Research Article

INNOVATIVE APPROACHES FOR CULTIVATION OF GREEN GRAM IN *JHUM* RICE -FALLOW FOR DOUBLING THE FARMERS INCOME UNDER LONGLENG DISTRICT OF NAGALAND

Manoj Kumar[1,3*], K.L. Meena[1], D.J. Rajkhowa[2], L.K. Baishya[2], Anup Das[4], Rakesh Kumar[5] and A. Namei[1]

[1]*Krishi Vigyan Kendra, Longleng, Nagaland, INDIA*
[2]*ICAR RC for NEH Region, Nagaland Centre, Medziphema, Nagaland, INDIA*
[3]*Krishi Vigyan Kendra, East Sikkim, Ranipool, Sikkim, INDIA*
[4]*ICAR RC for NEH Region, Tripura Centre, Agartala, INDIA*
[5]*ICAR RC for Eastern Region, Patna, Bihar, INDIA*
**Corresponding author's E-mail: mkumar_cprs@yahoo.co.in*

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ABSTRACT

Rice is most important crop in *Jhum* field under Longleng district of Nagaland. About 12% of the total geographical area of the district is under *Jhum* rice. Mixed cropping is practiced in *Jhum* farming where rice is predominant crop. Rice is cultivated during February-March to July-August, leaving rest of the period during the year as fallow and the rainfall continues up to the end of October and also moisture remains in the field till December. Thus there is potential for growing of green gram as a second crop for enhances the income of the *Jhumias* and also increase the cropping intensity. Therefore, frontline demonstrations (20 nos.) on Green gram (Cv. Pratap) was conducted under *Jhum* rice fallow by KVK Longleng in three different villages in an area of 2.0 ha and 2.5 ha during the year 2016 and 2017 respectively. From the two years data, result revealed that rice yield was recorded 1850 kg/ha. Mean yield (2 year) of Green gram was recorded 920 kg/ha. After introduction of Green gram as second crop at farmers field, Rice Equivalent Yield (REY) of Green gram was recorded 4007 kg/ha. System productivity in terms of REY was recorded 5987 kg/ha as compared to rice mono cropping (1850 kg/ha). System productivity (25.8, 11.4 kg/ha/day), system profitability (143.0, 35.0 Rs/ha/day), net income (Rs. 33183/ha, 5860/ha) and B:C ratio (1.76, 1.32) were recorded under rice- green gram and rice-fallow respectively. Therefore, it could be concluded that Green gram is an option for growing in residual soil moisture just after harvesting of *Jhum* rice for getting not only additional income of the farmers but also enhance the soil fertility which ultimately increase the yield of succeeding crop.

INTRODUCTION

Rice is primary food in Nagaland and cultivated in an area of ~18.3 thousand ha and producing ~38.14 thousand tonnes with a productivity of ~2.1 t/ha (Anonymous, 2014). About 12% of the total geographical area of the Longleng District is under *Jhum* rice cultivation. Rice is the stable food of Longleng and cultivated an area of ~7.42 thousand ha with the production (13.62 thousand ha). Mixed cropping is practiced in *Jhum* farming where rice is predominant crop. Rice is cultivated during February-March to July-August, leaving rest of the period of the year as fallow (Kumar *et al.,* 2016) and the rainfall continues up to the end of October and also moisture remains in the field till December. Thus there is potential for growing of pulse (green gram) as a second crop in *Jhum* rice - pulse (green gram) sequence mode, which is one of the component for doubling the farmers income. Pulse availability in NER is hardly 12.5 g against 43.3 g at national level. Considering the recommended per caput dietary pulse intake of 50 g, the pulse production in this region needs to be increased by almost 10 times to make this region self-sufficient in pulses. The fact that the productivity of the pulses in this region (848 kg/ha) is higher than that of country's (764 kg/ha) indicated that this region suits well to pulse production. Although the area and total production of pulses in NER

increased over the years. The requirement and deficit of pulses for NER, considering per caput consumption at 18.25 kg per annum. The NEH region as a whole has a deficit of 78.79% in pulses and 6.4% deficit in Nagaland (Das *et al.*, 2016). Thus there is potential for growing of short duration pulse (green gram) in *Jhum* rice- fallow which not only fulfill the deficit of pulses in Nagaland but also increase the cropping intensity, improvement of soil fertility status and income of the *Jhumias* for food and nutritional security.

