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Influence of land configuration on crop yield of *kharif* Groundnut (*Arachis hypogaea*) based cropping sequence under rainfed upland situation

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Abstract

A field experiment entitled “Influence of land configuration on crop yield of *kharif* Groundnut (*Arachis hypogaea*) based cropping sequence under rainfed upland situation” was carried out during *kharif* and *rabi* season of 2023-2024 at Research experimental field of the All India Coordinate Research project on Dryland, Biswanath College of Agriculture, Assam Agricultural University, Biswanath chariali, Assam. The experiment was laid out in split plot design with three replications comprising twelve treatment combination with four main plots of land configuration practices *i.e.* M1: BBF 90cm × 30cm, M2: BBF 120cm × 30cm, M3: BBF 150cm × 30cm, M4: Flatbed and three Sub plots of crop sequence *i.e.* C1: *Kharif* groundnut-toria, C2: *Kharif* groundnut-pea, C3: *Kharif* groundnut- rajmah. Treatment with the bed size BBF 150cm × 30cm recorded the maximum values of yield attributing parameters *viz.* number of branches plant⁻¹, number of pod plant⁻¹, pod yield (33.89 qha⁻¹) and stover yield (72.73 qha⁻¹) and harvest index (31.80 %) in groundnut. The flatbed recorded the lowest pod yield (29.06 qha⁻¹), stover yield (67.22 qha⁻¹) and harvest index (30.18%) in groundnut. The influence of the land configuration practices and groundnut-based cropping sequence were also evaluated in terms of chemical properties of the soil. The impact of land configuration practices and groundnut-based cropping sequences was also determined in terms of basic crop biometrics, soil chemical characteristics and economics of the practices. The treatment BBF 150cm x 30cm had the highest groundnut equivalent yield compared to the other treatments. The system duration and land utilization index did not differ significantly amongst land configuration methods. The BBF 150cm x 30cm recorded significantly higher production efficiency and rain water productivity of the system. The highest cultivation cost was recorded under BBF 90cm x 30cm whereas gross return, net return, B:C ratio and economic efficiency were recorded under BBF 150cm x 30 cm. Crop sequences *Kharif* Groundnut-rajmah outperformed the two crop sequences, *Kharif* Groundnut-pea and *Kharif* Groundnut-toria, in terms of growth, yield characteristics and yield. The sequence *Kharif* Groundnut-toria produced the lowest value. Crop sequences had no significant effect on system duration or the land utilization index. *Kharif* Groundnut-Rajmah produced a higher production efficiency and rainwater productivity than the other sequences. The crop sequence had little favorable impact on soil chemical characteristics, with the exception of nitrogen, which was found to be significant across all sequences. *Kharif* Groundnut-rajmah exhibited the highest gross return, net return, economic efficiency and B:C ratio among the sequences. Thus groundnut-rajmah was the best performing crop sequence in terms of system yield, production efficiency, and economic return, followed by the groundnut-pea sequence.

Keywords: BBF, Land configuration, Cropping sequence, *Kharif* groundnut, Economic efficiency

Introduction

Rainfed agriculture is most common form of agriculture in India, covering about 92.8 million hectares, which accounts for nearly 65% of the net sown area. It provides 44% to the country's food grain production (Gangwar *et al.* 2012) ^[8] thereby playing a crucial role in the national economy and food security. Rainfed agriculture is widely practiced in Assam where farmers depend entirely on rainfall for crop water requirements. Therefore, proper planning and crop management strategies based on regional rainfall patterns are essential for maintaining reasonable crop yields under *rainfed* conditions (Deka and Nath, 2000) ^[7]. Land surface management techniques such as raised and sunken beds, ridge and furrow, and broad bed and

furrow (BBF) systems have shown considerable potential in regulating surface runoff, reducing soil erosion, and improving water infiltration. By reducing runoff velocity, the BBF system increases the opportunity time for water infiltration and minimizes sediment losses. In addition, furrows facilitate the safe drainage of excess water during the periods of heavy rainfall thereby preventing waterlogging and congestion around crop root zones (Borde *et al.* 2022) ^[4]. The broad bed furrow (BBF) method is an emerging land configuration practice in *rainfed* farming system as it conserves moisture during dry periods while effectively draining excess water through furrows during heavy rainfall. (Baruah *et al.* 2021) ^[1]

Groundnut (*Arachis hypogaea* L.) is an important food legume found in tropical and subtropical regions. It is commonly known as peanut, monkey nut, earth nut due to its underground growth. Groundnut is mostly grown in countries like Brazil, Argentina, Senegal, Indonesia, Nigeria, China, India and USA (Singh *et al.* 2004) ^[15]. Often referred to as the "King of Oilseeds," groundnut ranks as the 2nd most produced oilseed in India and the 3rd most in the world. India is the world's greatest producer of groundnuts in terms of area and ranked 2nd in production. In Assam, major oilseed crops include rapeseed, mustard and sesamum which occupy a substantial proportion of the oilseed area. Although groundnut is cultivated on a relatively small scale in the state, it has considerable potential for expansion, particularly in the Brahmaputra riverbed ("char") areas.

