

REVIEW ARTICLE

Increasing rate of adoption of rice technologies in Assam: A need of the hour for food security

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Abstract

Rice is the staple crop of Assam, a small state of India. The economy of Assam continues to be predominantly agrarian. The agriculture sector in the state is providing employment to more than 50% of the rural people. The net cultivated area of the state is 28.11 lakh hectares (2009-10) which is about 88% of the total land available for agricultural cultivation in the state. The contribution of agriculture sector to the state domestic product was nearly 25% during 2010-11. The area covered under paddy cultivation was 25.71 lakh hectares and more than 91% of the total area under food grains in the state during 2010-11. According to the census of India, 2011 the population of Assam stands at 3,11,69,272. The decadal growth of the state's population works out to 16.93% during the decade 2001-2011 as against 17.64% for the country as a whole. But due to ever increasing population, the state is now experiencing food insecurity. But there is no dearth of technologies of rice to increase production. But one of the major problems is the poor adoption rate of farmers towards rice technology to increase production. If the rate of adoption is not increased urgently then the state will face serious problems of food security in near future. Large scale small and marginal farmers, poor irrigation facilities, poor mechanisation etc. are some hindering factors for poor rate of adoption of rice technologies. In this review, an attempt is made to discuss the food security problem in context to world situation and provide some suggestions to improve the situation in Assam.

Keywords: Rice, agriculture sector, food grains, population, food insecurity, adoption technologies.

Introduction

World is biting the bullet of swift population growth, progressively diminishing crop lands, food insecurity and an escalating threat of famine. The growing rate of population has led to an increase in the poverty as well as the starving people around the globe. Over 9 million people embrace death worldwide each year because of hunger and malnutrition, out of which 5 million are children. Some 2 to 3.5 billion people suffer from micronutrient deficiency (Shah, 2010). Total number of under-nourished people in the world was estimated to have reached 1023 million in the year 2009 and was expected to decline by 9.6% to 925 million in 2010. But still, this number remains unacceptably high. After increasing from 2006-09 due to high food prices and the global economic crisis, both the number and proportion of hungry people declined in 2010 as the global economy recovered and food prices remained below their peak levels. But hunger remains higher than before the crises-higher than it was 40 years ago and higher than the level that existed when the hunger reduction target was agreed at the world food summit in the year 1996 (FAO, 2010). According to FAO, every day, millions of people around the world eat only the bare minimum of food to keep themselves alive. Every night, they go to bed not certain whether there will be enough food to consume tomorrow (Nagarajan, 2013). This uncertainty about where the next meal will come from is called 'food insecurity'.

FAO defines food insecurity as (www.fao.org):

'A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life.'

The majority of the world's hungry people live in the underdeveloped and developing countries, where they account for about 16% of the population. Asia and the Pacific are home to the largest number of hungry people while sub-Saharan Africa has the highest prevalence of hunger, with one in three people being undernourished. Some of the numbers break down as per FAO (2010) values is as follows:

1. Sub-Saharan Africa: 239 million
2. Asia and the Pacific: 578 million
3. Latin America and the Caribbean: 53 million
4. Near East and North Africa: 37 million
5. Developed countries: 19 million

India had a glorious history. But after 65 years of independence, poverty and hunger can still be very easily found in India. India is facing the same harsh situations where the poorest of the poor of our country have to go to bed hungry. Poverty in India is widespread with the nation estimated to have a third of the world's poor.

According to 2005 World Bank estimate, 42% of Indian fall below the international poverty line. About 43% of Indian children under 5 are malnourished (Haq, 2010). If we have a look into the scenario of Assam, a small state of India, poverty and hunger also extensively spreads in Assam. It is an agricultural state where the majority of the population of this state is engaged in agriculture as their livelihood. In Assam, about 36% of total population is below the poverty line (Devi, 2010). So, these hunger and poverty facts clearly indicate that food security for mankind in the 21st century has become a burning issue and a common concern of the International community.