MATERIALS AND METHODS

Krishi Vigyan Kendra, Longleng is situated at 26° 26' 0" N Latitude, 94° 52' 0" E Longitude with altitude of 1366 m MSL. The soil is generally high in soil organic carbon (1.7-2.1%), low to medium in available N (296-340 kg/ha) and K (170-182 kg/ha) and low to medium in available P (10-16 kg/ha). Total annual rainfall varied between 1359 mm to 2094 mm during 2016-17 and 2017-2018 and average annual rainfall was 598.5 mm during (August-November) cropping period (Fig 1).The monthly mean maximum and minimum temperatures during the study period ranged from 24.16 to 32.92 ^{0}C and 12.32 to 24.50 ^{0}C, respectively. First time frontline demonstrations (20 nos.) on Green gram (Cv. Pratap) was conducted under *Jhum* rice -fallow by Krishi Vigyan Kendra, Longleng in different villages under the District in an area of 2.0 ha and 2.5 ha during the year 2016-17 and 2017-18 respectively. Rice was harvested and yield was calculated. Green gram was sown as second crop in residual soil moisture just after harvesting of *Jhum* rice during the last week of August to 1st week of September. The crop was sown with spacing of 30 cm between the row and plant-plant spacing was maintained 15 cm. Line was made with the help of adjustable row marker or with the help of locally available small spade. The recommended doses of fertilizers (RDF) was applied @ 20:60:40 kg NPK/ha with sources of DAP and MOP during the time of sowing as basal. After the germination of green gram, paddy straw was kept in between the row to conserve the soil moisture and suppress the weed growth. If necessary, weeding was done to field free from weed up to 35 days. Neem oil was sprayed @ 3-4 ml per litre of water to manage the insect pest and disease problem at interval of 7-10 days. The green gram crop was matured in 75 days and matured pod were picked up, threshed and yield was calculated. After the harvesting of green gram soil fertility (SOC, available, N, P & K) status was estimated as per the standard procedures.

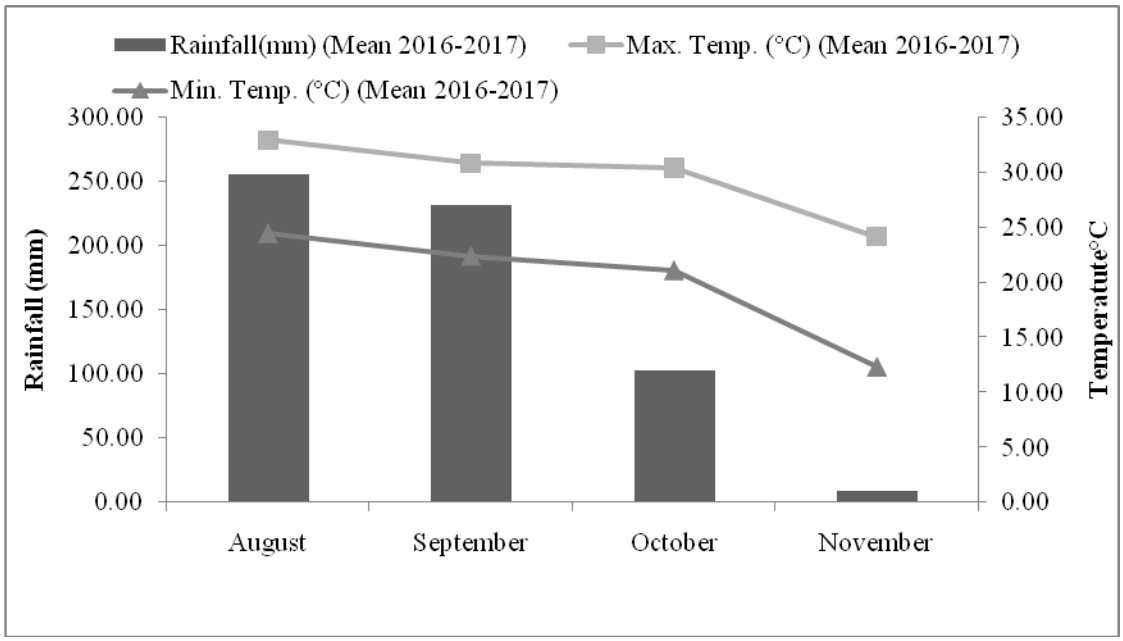

Fig. 1. Weather parameters during the pulse crop

Rice equivalent yield (REY) of green gram was calculated on price basis. Rice equivalent yield (REY) was estimated using formula:

$$\text{REY of system} = \text{Yield of rice} + \text{yield of green gram} \times \frac{\text{Price of green gram}}{\text{Price of rice}}$$

Land use efficiency (LUE) was obtained by dividing total number of days occupied by different crops by 365 days and multiplying with 100. System profitability in terms of kg/ha/day was obtained by net returns of the sequence

divided by total duration of crop sequences (Rautaray, 2005).Economics and REY were computed at prevailing market price during both the year for different commodities.