Cropping sequences involve the cultivation of different crops such as cereals, pulses, oilseeds etc in a planned order on the same field over time. A cropping sequence refers to the successive cultivation of crops on a given area within a defined period. Well-designed cropping systems often include complementary crop combinations, wherein a beneficial crop enhances soil fertility and resource use efficiency, while an exploitative crop optimizes overall productivity.

Keeping all the above aspects into consideration, an investigation was made to study the "Effect of land configuration on *kharif* Groundnut (*Arachis hypogaea*) based cropping sequence under *rainfed* upland situation" with the following three broad objectives:

- Study the effect of Broad Bed Furrow (BBF) as land configuration in groundnut based cropping sequence
- Identify suitable groundnut based cropping sequence (s) in *rainfed* upland situation
- Study the effect of treatments on soil moisture and soil nutrient status

Materials and Methods

The field experiment was conducted at the experimental field of All India Coordinated Research Project for Dryland Agriculture, Biswanath College of Agriculture, Biswanath Chariali, Assam Agricultural University, during *kharif* and *rabi* seasons of 2023-24. The experimental site is situated at 26° 43' 30" N latitude and 93° 08' 0" E longitude having an elevation of 86.70 m above mean sea level. The climatic condition of Biswanath Chariali of Biswanath district under North Bank Plain Zone (NPBZ) of Assam as a whole is sub-tropical having hot and humid summer, dry and cool winter and high relative humidity. The total rainfall received during crop growth period (*kharif* and *rabi* season) was 678.70 mm. The number of rainy days was 44 during the crop growing period of both the season. The weekly averaged maximum and minimum temperature ranged from 22.99°C to 36.64°C and 9.77°C to 27.10°C_m, respectively.

The soil of the experiment was sandy loam in texture and the initial available soil nitrogen, phosphorus and potassium were in

the range 388.86 kg ha⁻¹, 16.83 kg ha⁻¹ and 164.45 kg ha⁻¹ respectively. The experimental field was laid out into three blocks and each block was divided into four main plots to allocate the four land configuration practices randomly, for growing *kharif* (groundnut) and *rabi* (toria, pea and rajmah) crops in sequence, following the principles of Split plot design. The layout of the experiment consisting of the broad bed furrows at 90 cm, 120 cm and 150 cm apart with 30 cm width furrow in between them were constructed manually along with the flatbeds before sowing of groundnut. The main plots were divided into three sub-plots in *rabi* season to allocate the *rabi* crops randomly following a split-plot design and *kharif* groundnut crops were analysed in RBD.

In *rabi* season, after harvest of groundnut, all the plots in each block were prepared manually, retained the broad bed furrows and sub-plots and three *rabi* crops viz. toria, pea and rajmah were allocated following a split-plot design. However, due to dissimilarity in biometric observations on different *rabi* crop parameters, only average value of yield attributes and yield were recorded for the *rabi* crops. The yield parameter was converted into groundnut equivalent yield after harvesting of the *rabi* crops. The parameters for cropping system are determined by following formula:

Groundnut Equivalent Yield (GEY) of *Rabi* Crops: The seed yields of *rabi* crops (toria, pea, and rajmah) were converted into groundnut equivalent yield using the following formula:

$$\text{GEY (kg ha}^{-1}\text{)} = G_y + \left(C_{1y} \times \frac{P_{c1}}{P_g} \right) + \left(C_{2y} \times \frac{P_{c2}}{P_g} \right)$$

where:

- G (y) = yield of groundnut (kg ha⁻¹)
- P (g) = market price of groundnut (Rs kg⁻¹)
- C (1y) = yield of *kharif* crop (kg ha⁻¹)
- C (2y) = yield of *rabi* crop (kg ha⁻¹) converted into groundnut equivalent
- P (c1) = market price of *kharif* crop (Rs kg⁻¹)
- = market price of *rabi* crop (Rs kg⁻¹)

Land Utilization Index (LUI)

$$\text{LUI (\%)} = \frac{\text{TND}}{365} \times 100$$

where:

- TND = total number of days the field remained occupied by different crops in a year

Production efficiency (PE): The production efficiency (PE) indicates production of a cropping system per day in a unit area which is calculated by the formula

$$\text{PE (kg ha}^{-1} \text{ day}^{-1}\text{)} = \frac{\text{GEY (kg ha}^{-1}\text{)}}{\text{Duration of the cropping system (days)}}$$

Rainwater Productivity (RWP)

$$\text{RWP (kg ha}^{-1} \text{ mm}^{-1}\text{)} = \frac{\text{GEY (kg ha}^{-1}\text{)}}{\text{Total rainfall received during the cropping system (mm)}}$$