Food insecurity and poverty

Poverty is a major cause of food insecurity and sustainable progress in poverty eradication is critical to improve access to food. For ending poverty among the world's poor and to achieve food security, lots of activities and efforts are being undertaken by some of the world's most leading organizations. Some of such efforts are as follows:

At international level:

- a) *The 1996 World Food Summit Target:* The world food summit which was held in Rome in the year 1996 aims to reduce undernourished people across the world by the year 2015. Its activities are monitored by the FAO. FAO uses the average of the period 1990-92 (around 850 million people) as the baseline for monitoring progress towards this target.
- b) *The Millennium Development Goals:* The millennium development goals were adopted at the 2000 Millennium Summit held at the UN headquarter in New York. The millennium development goals comprise of eight time-bound goals to provide concrete, numerical benchmarks for tackling extreme poverty in its many dimensions. These goals are set to be achieved by the year 2015. The MDGs are tailored by each country to meet both global and local specific development needs. They provide a framework for the entire international community to work together towards a common end—making sure that human development reaches everyone, everywhere. If these goals are achieved, more people will have the opportunity to benefit from the global economy.
- c) *The International Rice Research Institute's (IRRI) efforts:* Poverty alleviation, developing sustainable rice systems, developing human health and nutrition, information and capacity building and restoring the rice genetic resources are the five strategic goals of IRRI. Responding to the 'rice crisis' across the world, IRRI aims at bringing out an agronomic revolution to close the existing rice yield gaps, delivery of new post harvest technologies of rice, accelerate variety replacement, strengthen breeding research for the future, tap the vast genetic reservoir of rice, develop policies to strengthen productivity and growth of rice and introduce and train a new generation of rice scientists and professionals.

- d) *Food and Agricultural Organization's (FAO) efforts:* Among other activities of the FAO, achieving food security for all is at the heart of FAO's efforts. FAO undertakes activities so that all people in all places and at all times may have physical and economic access to safe, nutritious and sufficient food. FAO's mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy. In order to achieve these ambitious goals, FAO provides assistance to help people and nations help themselves.

At national level:

- a) *Rashtriya Krishi Vikash Yojana (RKVY):* Rashtriya Krishi Vikash Yojana was launched in the year 2007-08 by the National Development Council (NDC) concerned with the slow growth in the agriculture and the allied sectors. The RKVY aims at achieving a 4% annual growth in the agriculture sector during the eleventh five-year plan by ensuring a holistic development of agriculture and the allied sectors.
- b) *The National Food Security Mission (NFSM):* The national food security mission is a centrally sponsored scheme which was launched in the year 2007-08 comprising rice, wheat and pulses to increase the production of rice by 10 million tons, wheat by 8 million tons and pulses by 2 million tons by the end of the eleventh plan (2011-12). The basic objective of this mission is to increase the production of rice, wheat and pulses through area expansion and productivity enhancement in a sustainable manner in the identified districts of the country.
- c) *Bringing Green Revolution to Eastern India:* The BGREI programme is the outcome of the recommendations of the Task Force constituted by GOI in pursuance of the decisions taken in the meeting of the Committee of Secretaries held on 29th Nov 2009 to make short and medium term recommendations for efficient management of water, power and other inputs as well as subsidy to maximize agricultural production on a sustainable basis. The project is running at Assam, Bihar, Chhattisgarh, Jharkhand, Orissa, Eastern UP and West Bengal. The key interventions are:
 - Developing additional water sources through tube wells, dug wells and farm ponds.
 - Promotion of hybrid rice.
 - Promotion of flood, drought, and salinity tolerant rice varieties.
 - Use of the drum seeders for timely planting of direct seeded rice.
 - Promotion of farm implements and their easy availability for timely operation.
 - Liming treatment in acidic soils.
 - Bringing additional area under:
 - Summer/Boro rice
 - Pulses and oilseed crops through relay cropping in rice fallows intercropping.

Scope of 'rice' in achieving food security and decreasing poverty

Rice is grown on all most all the continents of the world. It is the staple food for over half of the world's population. The crop plays an important role in the national economy in many developing countries. Rice accounts for more than 65% of caloric intake in the developing countries in tropical Asia and more for low income households in these countries. For the poor people, it is the basic crop and the major source of income and employment. In Asia alone, more than 2 billion people obtain 60-70% of their caloric intake from rice and its derived products (Diouf, 2003). Crop plays a great role in providing human nutrition and food security in these regions. Rice is not only a fundamental commodity and a primary food source in these countries, but it also influences some burning issues like food security for the present and the future population and also poverty alleviation. Rice production contributes to poverty alleviation by benefitting both the producers and the consumers through several pathways. These are:

- Higher productivity leads to higher profits or higher incomes to the producers–Direct pathway.
- Higher farm productivity for any given level of demand leads to lower prices for the consumers–Indirect pathway.

