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Constraints of Rainfed Rice Production in Eastern India: An Overview

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Introduction:

Rice is an important staple food-crop, which is grown in a diverse range of climatic and agro-ecological conditions in almost all parts of the world. More than a third of world's population, predominantly in Asia, depends on rice as a primary staple food. In Asia, more than 2.8 billion people derive 35 to 60 per cent of their calories from rice (Swaminathan, 1989). India occupies an important position both in acreage and production of rice. It has the largest area (42.9 million hectares) that accounts for about 27.1 per cent of the total rice growing area of the world. In respect of production, India ranks second after China by contributing 80.54 million tonnes (Fertilizer Statistics, 1997-98). However, the average productivity of rice is merely 1885 kg per hectare which is even lower than that of the countries like Mynamar (2148 kg\ha) and Indonesia (3310 kg\ha). This indicates the wide gap in the yield performance in India and major rice growing countries of the world. Probably one of the important reasons behind this can be traced out from the lower rice yield in eastern India where rice is grown mainly under rainfed condition.

Rainfed rice based systems of eastern India are home to hundred of millions of the India's poorest people. While modern rice technology has made tremendous contribution for irrigated rice farmers, little impact has been made on the rainfed rice farmers. Eastern India alone accounts for nearly 60 per cent of India's 43 million hectare of rice, of which 80 per cent is rainfed. An estimated 450 million people in the region depend on rainfed rice as their major source of livelihood (IRRI, 1997). But the observation that the green revolution had bypassed the rainfed ecosystem still holds true and raising the predominantly rural population of eastern India out of poverty will require a major increase in agricultural productivity as the final engine of development. A majority of these rice areas are characterized by the resource poor farmers growing traditional varieties with very low level of modern inputs in high risk conditions (Sakarung, 1995). Modern varieties have not been found best suited to rainfed production environments. Due to limited success in developing suitable rice varieties against prevailing

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natural and climatic conditions viz. drought, flood, submergence, soil salinity etc. these areas have not benefited much even after three decades of Green Revolution (Hossain, 1996). The average rice yield of the eastern India is just 1600 kg per hectare as against the average rice yields in the states like Tamil Nadu (3394 kg\ha), Punjab (3132 kg\ha), and Andhra Pradesh (2499 kg\ha). Hence enhancement of rice yields in the rainfed agroecosystems in general and in the eastern India in particular is of prime importance. A number of biotic and abiotic factors, mostly referred to as production constraints, affects the rice yield adversely and hence, needs a special attention so as the growing demand of continuously emerging population of this poor lagging region can be met (Kumar and Jha 2001). This productivity increase will require, among other factors, removal of major constraints to higher yields through research and policy intervention. The first step in this direction is identification of various productions that limits rice yield.

Constraints of rice production:

The production of rice is affected by a number of technical and socioeconomic factors. Constraints to high yield can be classified into two categories; those that affect potential of the crop under farmer's environment; and those that affect farmer's ability and willingness to achieve the yield potential on his farm (Barker, 1979). The first category of constraints is related to the development of new production technology and hence the organization of the production potential, given the existing technology and physical environment, and on the other with the degree and equity among farmers and landless workers in access to resource and inputs. Mahapatra (1994) classified different production constraints into six broad categories:

I. Biophysical constraints,
II. Socioeconomic constraints,
III. Administrative constraints,
IV. Institutional constraints,
V. Procedural constraints, and
VI. Technological constraints.

With the inclusion of rice biotechnology programmes, some more classifications like biotic and abiotic constraints came into existence (Widawsky & O'Toole, 1996). In nutshell, the factors restricting adoption of improved technologies and \ or attainment of potential yield may be

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biotic, abiotic or technical and socioeconomic and \ or combination of these. Often these factors are intertwined with each other and hence the need for a multidisciplinary approach for solving them. Thus, having a brief overview of various production constraints would be helpful in understanding the reasons for low rice productivity under rainfed ecosystem in eastern India and prioritize them accordingly. Subsequent paragraphs present some of the important constraints that have been identified on the basis of previous research works.

Insect-pests:

Insect-pests are serious yield reducing constraints for rainfed rice production in the eastern India. Damage caused by the insect-pests is one of the major components of yield gap accounting nearly 30 per cent of the difference between potential and actual farm yield (Widawsky & O' Toole, 1996). Different studies (Heinrichs, *et.al.*, 1986; Thakur, 1994; Jha, 1998) show that on average 30 to 40 per cent of the total yield loss in eastern India is caused by the insect-pests. Stem borer, gundhibug, brown plant hopper, armyworm, leaf folder, case worm etc. are the major insect-pests of rainfed rice in eastern India. Since damages from these insect-pests are widespread and there is limited natural resistance in locally cultivated varieties of rice, varietal improvement through biotechnology offers critical alternatives to insecticide use. This has a two-fold advantage: it serves to increase yields and reduces the dependency of resource poor farmers on insecticides, thereby addressing environmental concerns.