Efficiency (EE): Economic efficiency was calculated to compare the profitability of different cropping systems.

$$EE (Rs ha^{-1} day^{-1}) = \frac{\text{Net return of the cropping system (Rs ha}^{-1})}{\text{Total duration of the cropping system (days)}}$$

Result and Discussion

Effect of land configuration practices on *kharif* groundnut

Yield attributes: The yield attributes viz. branch plant-1 and pod plant-1 (Table 1) of *kharif* groundnut due to different land configuration practices differed significantly. The effect of the treatments BBF 150-30cm on branch plant-1 with was found maximum which is significantly at par with treatment BBF 120-30cm and BBF 90-30cm with and flatbed was found minimum. In respect to number of pod plant-1 maximum and minimum was recorded in BBF 150-30cm and flatbed respectively and former one is statistically at par with BBF 120-30cm with. The number of branch plant-1 and the number of pod plant-1 were significantly influenced by different land configuration practices. Among the treatments, BBF 150-30 cm recorded superiority in all parameters whereas flatbed recorded the lowest value. This best result obtained might be due to the fact of loose soil surface which helped better root growth and development thereby giving room for efficient accessibility of water and nutrients. These findings are in close agreement with Kamble *et al.* (2016) [9] who reported that the broad bed furrow created a loose soil structure with sufficient moisture retention, providing favourable conditions for peg penetration and pod development. Similarly, higher pod plant-1 under furrow methods of planting (Chowdary *et al.*, 2022) [6] may be due to effective drainage of excess rainfall through furrows.

Pod and Stover Yield: Data on pod yield and stover yield of *kharif* groundnut as influenced by different land configuration (Table 2). Results revealed that pod yield under the treatment BBF 150-30cm was produced significantly higher pod yield which is followed by BBF 120-30cm and BBF 90-30cm. While the lowest pod yield was recorded under the flat bed method of sowing. In respect to stover yield, BBF 150-30cm resulted in higher value which is at par with BBF 120-30cm and BBF 90-30cm and flatbed recorded the least stover yield. BBF 150-30cm recorded the highest pod yield and stover yield which were significantly superior to all other treatments. The increase in both pod yield and stover yield under BBF may be attributed due to loose and well-aerated seedbed which facilitated effective peg penetration and pod development, as groundnut pods develop underground. Similar increases in yield under broad bed furrow systems due to improved soil conditions have also been reported by Sathiya *et al.* (2020) [14]. The broad bed furrow provided a loose soil mass with adequate soil moisture, thereby creating favourable conditions for crop growth. Furthermore, a positive correlation between water use efficiency and pod yield has been reported by Bharade *et al.* (2019) [2] supporting the yield advantage observed under BBF.

Effect of land configuration practices on Toria

Yield attributes and yields: The number of branch plant-1, number of siliqua plant-1, number of seed siliqua-1, test weight, seed yield, stover yield and harvest index of toria were recorded highest in T₇ (BBF 150-30cm, GN-Toria) which was followed by T₄ (BBF 120-30cm, GN-Toria). While, T₁₀ (BBF Flat bed, GN-Toria) maintain the lowest number of branch plant-1, number of siliqua plant-1, number of seed siliqua-1, test weight, seed yield, stover yield, biological yield and harvest index as shown in table 3 and 4.

Effect of land configuration practices on Pea

Yield attributes and yields: The highest number of branch plant-1, number of pod plant-1, number of seed pod-1, seed

index, pod yield, stover yield and harvest index of pea were found in T₈ (BBF 150-30cm, GN-Pea) which was followed by T₅ (BBF 120-30cm, GN-Pea). While, the lowest number of branch plant-1, number of pod plant-1, number of seed pod-1, seed index, pod yield, stover yield and harvest index were found in T₁₁ (BBF Flat bed, GN-Pea) as shown in table 3 and 4.

Effect of land configuration practices on Rajmah

Yield attributes and yields: The maximum number of branch plant-1, number of pod plant-1, number of seed pod-1, seed index, pod yield, stover yield and harvest index of rajmah were found in T₉ (BBF 150-30cm, GN-Rajmah) which was followed by T₆ (BBF 120-30cm, GN-Rajmah) and the minimum number of branch plant-1, number of pod plant-1, number of seed pod-1, seed index, pod yield, stover yield and harvest index of rajmah were found in T₁₂ (BBF Flat bed, GN-Rajmah) as shown in table 3 and 4.