Rice is therefore on the frontline in the fight against world hunger and poverty. For all these reasons, "Rice is life" (Diouf, 2003). The Green Revolution, which took place from the late 1960s to the 1980s enabled the rice production to meet the demands of the increasing population and helped many countries to escape from starvation. But it is said that after the 1990s, the rice production has not been increasing at the same rate as that of the population of the world. To achieve national food security, many countries strived to increase the rice production to reach self-sufficiency, but the ever increasing population rate has made self-sufficiency to disappear fast. The decrease in the rice production has become a major concern in relation to the world food security and poverty alleviation which is the dramatic and the most urgent problem of today's world. The continued population increase in Asia at the rate of 1.8% per year requires 70% more rice production in 2025 than that in 1995 (Peng *et al.*, 1999).

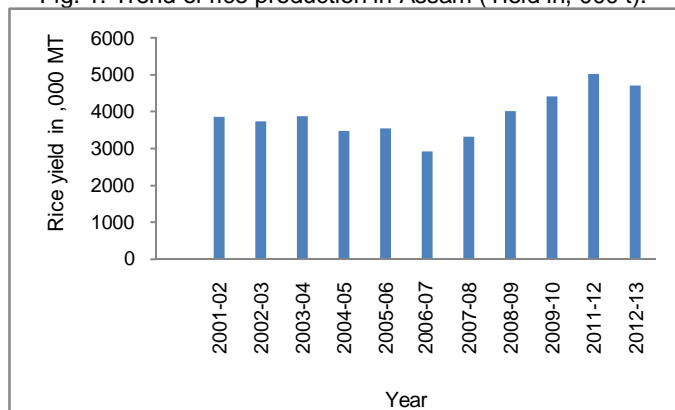
According to FAO of the United Nations, the global rice requirement in 2025 will be on the order of 800 million tons. Now, production is less than 600 million tons. The additional 200 million tons needed, will have to be produced by increasing productivity per hectare. The average productivity may have to go up to 8 tons per hectare from the present near 5 t/ha (Swaminathan, 2007). The growth of population is imposing an increasing pressure on the farmers to produce more rice, that too, with better quality to meet the future demands so that the rice becomes more affordable, available, accessible and safe which is the main essence of food security.

Moreover, this additional larger quantity of rice has to be produced on limited land, water, labour, chemicals and other resources. Now, to meet this challenge of increasing rice production while sustaining the natural resource base, the farmers' adoption rate of new and the existing technologies has to be increased. Numerous technologies have already been developed to harness the potential yield of rice. Biotechnology, for example, has enabled the development of rice varieties that resist virulent pests and diseases or overcome water and micronutrient problems, etc. But these technologies still awaits their full exploitation by the farmers.

Situation of rice in Assam

Assam is an agricultural state and hence the economy of the state rests primarily on agricultural producers. Agriculture sector continues to support more than 75% population of the state directly or indirectly providing employment for more than 53% of the total workforce (Economic Survey, Assam, 2011-12). Rice is the major crop of this state. In Assam, production of rice was 38, 54,000 MT in 2001-02 which is increased to 50, 33,000 MT in 2010-11 (Fig. 1). But due to increase in population the state targeted 75 lakh MT at the end of 2016-17. Despite the fact that yield rates of the principal crops have increased since independence, these are still below the average yield rates of the country and significantly below the yield rates of high performing states (Assam Human Development Report, 2003).

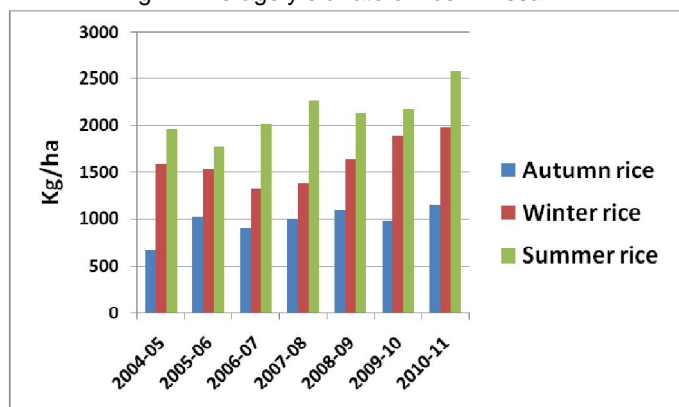
Fig. 1. Trend of rice production in Assam (Yield in, 000 t).