Diseases:

Occurrence of various diseases in rice varieties grown under rainfed ecosystems in eastern India is very common. Selection of varieties unsuitable for the cultivation on rainfed lands and favourable moist weather harbor a number of rice diseases. As a result an average yield loss of 25-30 per cent per annum due to diseases is a regular feature in eastern India. It was found that occurrence of bacterial leaf blight (generally sporadic), brown leaf spot, and narrow brown leaf spot were severe in years of poor rain falls (Singh and Sahu, 1987). Other important diseases are blast, sheath rot and sheath blight. Bacterial leaf blight and rice blast was found most serious diseases in eastern India (Ramasamy and Jatilekson, 1996). Varietal resistance to disease, particularly bacterial leaf blight and rice blast, are needed against which there is currently no effective genetic resistance. Chemical and cultural controls need to be maintained and search for genetic resistance should be continued.

Weeds:

Weeds are other important constraint as they compete with the rice crop and lead to a substantial loss in production. The yield loss due to weeds in rainfed ecosystems was found to be greater than that of irrigated ecosystems (Moody and De Dutta, *et.al.*1986). In rainfed lowland areas, moist aerobic conditions or shallow water for extended period of flooding during early crop growth, followed by prolonged periods of flooding to variable depths favour the growth of a more diverse weed flora and more competitive weed species and their population. Weeds competed severely with rice, reducing yield by 10-15 per cent depending on such factors as the weed species and their population. Yield losses due to unchecked weed growth ranged from 13 to 40 per cent with a mean value of 25 per cent (AICRP, 1969-1986). As far as rainfed lowland ecosystem is concerned, which is a dominant ecosystem in eastern India studies show that yield loss due to uncontrolled weed growth may be as high as 62 to 75 per cent. Hence, development of fast growing weed tolerant varieties and effective weed management techniques are essential for increasing the rice yield in eastern India.

Rodents:

Apart from insects, diseases and weeds, losses incurred by the rodents are substantial. The damages made by the rodents in rice fields and in storage accounts for about 10 to 18 per cent of the total production. In eastern states where rice is cultivated under rainfed rice lands, production losses due to rodents are significantly high. However, control of rodents is only possible through community approach, which requires more reliable Integrated Pest Management practices and creation of awareness among the farmers.

Abiotic Technical Constraints:

As stated earlier, production of rice is a subject to a set of biotic and abiotic constraints. The reviews of some important abiotic constraints are being presented in following paragraphs.

Non-adoption \ Poor adoption:

Non-adoption of modern varieties as well as their component technologies has been a crucial production constraint under rainfed rice ecosystem. The studies show that the accumulated stock of technologies for rainfed rice production was able to increase yield by 30 to 40 per cent (Shenoi and Mandal, 1986; Jha, 1998). Almost all constraint studies reveal that the average rice yield achieved on farmers' fields, especially in rainfed rice ecosystem are lower than those commonly obtained in experimental plots (Srivastava *et.al.*,1990). The status of rainfed rice

production in eastern India is even more concerning. It was estimated that the actual yield of rainfed rice in eastern India is 86 per cent lower than its potential farm yield. (Dey and Upadhyaya, 1986).

Scarcity of suitable package of practices:

The component technologies developed so far, due to one reason or the other, has failed to satisfy the expectations of rainfed rice farmers. The findings of a number of studies (Thakur, 1994; and Jha, 1998) put forth the need for the development of more doable, problem based, cost effective and area specific technologies for rainfed rice production.

Temperature and radiation:

Rice has a wide range of adaptability. However, it is susceptible to a number of environmental factors. Temperature and radiation are the two other important factors, which play crucial role in the production of rainfed rice in eastern India. The high minimum temperature and radiation during the monsoon seriously limit the yield potential of wet season rice in eastern India unless it is harvested late in the year (Garrity, Oldeman and Lenka, 1986). Occurrence of cold at anthesis affects the rice production seriously. A majority of rice areas in eastern India experiences severe cold in winters and thus observes cold at the time of anthesis in the late transplanted rice. Huke (1982) reported that from high altitudes in north eastern India where low temperature is a constraint to low altitudes where high night temperature limits yield, temperature becomes one of the important production constraints. Therefore, it is important to develop rice varieties, which may withstand vagaries of high and low temperatures, which are phenomenal in eastern states in India.