RESULTS AND DISCUSSION

Result revealed that rice yield was ranges from 1710-1910 kg/ha (mean: 1820 kg/ha) before the adoption of technology at farmers field. Green gram crop was harvested and mean seed yield was recorded 920 kg/ha. Rice equivalent yield (REY) of green gram was recorded 4007 kg/ha. REY of system was recorded 5987 kg/ha and 1850 kg/ha with *Jhum* rice- green gram and *Jhum* rice-fallow. System productivity and Land use efficiency were recorded 25.80, 11.40 kg/ha/day and 64.70 %, 44.10 % under *Jhum* rice-green gram and *Jhum* rice-fallow respectively. This might be due to inclusion of second crop in the system. Crop diversification utilized land efficiently throughout years, which will not only enhance profitability but also generate more employment to the farmers during lean period. Cropping system analysis not only illustrates current land use but also it reflects how the land pattern has been changed over the time (Gangwar and Ram, 2005). Mishra *et al.* (2007) also obtained higher productivity with inclusion of vegetables and pulses in rice based cropping systems Sharma *et al.* (2004) has also reported that intensification of vegetables and legumes crops increase the LUE. Rice equivalent yield of green gram and system productivity of Jhum rice-green system was also reported by Kumar *et al.* (2018).

Table 1. Yield and system productivity under Jhum rice

Crop / Enterprise	Rice Yield kg/ha	Pulse yield (kg/ha)	REY of pulse kg/ha	System REY (Kg/ha)	System productivity (kg/ha/day)	LUE (%)
Rice-fallow	1850 ± 103.4	-	-	1850 ± 103.4	11.40 ± 0.56	44.10 ± 0.28
Rice-green gram	1980 ± 81.9	920 ± 108.20	4007± 470.2	5987 ± 552.6	25.80 ± 2.39	64.70 ± 0.78

Table 2. Economics of the system under Jhum rice

Crop / Enterprise	Net income (Rs/ha)	B:C ratio	System profitability (Rs/ha/day)	Energy Input (MJ/ha)	Energy output (MJ/ha)	Out/ input ratio	Net energy (MJ/ha)	Energy productivity (Kg/MJ)	Energy profitability (Rs/MJ)
Rice-fallow	5680	1.32	35.06	5716.8	46250	8.09	40533.2	0.32	7.0
Rice-green gram	33183	1.76	143.00	10477.2	149675	14.29	139197.8	0.57	13.2

Table 3. Effects on soil properties under rice green gram cropping sequences

	SOC (%)	Available N (Kg/ha)	Available P (Kg/ha)	Available K (Kg/ha)
Rice- fallow	1.25± 0.13	317.8 ±36.4	12.93± 2.6	173.4 ± 6.4
Rice- green gram	1.29 ± 0.09	341.2 ± 27.6	14.6 ± 1.8	186.7 ± 7.2
Initial	1.24	315.6	11.7	171.3

Net profit was recorded Rs. 5680/ha in *Jhum* rice-fallow, whereas Rs. 33183/ha with *Jhum* rice - green gram system. *Jhum* rice - green gram system recorded additional income of Rs. 27503/ha than *Jhum* rice-fallow. Benefit cost ratio and system profitability were found 1.32, 1.76 and Rs. 35/ha/day, Rs 143/ha/day with *jhum* rice-fallow and *jhum* rice-green gram system. Maximum profitability might be due to inclusion of green gram in *Jhum* rice-fallow. This result was conformity with the findings of Kumar *et al.*, 2018.

Energy analysis is the tool for judging the efficiency of treatments (Yadav *et al.*, 2018). A treatment is considered more efficient when it produces higher energy output with less energy input. Highest energy input, energy output, input /output ratio, net energy, energy productivity and energy profitability were recorded 10477.2 MJ/ha, 149675 MJ/ha,14.29, 139197.8 MJ/ha, 0.57 Kg/MJ and 13.20 Rs/MJ with rice-green gram cropping system as compared to rice-fallow (Table 2). This might be due to respective treatment, energy input was the minimum and comparatively higher output was noted (Kumar *et al.*, 2017). Soil fertility status was improved after the cultivation of green gram in *Jhum* rice -fallow due to nitrogen fixation through nodulation and leaf fall. Higher soil organic carbon, available N, P and K were recorded 1.29 %, 341.2 kg/ha, 14.6 kg/ha and 186.7 kg/ha with *Jhum* rice-green gram as compared to rice-fallow (table 3) and initial status of soil. Percentage increase in SOC, available N, P & K by 4 %, 8 %, 25 % and 10 % with *Jhum* rice-green gram as compared to initial status of soil fertility. This result was conformity with the findings of Kumar *et al.*, (2018) and Das *et al.*, 2017.