Performance of toria, pea and rajmah

The data recorded on *rabi* crops viz. toria, pea and rajmah revealed that the yield attributes as well as the yield of different *rabi* crops were comparatively higher in all the BBF. Among the land configurations, BBF150-30cm produced the highest yields followed by BBF 120-30cm and BBF 90-30cm flat bed recorded the lowest values. The higher residual soil moisture content under BBF treatments might have contributed to the superior performance of *rabi* crops compared to the flat bed. The BBF system improved soil moisture retention and nutrient availability by directing runoff water into furrows and reduced water stress. Consequently, crops experienced a more favourable growing environment, leading to improved performance, as also reported by Choudhary and Bhagawati, (2019) [5].

Impact of land configuration practices and *kharif* groundnut-based cropping sequence

Groundnut equivalent yield of *rabi* crops

The groundnut equivalent yield (GEY) was computed and are presented in table 5. GEY were significantly influenced by different land configuration practices. The highest GEY was recorded under BBF 150-30cm while the lowest value was observed under flatbed methods. The higher GEY under BBF treatments may be attributed to improve residual soil moisture availability, which subsequently enhanced the yield of component crops in the cropping sequence. This, in turn, contributed to higher groundnut equivalent yield under these treatments. Similar findings were reported by Tumbare and Bhoite (2000) [16], where maximum chickpea equivalent yield was recorded with ridges and furrow method of sowing over other methods.

The GEY also varied significantly among different crop sequences. The GEY of *kharif* Groundnut-rajmah was significantly higher than that of *kharif* Groundnut-pea and *kharif* Groundnut-toria. Since groundnut was the base and uniform crop across all sequences, variations in GEY were mainly influenced by the yield performance of the succeeding *rabi* crops, particularly *kharif* Groundnut-rajmah. In addition, the higher production potential and better market price of rajmah compared to other *rabi* crops contributed substantially to the higher GEY under this sequence. These findings are in conformity with those of Reddy and Suresh (2009) [13]. Furthermore, according to Pacharne *et al.* (2015) [12] the increase GEY may be attributed to the favorable residual effect of *kharif* groundnut, which fixes atmospheric nitrogen through biological processes and enhances nutrient availability for the succeeding crop through mineralization of crop residues, increasing the yield of the subsequent crop.

Groundnut equivalent yield of the system (q ha⁻¹)

Total system yield was significantly influenced by different land configuration practices as shown in table 5. System yield was calculated by adding the groundnut yield with the groundnut equivalent yield of the *rabi* crops. The highest total system yield was recorded under BBF 150- 30cm whereas the lowest was observed under the flatbed. Among the cropping sequences *kharif* Groundnut-rajmah performed the best followed by *kharif* Groundnut- pea sequence while the lowest system yield was recorded under the *kharif* Groundnut-toria. Similar findings were also reported by Pacharne *et al.* (2015) ^[12].

Production efficiency

It was observed that the production efficiency (PE) of different cropping systems due to different land configuration practices had a significant impact (Table 7). The highest value was recorded under BBF 150-30cm and the lowest was under flatbed. The increased yield of individual crops as well as their groundnut equivalent yield under the BBF 150-30 cm directly had a positive influence in resulting higher production efficiency of the groundnut-based cropping sequence under the said treatment.

The production efficiency differed significantly among the cropping sequences. The maximum production efficiency was recorded under *kharif* Groundnut-rajmah which was significantly superior to the other cropping sequences whereas *kharif* Groundnut-toria sequence registered the lowest production efficiency. The contributions of higher groundnut equivalent yield in *kharif* Groundnut-rajmah sequence was evident when compared to the other sequences, resulting in the highest production efficiency under this cropping sequence. The present findings are in agreement with the findings of Borate *et al.* (2023) ^[3] who reported maximum system production efficiency in the sweet corn- rajmah cropping sequence.

Rain water productivity

Different land configuration practices brought about significant variation in rainwater productivity of groundnut-based cropping systems (Table^[7]). BBF 150-30cm recorded the highest rainwater productivity compared to other treatments whereas the lowest value was recorded under the flat bed. The higher rainwater productivity under BBF 150-30cm may be attributed to increased soil moisture availability and higher groundnut equivalent yield of different crops under this treatment.

Among the different groundnut-based cropping sequences *kharif* Groundnut-rajmah registered significantly higher rainwater productivity while *kharif* Groundnut-toria showed the lowest values. The higher seed yield coupled with greater moisture availability under the *kharif* Groundnut-rajmah cropping system might have contributed to its superior rainwater productivity

Effect of land configuration practices and cropping sequences on soil moisture content

Effect of land configuration practices and cropping sequences on soil moisture content and available NPK

The data pertaining to soil moisture (Table 8) was recorded during the *rabi* season at 10 days interval as influenced by different land configuration practices and cropping sequence. The soil moisture did not exert any significant variation among the treatments. However, BBF 90-30cm recorded the highest moisture content followed by BBF 120- 30cm and BBF 150-30cm compare to flat bed method. This trend is illustrated in Figures 1 and 2, where variations in the curves reflect changes in soil moisture content during the *rabi* cropping period. During

that period more conserved moisture was recorded in all the beds irrespective of size as compare to flat bed. Among the broad bed furrows, higher moisture content under BBF 90-30cm may be attributed due to the greater number of furrows as compared to other bed sizes.