Recurrent floods and droughts:

Occurrence of recurrent floods and droughts are the regular features in most of the parts of eastern India. A majority of rice area, mostly rainfed, in Assam, North Bihar, Orissa and West Bengal experiences either floods or droughts or even both every year. Nearly 10 million hectares of lowlands in Bihar, Orissa and West Bengal are affected with flash flood and water logging (Prasad, *et. al*.,1986). In contrary, drought and moisture stress are the major limiting factors in upland rainfed rice in these state. Constraint studies on rice in Bihar show that yield losses due to occurrence of floods and droughts are substantial (Thakur, 1994 and Jha, 1999). Nearly, 95 to 100 thousand tonnes of rainfed lowland rice are lost every year in Bihar only. The losses caused by the floods in rainfed up and lowlands in Bihar accounts for about 12 to 27 per cent per annum

of the actual production. Different studies reveal that drought is most significantly contributing to the yield gap in upland rainfed rice, where as flash floods submergence is the major constraint of rainfed low land rice (Herdt, 1996). The problem of flood and droughts can not be solved merely through conventional technologies. Biotechnology embraces a range of technical possibilities, the future potential of which is still being hypothesized. However basic research on transfer of drought and flood tolerant genes is distinct possibility.

Water management:

Results of different water management studies show that the production of rice can be increased up to 20 per cent with the help of suitable water management technology. However, indiscriminate use of canal irrigation and drainage is affecting the rice yield adversely. Water management of ill -drained soil in rainfed lands is one of the major constraints (Prasad, *et.al*., 1986; and Hossain and Laborte, 1996). It was found that about one third of total rice, grown in eastern states is rainfed and grown in low topography, problem of drainage depressed rice fields (Shenoi and Mandal, 1986). Hence, introduction of new and efficient water management techniques for rainfed rice production might be helpful in the enhancement of rice yield in eastern India.

Problem soils:

A bulk of soils in eastern states is problematic. Hence, they have become detrimental to the production of rice. Poor soil fertility is common in rainfed uplands where yields are constrained by lateritic soils with high iron and low nitrogen content, and a pH occasionally below five. Soil problem in other rainfed areas includes salinity, alkalinity and \or zinc deficiency. Apart from coastal saline soils of West Bengal and Orissa a majority of rainfed lands in Bihar and Assam are suffering from the problem of soil salinity. While some of these problems may be efficiently solved with affordable soil amendments, other constraints such as alkalinity and salinity cause greater yield losses, which might be partially averted through tolerant high yielding varieties.

Inadequate input use:

Due to fear of crop failure or other input related constraints like, high input costs, unavailability of input on time in required quantity and other technical and socioeconomic constraints, inadequate input use is common in rainfed ecosystem of eastern India. Studies show that application of fertilizer is positively correlated with the availability of irrigation water but uncertainty of rainfall and accumulation of water in fields constrain fertilizer use in rainfed rice

fields. Similarly, high cost of agro-chemicals constrains the use of these chemicals and pesticides on the farm. Thus policies are needed to encourage the use of potential biological substitutes to the agrochemicals besides ensuring timely supply of critical inputs. Finally development agencies should make a concerted effort to develop irrigation potential through water harvesting.

Conclusions:

Rice is one of the most important crops in eastern India and it will continue to enjoy its leading position so long as it remains the staple food of almost entire of the population of this region. Under the influence of increasing population pressure the demand for rice is expected to rise persistently in coming years. As the land frontier has already been exhausted the future source of growth in this region lies in raising the productivity of rice crop. Even to sustain in food grains production, it is important to give due attention to the eastern India in general and to accord high priority to the constraints of rice production in this region in particular. This can be achieved if rice research helps to reduce production losses due to various biotic and abiotic constraints in rainfed rice ecosystems. Since elimination or partial solution of these constraints would have a major impact on rice production in eastern India because the yield gaps are very high, the major constraints to rice production in eastern India require more objectivity and concerted efforts while addressing them. The major rice production constraints and priority research problem areas of rainfed rice production in eastern India are drought and submergence, bacterial blight, leaf blast, weeds, brown plant hopper and poor soil fertility. Hence, it would be logical to prioritize rice research on the basis of prevailing constraints under rainfed areas of eastern India. Besides, low input use, inappropriate plant spacing, late sowing and selection of wrong cultivars are some of the other technical constraints, which can be effectively reduced through the diffusion of relevant technologies among ultimate users or farmers. It requires further strengthening of linkages between ‘Research & Extension’ that facilitates feed-backs and disseminates technical information.

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