Yield Gap Analysis of Rice Cultivars in Meghalaya: An Empirical Study

Ram Singh[1] and S.M. Feroze[2]

1. Associate Professor and 2. Assistant Professor, School of Social Sciences,
College of Post Graduate Studies, Barapani, Meghalaya (Central Agricultural University, Imphal)
Corresponding author e-mail: ramsingh.cau@gmail.com

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ABSTRACT

The research was conducted in Ri-Bhoi District of Meghalaya in all three blocks using probability proportionate to population size. Yield gap was calculated based on the difference of potential farm yield and actual farm yield. Cobb-Douglas production function was applied to know the factors associated with the yield gap of rice. Ranjit *cultivar and* Lahi *cultivar were found to have the highest yield gap among the major rice cultivars in Meghalaya. The yield gap was found to be high in Meghalaya which may be due to lack of technical knowhow, lack of new technology for cultivation of rice and non-availability of irrigation. There are many scope to improve the productivity of different cultivars by filling the yield gap through the use of new technology for the cultivation of rice in the state. Further research suggests to popularised* Pasyrbhuh, Ranjit *and* Lahi *which have more actual yield. The gap in yield of these cultivars must be reduced by refinement through research intervention. Input use of seed and human labour were found to be positive at 1 per cent level of significance in accelerating the yield gap in the state. Farmers should be trained about the use of seed of rice for its quantity, quality, germination* etc. *and same time rice cultivation is very labour intensive, hence introduction of new small machine will help to reduce/bridge gap of rice.*

Key words: *Meghalaya; Rice; Cultivars; Yield gap; Empirical;*

The Meghalaya state of north eastern hill region of India is an agrarian state. During the post-green revolution period introduction of improved varieties, pushed the rice yield by about 40 per cent in North Eastern Hilly (NEH) region (*Panda and Reddy, 1989*) including Meghalaya. Rice cultivation in the NEH region of India is exposed to different biotic and abiotic stresses that include extreme temperatures at the time of flowering and grain filling stages, thereby demonstrating a very dismal picture of rice yield and production of the region (http://www.rkmp.co.in/sites/default/files/ris/rice-state-wise). NEH region has been striving hard to attain food self-sufficiency and food security. The main threats to the future food-security are: shrinking land, depleting water resources, declining trends in soil fertility and productivity and depletion of ground water table (*Devi and Ponnarasi, 2009*) and most importantly climate change *i.e.,* increase in temperature, low rainfall, shift in monsoon *etc. Birthal et al., 2014* in their study has shown the projection of climate impacts for the year 2100 which suggested that with significant changes in temperature and rainfall the rice yield will be lower by 15 per cent. Rice is mainly cultivated in vast area of hilly uplands and in patches in the valleys of the state. The yield of upland rice is much lower than that of valleys as well as than plains; hence, the state is lagging behind comparative to other states as far as the production and yield of rice concerned. Average rice yields have increased considerably with the introduction of high-yielding varieties and improved crop management technologies. But, there is still a wide gap between the potential and actual yields of farmers. Increasing the productivity of rice remains to be the major challenge for the governments and researchers in all the rice growing countries (*Devi and Ponnarasi, 2009*). HYV of rice generate additional employment being labour intensive in comparison to local varieties and also helps socio-economic transformation of farmers. On an

average the yield of rice in India is 2.46 ton per hectare where in Meghalaya it was 2.13 ton per hectare which was accounted to be 13.41 per cent lesser than the national average during 2012-13 (*GoI, 2014*).

METHODOLOGY

The research was conducted in Ri-Bhoi District of Meghalaya in all three blocks using probability proportionate to population size. The research pertains both primary and secondary data. The secondary data on area, production and productivity of rice were collected from the district statistical office, Ri-Bhoi. Primary data were collected through well structured pre-tested schedule from the farmers pertaining to cropping pattern in which crop grown, production, yield, varieties/cultivars, date of sowing/transplanting, fertilizers, manures, harvesting date *etc.* were collected.

Yield gap analysis: Yield gap have been calculated on the basis of per hectare potential farm yield and actual farm yield using simple statistical tools as follows

Yield gap = Potential farm yield (Y_d) - Actual farm yield (Y_a).

Factors associated with yield gap of rice: To identify the factors associate with yield gap of rice, Cobb-Douglas production function was used with the following specification:

$$\text{Log } Y = \log \beta_1 + \beta_2 \text{Log } X_1 + \beta_3 \text{Log } X_2 + \beta_4 \text{Log } X_3 + \beta_5 \text{Log } X_4 + \beta_6 \text{Log } X_5 + \beta_7 \text{Log } X_6 + \beta_8 \text{Log } X_7$$

Where,

Log Y = Yield (Kg/ha)

Log X_1 = Seed (Kg/ha)

Log X_2 = FYM (Kg/ha)

Log X_3 = DAP (Kg/ha)

Log X_4 = Labour (Mandays/ha)

Log X_5 =Date of sowing for nursery/date of direct seeded rice (DSR) (Julian date).