Available nitrogen, phosphorus, and potassium contents at the end of the cropping sequence, as presented in Table 9, differed significantly due to different land configuration practices. Flatbed reveal the highest N, P, K while the lowest value was observed under BBF 150-30cm. This may be attributed to greater nutrient and water uptake by crops under BBF treatments, resulting in higher yields. Similar findings were reported by Mandal *et al.* (2019) ^[11] that increased production was associated with higher nitrogen uptake, indicating that a combination of higher irrigation regime and soil N treatment resulted in enhanced uptake due to optimal accessible moisture and nitrogen to the groundnut crop.

Cropping sequences did not significantly influence the available phosphorus or potassium levels at the end of the cropping sequence except for nitrogen (Table 9). Among the cropping sequences, *kharif* groundnut-pea resulted in significantly higher available nitrogen compared to groundnut- toria and groundnut-rajmah. This increase may be attributed to the ability of legumes to enhance soil fertility through symbiotic association with microorganisms such as *Rhizobium* which fix atmospheric nitrogen and make it available to the host plant and subsequent crops through biological nitrogen fixation. This results are in conformity with the findings Kebede (2021) ^[10].

Economics of land configuration practices and *kharif* groundnut-based cropping sequences

The economics (Table 10) of the *kharif* groundnut- based cropping sequence were significantly impacted by various land configurations. The treatment BBF 90-30cm incurred the highest cost of cultivation followed by BBF 120-30cm and BBF 150-30cm. This was mainly due to the expense of creating wide bed furrows in accordance with closure, the enlarged bed sizes and the labour requirement. In contrast, flat bed method recorded the lowest cultivation cost.

BBF 150-30 cm registered significantly higher gross return, net return and benefit cost ratio compare to other methods of planting. The higher gross return, net return and benefit-cost ratio were attributed to higher yields of *kharif* groundnut-rajmah. Similar findings were reported by Borde *et al.* (2022) ^[4] where superior economic returns under the broad bed furrow method compared to conventional and flat bed methods of sowing

Among the cropping sequences, *kharif* Groundnut-rajmah recorded the highest cost of cultivation, gross return and net return followed by the crop sequence *kharif* Groundnut-pea while the lowest was recorded *kharif* Groundnut-toria. However, the differences in B: C ratios due to different crop sequences. The higher gross and net return under *kharif* Groundnut- rajmah was mainly due to higher production potential and better market price of rajmah. Similar trends were reported by Borate *et al.* (2023) ^[3] where among different cropping sequences, sweet cornrajmah cropping sequence contributed higher net returns and B: C ratio.

The economic efficiency was recorded the highest in BBF 150-30cm followed by BBF 120-30cm while the lowest economic efficiency was recorded under flat bed. The higher yield of the individual crops which led to generate higher net returns under the treatment BBF 150- 30cm which directly contributed to higher economic efficiency under the said treatments.

Among the crop sequences, *kharif* Groundnut-rajmah showed

the highest economic efficiency compared to other crop sequences, mainly due to its shorter crop duration coupled with higher net return of rajmah. Similar finding was also reported by

Borate *et al.* (2023) [3]. The lowest economic efficiency was obtained under *kharif* Groundnut-toria.

Table 1: Effect of land configuration practices on yield attributes of *kharif* groundnut

Treatment	Branches plant -1	Pods plant -1	Seeds pod-1	Seed index (g)
Land configuration practices				
M1: BBF 90 cm x 30cm	7.11	35.82	1.85	43.23
M2: BBF 120 cm x 30cm	8.11	40.57	2.30	44.07
M3: BBF 150 cm x 30cm	8.22	42.45	2.93	45.04
M4: Flat bed	6.63	35.44	1.96	43.13
SEd ₊	0.48	1.33	0.42	0.98
CD (P=0.05)	1.19	3.32	NS	NS

Table 2: Effect of land configuration practices on pod yield, stover yield and harvest index of *kharif* groundnut

Treatment	Pod yield (q ha-1)	Stover yield (q ha-1)	Harvest index (%)
Land configuration practices			
M1: BBF 90 cm x 30cm	30.17	69.17	30.37
M2: BBF 120 cm x 30cm	32.72	70.94	31.56
M3: BBF 150 cm x 30cm	33.89	72.73	31.78
M4: Flatbed	29.06	67.22	30.18
SEd ₊	0.29	0.74	0.37
CD (P=0.05)	0.72	1.85	0.93

Table 3: Yield attributes of *rabi* crops under *kharif* groundnut-based cropping sequences

