroda, 2002), which have to be produced under shrinking natural resources. Though it has come up as a great challenge before the agricultural scientists, still the advent of new technologies will certainly provide the strength and confidence to achieve the goal. There is an increasing demand for land from non-agricultural sectors and the agricultural land is being reduced at the rate of 25 million hectares worldwide every year (Buring, 1982). The present per capita availability of land in India is 0.14 hectare which is likely to go down to 0.09 hectare by 2030. Under such circumstances horizontal expansion of cultivated land is remote. Thus, future augmentation in food grain production has to be harnessed vertically through efficient cropping systems. Selection and sequencing of component crops in a cropping system is of paramount importance as it is influenced by several factors like soil, climate, available technologies, socio-economic constraints and available infrastructure facilities. Biological complexities and interactions in cropping systems can integrate the efficiencies resulting in increased productivity when appropriate crops are chosen (Francis, 1989). Crop sequencing can also accentuate synergistic interaction among the crops (Tanaka et al., 2005). It is the need of the time for diversification of existing cropping patterns to enhance the agricultural production with an ultimate aim of poverty alleviation, environment preservation and moreover, to meet the ever increasing demand for cereals, pulses, oil seeds, fibre, fodder and fuel (Newaj and Yadav, 1994). Thus promising cropping systems with respect to
productivity and income have to be identified for varied farming situations of the country.

Rice is the staple food of more than 65 per cent population of India. To cater to the need of the ever increasing population of the country, rice production has to go up to 1360 million tonnes by 2020 with a minimum annual growth rate of 2.35 per cent (Virmani, 1996). The present scenario of rice cultivated in 42.41 million hectare of land with a production of 235.88 million tonnes contributes about 41 per cent to the national food basket (Ministry of Agriculture, GOI, New Delhi). Eastern India comprising Orissa, West Bengal, Bihar and Assam accounts for 45 per cent of country’s rice area and 37 per cent of total production. Rice is life for the people of eastern India. Hence, there is always welcome to the rice-based cropping systems which are more productive as well as profitable in addition to the normal performance of rice. ‘Thriving with rice’ concept as given by Nguyen et al. (1994) happens to be more befitting to eastern India. Hence, it is more judicious to study rice-based cropping systems suitable for this part of the country.

Inclusion of vegetables like okra, tomato and radish as well as leguminous vegetables like frenchbean and cowpea will increase the economic return from any cropping system. Legumes are known to increase the soil fertility through their capacity to fix atmospheric nitrogen and to improve nitrogen mineralization potential of soil. Other advantages due to inclusion of legumes in crop rotation are improvement in biological, physical and chemical properties of soil, soil conservation, increased soil mineral activity, organic matter restoration and pest and disease control (Parihar et al., 2003). Thus, legumes are rightly called “the unique jewels of Indian crop
husbandry”. Acreage and production of vegetables can be increased suitably through their inclusion in different cropping systems.

The per capita availability of edible oils in India is only 12 gram as against the ICMR recommendation of 18 gram. The edible oil requirement for 1.37 billion people of India by 2030 will be 11.8 to 12.6 million tonnes (Paroda, 2002). Oil seeds occupy the second position after cereals in India accounting for 14 per cent of the gross cropped area, 5 per cent of gross national production and 10 per cent of the value of agricultural products. Oil seeds are mainly grown in rotations with other crops. Oil seed crops contribute significantly towards the economics of a cropping sequence because of their higher market price (Tomar and Tiwari, 1990; Gupta and Rai, 1990). Being a rich source of energy and nutrients, a minimal intake of dietary fat containing essential fatty acids is critical to meet the structural and functional roles in all cells besides their functions as energy supplement. Therefore, in the present context, achieving desired oil seed production is very important from food and nutrition security point of view (Pal and Gangwar, 2004).

Land, water, nutrients and energy are the critical inputs for increasing the agricultural production. With the increasing demand for the food, these inputs are becoming limited as well as costlier day by day. Moreover, their temporal and spatial availability is restricted by one factor or other (Parihar et al., 1999). Hence, resource use efficiency plays an important role for considering the suitability of a cropping system (Saxena et al., 1998; Yadav, 2002).

Although water is a renewable resource, its availability for agricultural production vis-a-vis its demand is highly limited (Bindraban, 2002). At present the per capita availability of water in India is 2218 cubic meter and is expected
to reduce below stress level of 1700 cubic meter by 2030. With the increasing competitive demand for civic, industrial and recreational uses, the fraction of water available for agriculture is likely to decrease in near future. Falkenmark et al. (1990) cautioned that water would be the major constraint for producing enough food, feed, fuel and fibre in future especially in the developing countries. Renault and Facon (2004) also made a strong note that the rice-based cropping systems are intimately connected with water development of water resources. Hence, it is imperative enough to use water judiciously and efficiently for sustainable agricultural production through water use efficient cropping systems.

Application of fertilizers to supply essential nutrients is another important component that has helped to increase the cropping intensity and to boost productivity. Most developing countries, including India, are net importers of fertilizers. But limited availability of non-renewable energy required for manufacturing chemical fertilizers and its cost escalation are likely to restrict the availability and use of fertilizers in future. But at the same time, ensuing threat of mining of nutrients from soil due to intensive cropping is to be carefully maneuvered. On the other hand, environmental pollution has become a matter of great concern due to indiscriminate use of chemical fertilizers.

Energy is also a critical input for agricultural production. The renewable form of energy is not limiting in the countries like India whereas the availability of non-renewable energy is becoming scarce and costly day by day.

Keeping these compounded problems in view, the present investigation entitled “Relative efficiency of rice-based cropping systems in coastal Orissa” was undertaken for two consecutive years during 2006-07 and 2007-08 at the
Central Research Station, Orissa University of Agriculture and Technology, Bhubaneswar with the following objectives:

i) To identify the promising rice-based cropping systems with higher productivity and income

ii) To assess the employment generation of various rice-based cropping systems

iii) To assess the energetics of different rice-based cropping systems

iv) To study the economics of different rice-based cropping systems

v) To study the soil health parameters and nutrient uptake pattern of each system