Mulching with paddy straw

Bumper crop of Green gram

Field Day of Green gram

Picking of Green gram pod

Fig. 2. Glimpses of activities

CONCLUSIONS

It could be concluded that Green gram is an option for growing in residual soil moisture just after harvesting of *Jhum* rice not only in Longleng, but also in all the *Jhum* land where similar climate is existing for getting additional income of the farmers and also enhance the soil fertility status which ultimately increase the yield of succeeding rice/green gram crop.

REFERENCES

Anonymous, 2014. Hand Book of Nagaland. Department of Agriculture, Govt. of Nagaland.

Das, A., S, Babu., G.S. Yadav, M.A. Ansari, R. Singh, L.K. Baishya, D.J. Rajkhowa and S.V. Ngachan. 2016. Status and strategies for pulses production for food and nutritional security in north-eastern region of India. *Indian Journal of Agronomy*, 61: 43-57

Das, A., D.P. Patel, M. Kumar, G.I. Ramkrushna, A. Mukherjee, J. Layek, S.V. Ngachan, and J. Buragohain. 2017. Impact of seven years of organic farming on soil and produce quality and crop yields in Eatsern Himalayas, India. *Agriculture, Ecosystems and Environment*. **236**: 142-153. http://dx.doi.org/10.1016/j.agee.2016.09.007**.**

Gangwar, B. and Ram Baldev. 2005. Effect of crop diversification on productivity and profitability of rice (*Oryza sativa*) - wheat (*Triticum aestivum*) systems. *Indian journal of Agricultural Sciences.* **75**: 435-438.

Kumar, R., M.K. Patra, A. Thirugnanavel, D. Chatterjee and B.C. Deka. 2016. Towards the natural resource management for resilient shifting cultivation system in eastern Himalayas. pp: 409-436. Conservation Agriculture: An Approach to Combat Climate Change in Indian Himalaya Editor, Bisht J.K, Meena V.S, Mishra P.K and Pattanayak A, ISBN: 978-981-10-2557-0(Print) 978-981-10-25587(Online),http://link.springer.com /book/10.1007/978-981 -10-2558-7**.**

Kumar, M., K.L. Meena, D.J. Rajkhowa, L.K. Baishya and A. Namei. 2018. Incresing the cropping intensity and income of *Jhum* farmers through crop diversification in Longleng District of Nagaland. Paper presentd in National Extension Education Congress at CAPHET, Sikkim (CAU Imphal) during 15-17th November, 2018. Page No.199.

Kumar, M., D.J. Rajkhowa, K.L. Meena, P.K. Zeliang, E. Lireni, R. Kikon, K. Lily and A. Namei. 2017. Effect of nutrient management in lowland rice for improving the productivity, profitability and energetic under the mid hill altitude of Nagaland. *Journal of Agri Search*, **4**(4):247-250**.**

Mishra, M.M., S.S., Nanda, M. Mohanty, K.C. Pradhan and S.S. Mishra. 2007. Crop diversification under rice-

based cropping systems in western Orissa.(In:)Extended Summaries of 3rd National Symposium on Integrated farming systems and its role towards Livelihood Improvement, Organised by Farming System Research and Development Association,26-28 October, Agricultural Research Station, Durgapur, Jaipur. Pp.154-56.

Rautaray, S.K. 2005. Effect of mulching on yield and economics of rainfed rice (*Oryza sativa*) - based cropping sequence in lower Assam. *Indian Journal of Agronomy*, **50:** 13-15**.**

Sharma, R.P., S.K. Pathak, Haque and K.R. Raman. 2004. Diversification of Traditional rice (*Oryza sativa*) - based cropping systems for sustainable production in South Bihar alluvials plain. *Indian Journal of Agronomy*, **49**(4): 218-22**.**

Yadav, G.S., A. Das, R. Lal, S. Babu, R.S. Meena, P. Saha, R. Singh and M. Datta. 2018. Energy budget and carbon footprint in a no-till and mulch based rice–mustard cropping system. *Journal of Cleaner Production*, **19**: 144-157.

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