Treatment combination	Branches plant-1	Siliquea plant-1/Pod plant-1	Seeds siliquea-1/Seed pod-1	Test wt.(g)/Seed index (g)
T1: BBF 90-30cm, GN-Toria	3.44	118.67	16.03	2.90
T2: BBF 90-30cm, GN-Pea	2.76	6.20	5.87	31.45
T3: BBF 90-30cm, GN-Rajmah	3.20	5.13	3.53	43.64
T4: BBF 120-30cm, GN-Toria	3.58	133.72	16.43	2.94
T5: BBF 120-30cm, GN-Pea	2.83	6.64	6.07	32.70
T6: BBF 120-30cm, GN-Rajmah	3.67	5.40	3.60	44.00
T7: BBF 150-30cm, GN-Toria	4.17	149.40	17.47	3.00
T8: BBF 150-30cm, GN-Pea	3.04	7.53	6.47	33.37
T9: BBF 150-30cm, GN-Rajmah	4.09	6.28	4.07	44.95
T10: BBF Flat bed, GN-Toria	3.35	107.33	15.80	2.88
T11: BBF Flat bed, GN-Pea	2.57	5.73	5.13	31.25
T12: BBF Flat bed, GN-Rajmah	3.07	4.77	3.13	43.14

#Siliquea parameters apply to toria; pod parameters apply to pea and rajmah.

Table 4: Seed/pod yield, Stover yield and harvest index of *rabi* crops under *kharif* groundnut-based cropping sequences

Treatment combination	Seed/pod yield (q ha-1)	Stover yield (q ha-1)	Harvest Index (%)
T1: BBF 90-30cm, GN-Toria	7.67	18.53	29.26
T2: BBF 90-30cm, GN-Pea	8.67	24.71	25.97
T3: BBF 90-30cm, GN-Rajmah	12.53	20.81	37.59
T4: BBF 120-30cm, GN-Toria	9.17	21.07	30.32
T5: BBF 120-30cm, GN-Pea	9.83	27.71	26.19
T6: BBF 120-30cm, GN-Rajmah	13.17	21.78	37.67
T7: BBF 150-30cm, GN-Toria	9.50	21.60	30.55
T8: BBF 150-30cm, GN-Pea	10.17	28.47	26.32
T9: BBF 150-30cm, GN-Rajmah	14.17	23.39	37.72
T10: BBF Flat bed, GN-Toria	6.33	16.70	27.50
T11: BBF Flat bed, GN-Pea	7.50	23.38	24.29
T12: BBF Flat bed, GN-Rajmah	10.50	17.98	36.86

Table 5: Effect of land configuration practices and crop sequences on groundnut equivalent yield of *rabi* crops and cropping system

Treatment	Groundnut equivalent yield of <i>rabi</i> crops (q ha-1)	Groundnut equivalent yield of the system (q ha-1)
Land configuration practices		
M1: BBF 90 cm x 30cm	10.52	40.69
M2: BBF 120 cm x 30cm	11.61	44.34
M3: BBF 150 cm x 30cm	12.25	46.13
M4: Flatbed	8.89	37.95
SEd ₊	0.48	0.45
CD (P=0.05)	1.20	1.13
Crop sequences		
C1: <i>kharif</i> Groundnut-toria	5.95	37.50
C2: <i>kharif</i> Groundnut-pea	10.70	42.08
C3: <i>kharif</i> Groundnut-rajmah	15.80	47.26
SEd ₊	0.45	0.56
CD (P=0.05)	0.97	1.20

Table 6: Effect of land configuration practices and crop sequences on System duration and Land utilization index