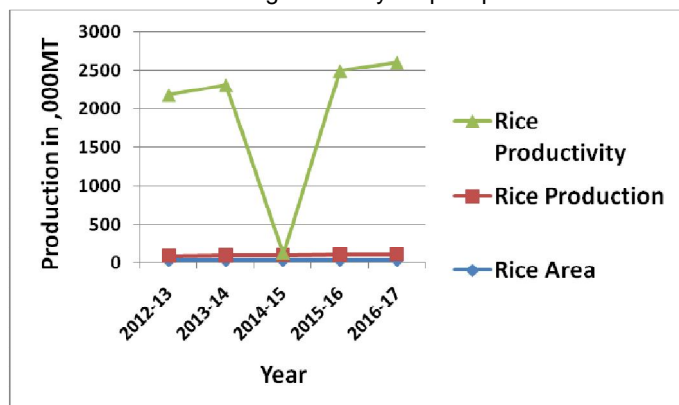
(Source: Directorate of Economics and Statistics, Assam).

This has implications for food security, in particular for vulnerable and disadvantaged sections. So, this implies that to increase or to meet the projected demand of rice in this state, we have to either increase the production of rice by introducing some new modern varieties (either HYV or Hybrid) or with the existing modern varieties or steps have to be initiated for the expansion of area under rice cultivation. But more than 83% of the farmers of Assam are small and marginal farmers and situation is rainfed, hence there is no ample scope to increase the area under rice cultivation (2005-06 Agricultural Census, Assam).

Fig. 2. Average yield rate of rice in Assam.



(Source: Directorate of Economics and Statistics, Assam).

Fig. 3. Target of area, production and productivity of rice in Assam during 12th five year plan period.

(Area in hectares, production in lakh MT and productivity in kg per hectare; Source: Directorate of Agriculture, Assam).

Assam is facing the challenge of producing more food on less land with limited water resources. So, the best way to meet the projected demand of rice is to increase the production of rice by introducing some new varieties or by achieving the potential yield of the existing varieties. According to agronomists, the potential yield and average yield of some varieties of rice like Ranjit, Bahadur, Kushal, Maniram, Piyolee, Gitesh, Jalashree, etc. ranges from about 5-7 t/ha provided, all the recommended practices are followed rightly. Whereas, the present average yield of rice in the farmers' fields ranges from about 1-2.5 t/ha (Fig. 2). This indicates that the potential yield of rice has not been exploited so far. The existing performance of rice is still poor as compared to the expected performance. Yield gaps can be found in many country's states of the world and the observed scenario in Assam is also suggesting that Assam is also no exception to it and there exists a wide yield gap in between the yield found in the research stations to the yield in the farmers' fields. There may be several factors responsible for such yield gaps. In general, various constraints in terms of physical, biological, socioeconomic and institutional lead to exploitable rice yield gaps.

Also, it is found in various cases that the progressive farmers generally obtain higher yields and larger profits as compared to the other ordinary farmers suggesting the presence of knowledge gaps. Hence, to decrease such yield gaps and to obtain the potential yields of the existing varieties, the best way is to increase the farmers' adoption rate of a whole package of technologies. In the 12th five year plan period Assam targeted 75 lakh MT of rice with an average yield of 2.5 kg per ha (Fig. 3). This narrowing and minimizing the rice yield gap by adoption of full package of practices of rice will not only help to increase the rice production and productivity, but also will help to improve the efficiency of the utilisation of resources like land, water, labour, reduce the cost of production and to achieve food security.

Necessity for increasing rate of adoption of rice technologies

Agriculture and its allied activities played an important role in the socio-economic development of the state of Assam as this sector is the major contributor to the State economy as well as providing livelihood to a significant proportion of the population of the state. About 99% area of total land mass of the state is rural. According to the census of India, 2011 the population of Assam stands at 3,11,69,272 of which 1,59,54,927 are males and 1,52,14,345 females. The decadal growth of the state's population works out to 16.93% during the decade 2001-2011 as against 17.64% for the country as a whole. Because of high rate of population the demand of rice is also increasing day by day in Assam. In view of growing demand and to attain self sufficiency in food production, the state agriculture department had set the target to cover 27.1 lakh hectare of area under rice so as to increase the production of rice more than 54 lakh MT during the year 2011-12. But the report submitted to Assam assembly by government of Assam on 22nd March, 2013, the yield of rice in the state is reduced to 47,16,000 MT in 2011-12 (Dainik Janambhumi, 2013). Insufficient irrigation support, damage caused by natural calamities coupled with inconsistent weather like flood also stands as impediment in attaining self sufficiency in food production by the state. Despite such situation, the state agriculture department has given more focus of attention to increase production of food grains to provide food security to the growing population by increasing productivity of crops and cropping intensity.