Log X_6 = Harvesting date (Julian date).

Log X_7 = Irrigation (₹/ha)

RESULTS AND DISCUSSION

Yield Gap: It has been observed that on an average the potential yield in hill region was 3.75 ton per hectare while the actual yield in Meghalaya remained at 1.71 ton per hectare. Thus, the yield gap was calculated to be 2.04 ton per hectare which was 54.49 per cent of the potential yield and it was higher than the finding of Nirmala *et al*., 2009 in which it was estimated as 11.82 per cent. Among the different cultivars, the potential yield was highest (3.75 t/ha) in case of *Ranjit* followed by *Lahi* and *Pasyrbhuh* (3.50 t/ha), *Hybrid* (2.50 t/ha), and *Assam* (1.60 t/ha). The actual yield was highest in *Pasyrbhuh* (2.10 t/ha); followed by *Ranjit* (1.80 t/ha), *Lahi* (1.70 t/ha), *Hybrid* (1.38 t/ha) and *Assam* (1.23 t/ha).

The yield gap was found to be highest of the *Ranjit* cultivar (1.95 t/ha), which was accounted to be 51.99 per cent of potential yield and followed by *Lahi* cultivar (1.80 t/ha), *Pasyrbhuh* cultivar (1.40 t/ha), *Hybrid* cultivar (1.12 t/ha) and *Assam* (.37 t/ha). The yield and yield gap varied from cultivars to cultivars, Ajeet and *Namdeo 2005* also found similar results with respect to variation in the grain yield of hybrid rice and IR 36 variety of rice. Among the cultivars, *Assam* and *Hybrid* has lower yield gap which shows a good indication but the potential and actual yield of *Hybrid* cultivar and *Assam* cultivar was less as compared to the others. The extent of yield gap of rice in Meghalaya is higher than the findings of (*Akintayo and Rahji, 2011*) in Nigeria which was 0.90 to 1.50 ton per hectare of yield gap. The yield gap was found to be high in Meghalaya which may be due to lack of technical knowhow, lack of new technology for cultivation of rice and non-availability of irrigation. Therefore, there are many scopes to improve the productivity of different cultivars by filling the yield gap through the use of new technology for the cultivation of rice in the state. Further research suggests to popularised *Pasyrbhuh, Ranjit* and *Lahi* which have more actual

Table 1. Extent of yield gap in rice production in Meghalay (ton/ha)

Particulars	Rice cultivars					
	Lahi	*Pasyrbhuh*	*Ranjit*	*Hybrid*	*Assam*	Overall
Potential yield	3.50	3.50	3.75	2.50	1.60	3.75
Actual yield	1.70	2.10	1.80	1.38	1.23	1.71
Yield gap	1.80 (51.50)	1.40 (39.98)	1.95 (51.99)	1.12(44.66)	0.37 (22.98)	2.04(54.49)

Note: Figures in parentheses shows yield gap as per cent to potential yield

yield. The gap in yield of these cultivars must be reduce by refinement through research intervention.

Table 2. Functional analysis of factor associated with yield gap in rice

	β	t-value	p-value
Intercept	1.97	0.61	0.54
Seed	0.10	2.67	0.01***
FYM	0.07	1.31	0.19
Fertilizer	0.00	0.07	0.94
Human labour	0.43	9.43	0.00***
Date of sowing for nursery/DSR	0.25	1.30	0.20
Date of harvesting	0.27	0.46	0.65
Irrigation	0.00	0.77	0.44
R^2	62.31		

Note: *** Indicates significant at 1% level of significance.

Factors responsible for the yield gap in rice : The regression coefficient for seed and human labour were worked out to be positively significant at 1 per cent level of significance. In terms of magnitude, one per cent increase in input on seed would increase the productivity of rice by 0.10 per cent and one per cent increase in input of labour would increase by 0.43 per cent.

The value of R^2 was found to be 0.62, indicating 62 per cent of variation in yield was explained by the, seed, FYM, fertilizer, human labour, date of sowing, date of harvesting and irrigation taken in the functional analysis. The remaining 38 per cent of variation might be due to some other factors which have not been captured in the function such as land, rainfall, temperature, humidity, *etc*.

CONCLUSIONS

The state has variability in production of rice cultivar as well as yield among the various rice cultivars grown by the farmer. Through the research it has been found that the state lagging behind the yield comparative to national level rice yield (13.41%). The *Pasyrbhuh, Ranjit* and *Lahi* were identified the cultivars of rice which need to popularised as these have good potential yield as well as actual yield in the state. Research also suggests some more refinement in these cultivars to reduce the yield gap. Further, research found the seed and human labour as significant factor for accelerating the yield in the state. It is shown that farmers should be trained about the use of seed of rice for its quantity, quality, germination *etc.* and same time rice cultivation is very labour intensive, hence introduction of new small machine and implement by the state department ICAR research complex for NEH region and Central Agriculture University Imphal was the need of hours which will help to reduce/bridge gap of rice.

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