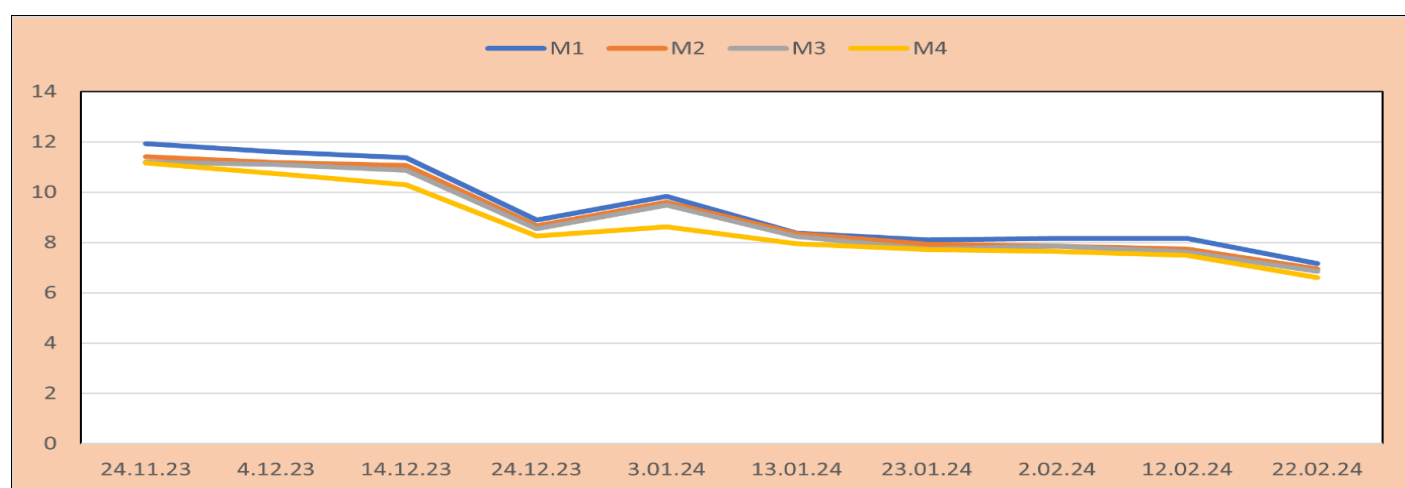
Treatment	System duration (days)	Land utilization index (%)
Land configuration practices		
M1: BBF 90 cm x 30cm	197.33	54.06
M2: BBF 120 cm x 30cm	197.33	54.06
M3: BBF 150 cm x 30cm	197.33	54.06
M4: Flatbed	197.33	54.06
CD (P=0.05)	NS	NS
Crop sequences		
C1: <i>kharif</i> Groundnut-toria	193	52.88
C2: <i>kharif</i> Groundnut-pea	197	53.97
C3: <i>kharif</i> Groundnut-rajmah	202	55.34
CD (P=0.05)	NS	NS

Table 7: Effect of land configuration practices and crop sequences on Production efficiency and Rainwater productivity

Treatment	Production efficiency (kg ha ⁻¹ day ⁻¹)	Rainwater productivity (kg ha ⁻¹ mm ⁻¹)
Land configuration practices		
M1: BBF 90 cm x 30cm	20.60	6.00
M2: BBF 120 cm x 30cm	22.43	6.53
M3: BBF 150 cm x 30cm	23.34	6.80
M4: Flatbed	19.20	5.59
SEd ₊	0.23	0.06
CD (P=0.05)	0.56	0.17
Crop sequences		
C1: <i>kharif</i> Groundnut-toria	19.43	5.53
C2: <i>kharif</i> Groundnut-pea	21.36	6.20
C3: <i>kharif</i> Groundnut-rajmah	23.40	6.96
SEd ₊	0.28	0.08
CD (P=0.05)	0.60	0.18

Table 8: Effect of land configuration practices and *kharif* groundnut-based cropping sequences on soil moisture content (%) at 10 days during *rabi* season

Treatment	24.11.23	4.12.23	14.12.23	24.12.23	3.01.24	13.01.24	23.01.24	2.02.24	12.02.24	22.02.24
Land Configuration practices										
M1: BBF 90 cm x 30cm	11.94	11.60	11.38	8.89	9.84	8.38	8.11	8.16	8.16	7.16
M2: BBF 120 cm x 30cm	11.41	11.19	11.07	8.66	9.60	8.35	7.93	7.86	7.75	6.96
M3: BBF 150 cm x 30cm	11.21	11.10	10.88	8.54	9.49	8.25	7.74	7.85	7.63	6.86
M4: Flatbed	11.17	10.73	10.29	8.26	8.62	7.96	7.73	7.64	7.49	6.60
SEd ₊	0.37	0.27	0.56	0.36	0.62	0.34	0.43	0.18	0.26	0.18
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Crop sequences										
C1: <i>kharif</i> Groundnut-toria	11.48	11.07	10.63	8.53	8.93	8.12	7.55	7.57	7.40	6.81
C2: <i>kharif</i> Groundnut-pea	11.25	11.09	10.92	8.72	9.36	8.24	7.94	7.99	7.74	6.90
C3: <i>kharif</i> Groundnut-rajmah	11.56	11.31	11.16	8.51	9.86	8.34	8.15	8.09	8.14	6.98
SEd ₊	0.25	0.37	0.50	0.25	0.42	0.36	0.31	0.26	0.28	0.17
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