Accordingly, the state agriculture department has prioritized optimum and efficient use of available resources to enhance the production and productivity of the rice. In Assam, the soil, topography, rainfall and climate in general are congenial for agricultural activities mainly for paddy cultivation. The paddy cultivation occupies 91.5% of the net cropped area and 62.6% of the gross cropped area in the state during the year 2010-11 (Economic survey, 2011-12, Assam).

For production of yield fertilizer plays an important role. But the trend of fertilizer consumption in the state in terms of nutrient (NPK) per hectare is much lower than the national average consumption. According to the state agriculture department consumption of fertilizer in the state was at 67.09 kg per hectare during the year 2010-11. Integrated Pest Management (IPM) is another key component of sustainable agricultural production. Assam having a diverse eco-system with sub-tropical climate, the crop production is associated with loss of biotic stress problem which share 20-30% of the yield loss. In case of modern rice cultivation farm mechanization is a critical input as it facilitates timely agricultural operation. But in Assam, the growth of mechanization is also slow. At present, the availability of farm power in the state is only 0.90 HP per hectare as compared to 1.40 HP per hectare at national level (Economic survey, 2011-12, Assam). To achieve the target of rice production, it is important to increase the rate of adoption of rice technologies. According to Sharma (1970) defined adoption as a psychological process on the part of each individual within a system which ultimately results in adoption of innovation. According to Rogers (1995), it is the decision to make full use of an innovation as the best course of action available. But average operational holding is 1.15 hectare only and more than 83% of the farmer family is small and marginal farmers (2005-06, Agricultural census). The operational land holding is reducing day by day which is a major problem for introducing new technologies of rice in Assam.

At present numbers of rice technologies are developed to suit the Assam condition. But those technologies are yet to adopt by farmers to a greater extent. From various studies, it is clear that Assamese farmers do not adopt rice technologies properly. In a study conducted by Hussain (1982) found that majority of Assamese farmers did not adopt recommended rice technologies. Women farmers also had medium level of knowledge on improved rice cultivation though they are actively engaged in rice cultivation in Assam (Gogoi, 1989). In another study, Gogoi (1989) found that overall adoption of recommended plant protection measures was low to medium in Assam. Das (1996) observed that 37.5% farmers had full gap of adoption of sali rice technologies. In case of hybrid rice varieties, Basumatary (2000) found that majority of farmers of Assam obtained low yield to very low as compared to the yield of potentials of hybrid varieties of rice. In a recent study conducted by Saikia (2012) found that the adoption behaviour of farmers of Assam is very poor. According to her, 79.17% farmers possessed poor adoption behaviour in case of sali rice production technology, the main crop of Assam. If this trend continues then Assam will not achieve the target and will face the problems of saviour food insecurity. Therefore, the state should take necessary step to increase the rate of adoption of rice technologies among farmers.

Suggestions for increasing adoption rate in Assam

Since there is no dearth of technologies for increasing production of rice in Assam but low rate of adoption is a major problem for it. For increasing rate of adoption some suggestion are given below:

1. Socio-economic, psychological, communication variables of farmers should be identified which influence the rate of adoption of rice technologies and such variables should be properly manipulated to increase the rate of adoption.
2. Stakeholder analysis of rice production system should be analyzed properly and if needed it should be strengthened.
3. Proper use of ICT suitable for small and marginal farmers may be explored to increase the rate of adoption.
4. The concept of social marketing may be introduced to increase the rate of adoption of rice technology.
5. Knowledge levels of extension personnel and their constraints in disseminations of technologies should be determined and that should be taken care of.
6. Improvement of extension contact among farmers is also important and that should be improved.

Conclusion

Assam is an agrarian state and its rice cultivation is entirely depends on rainfed condition. Most of the farmers are small and marginal so under such conditions adopting full package of practices is also a difficult task. If steps are not taken urgently, farmers' rate of adoption will not increase satisfactorily. In such situations, Assam will not able to achieve the target of rice production and as a result will face the situation of food insecurity in the near future.

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