**Fig 1:** Soil moisture content (%) as influence by land configuration practices

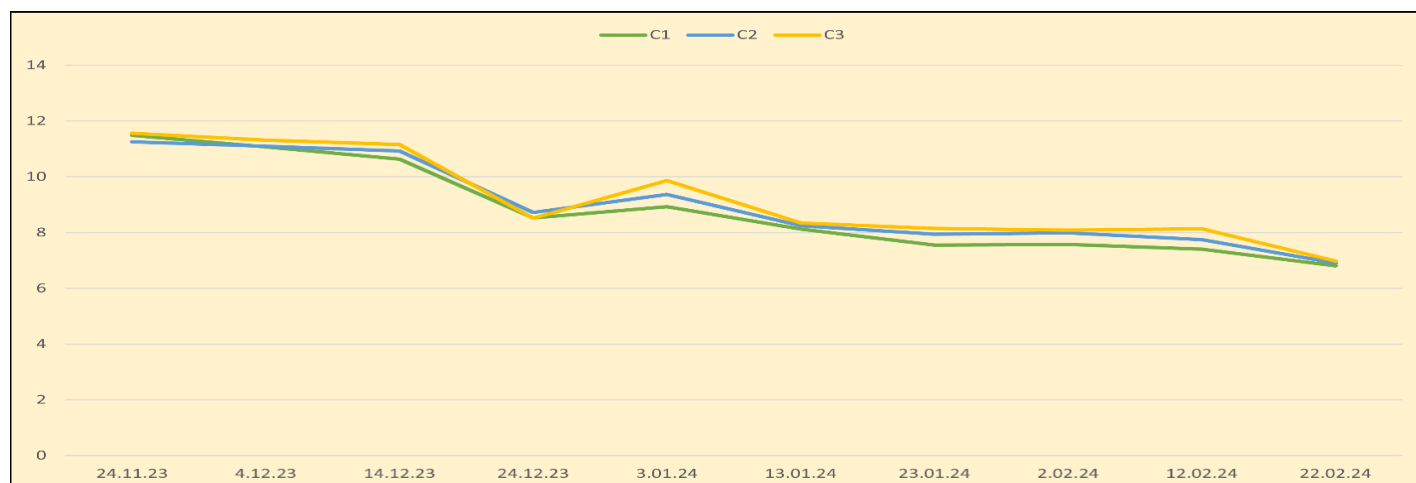


Fig 2: Soil moisture content (%) as influence by crop sequences

Table 9: Effect of land configuration practices and *kharif* groundnut-based cropping sequences on available soil nutrient after completion of cropping sequence

Treatment	Available nutrient (kg ha ⁻¹)		
	N	P	K
Land configuration practices			
M1: BBF 90 cm x 30cm	351.82	11.96	139.87
M2: BBF 120 cm x 30cm	332.70	9.38	95.83
M3: BBF 150 cm x 30cm	330.43	8.10	92.64
M4: Flat bed	361.22	12.67	150.76
SEd+	1.27	0.14	1.69
CD (P=0.05)	3.16	0.35	4.22
Crop sequences			
C1: <i>kharif</i> Groundnut-toria	337.69	10.71	119.69
C2: <i>kharif</i> Groundnut-pea	359.79	10.39	119.57
C3: <i>kharif</i> Groundnut-rajmah	334.64	10.49	120.06
SEd+	2.75	0.19	1.36
CD (P=0.05)	5.88	NS	NS

Table 10: Effect of land configuration and crop sequences on economics of the cropping system

Treatment	Cost of cultivation (Rs ha ⁻¹)	Gross return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Economic Efficiency (Rs ha ⁻¹ day ⁻¹)	B:C Ratio
Land configuration practices					
M1: BBF 90 cm x 30cm	79,055	2,59,489	1,80,433	913.01	3.28
M2: BBF 120 cm x 30cm	77,645	2,82,736	2,05,090	1037.42	3.63
M3: BBF 150 cm x 30cm	76,236	2,94,198	2,17,962	1102.56	3.85
M4: Flat bed	72,007	2,42,014	1,70,006	860.00	3.35
Crop sequence					
C1: <i>kharif</i> Groundnut-toria	71,158	2,39,116	1,67,958	870.25	3.36
C2: <i>kharif</i> Groundnut-pea	76,643	2,68,342	1,91,699	973.10	3.50
C3: <i>kharif</i> Groundnut-rajmah	80,908	3,01,369	2,20,461	1091.39	3.72

Price of groundnut: Rs. 6377/q, Price of toria: Rs. 4650/q, Price of pea: Rs. 7550/q, Price of rajmah: Rs. 8000

Conclusion

Based on the two season of investigation (2023-2024) carried out in the research experimental field of the AICRP on dryland Agriculture, it could be concluded that growing of sequence crops in different land configuration is feasible and

economically beneficial. The land configuration practices of broad bed furrow were effective in relation to yield attributes and yield of *kharif* groundnut and different *rabi* crops (toria, pea and rajmah) grown after *kharif* groundnut. Among the beds, the bed size of BBF 150cm x 30cm was found best. The practice had not only influenced the crop performance but also helped in conserving soil moisture, soil chemical properties along with higher economic return. The *kharif* groundnut-rajmah was the most performing crop sequence in terms of higher system yield with better production efficiency and economic return which was followed by *kharif* Groundnut-pea sequence. Thus, *kharif* Groundnut-pea could also be advocated as an alternative to rajmah in *rabi* season in *rainfed* upland situations of Assam.

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