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PROSPECT OF MULTI-CROPPING WITH TEA IN SMALL HOLDINGS: A CASE STUDY IN ASSAM

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Abstract
Assam the bastion of India's tea industry had its formal beginning of commercial plantation in the hands of British rulers in the year 1835. This industry witnessed still another relatively new phenomenon since the latter half of 1970s when common farmers of rural areas in some Upper Assam districts started tea cultivation in the intermediary spaces of their existing areca-nut and/or orange orchards. The practice of multi-cropping with tea, which requires minimal expenses, is now found to be a most profitable venture as a potential way to supplement the existing farm income of the small tea growers of rural Assam.

The present paper is based on empirical data collected from 448 small tea growers practicing multi-cropping with tea and are operating from the twin upper Assam districts of Dibrugarh and Tinsukia. The paper aims towards attainment of the following objectives:

1. *To highlight the success story of multi cropping with tea in Assam.*
2. *To workout the future prospect of the venture through optimum utilization of resources.*

The study finds that the practice of multi-cropping with tea thrives well, generating high Return on Investment (ROI) for the planters in addition to ensuring high factor productivity. However, the study observes that the existing planters, due to their poor knowledge, fail to utilize the potentials of their gardens by planting ideal plant population of various crops. The study finds that the ROI vary from 281.23 percent to 881.79 percent with average of 489.22 percent while ideal crop combination is adopted. Similarly, factor productivity can also be increased significantly with the practice of multi-cropping as compared to mono cropping. The study suggests the urgent need for training of the planters to gain the most out of multi-cropping practices with tea.

Introduction

Assam the bastion of India's tea industry had its formal beginning of commercial plantation in the hands of British rulers in the year 1835. This industry witnessed still another relatively new phenomenon since the latter half of 1970s when common farmers of rural areas in some Upper Assam districts started tea cultivation in the intermediary spaces of their existing areca-nut and/or orange orchards. This practice of multi-cropping with tea, which requires minimal expenses, is now found to be a most profitable venture as a potential way to supplement the existing farm income of the small tea growers of rural Assam.

Objectives of the Study

1. To highlight the success story of multi cropping with tea in Assam.
2. To workout the future prospect of the venture through optimum utilization of resources.

Scope and Methodology

The study is confined to the Dibrugarh and Tinsukia districts of Assam, as the highest concentration of small tea growers is in these two districts. The study is conducted on primary data collected from a total of 448 sample small tea gardens which includes 242 gardens from Dibrugarh district and 206 from the Tinsukia district. In drawing the sample, all such small gardens were categorized as per their location in Development Block and 5% of gardens from each block is taken for intensive study. The sample gardens were deliberately selected in such a manner that all the crops under cultivation in a multi-cropping garden have produced yield for at least 5 years as on year ending 2012-13, so that a stable record of yield could be obtained for three consecutive years. The field survey was completed in September, 2013.

Varieties of Crops under Multi-Cropping

In Assam, multi-cropping practice with tea is mostly accomplished by using crops like areca-nut, pepper, orange and betel-vine. Commonly found multi-cropping combinations are: Tea+Areca-nut, Tea+Orange, Tea+Areca-nut+Pepper, Tea+Areca-nut+Betel-vine, Tea+Areca-nut+Pepper+Orange, Tea+Areca-nut+Betel-vine+Orange, Tea+Areca-nut+Pepper+Betel-vine, Tea+Areca-nut+Pepper+Betel-vine+Orange.

Prospect of Small Tea Cultivation with Multi-Cropping

Prospect based on gain in factor productivity

The prospect of small tea cultivation with multi-cropping is analyzed in the present section of the study on the basis of gain in productivity of land, labour and capital employed by the sample growers as presented in Table 1.

The highest gain in productivity of land(Rs.103324.81 per acre) is recorded under crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange' followed by 'Tea+Areca-nut+Betel-vine+Orange', 'Tea+Orange', 'Tea+Areca-nut+Betel-vine'and 'Tea+Areca-nut'.

As regards gain in productivity of labour, the table denotes that highest gain (Rs.204.26 per person-day) is recorded under crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange'. Table 1 also reflects that the highest gain in productivity of fixed capital(2.25) is recorded under crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange'. The highest gain in productivity of working capital (7.47) is recorded under crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange'. The highest gain in productivity of productive capital(1.73) is recorded under crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange'.

However, with a view to pointing out the crop combinations which yield the maximum benefit in terms of factors' productivity, Table 2 is compiled and presented indicating the ranks obtained by each of the crop combinations on the basis of gain in productivity of various factors as shown in Table 1.

For this purpose, different crop combinations are ranked in ascending order according to gain in productivity under each of the factors, so that the lowest numerical value of rank suggests highest gain and vise -versa. The table is self- explanatory and clearly shows that the three high ranking crop combinations according to gain in productivity in order of their merit are (1) 'Tea+Areca-nut+Pepper+Betel-vine+Orange'. (2) 'Tea+Areca-nut+Betel-vine+Orange', (3) 'Tea+Orange'.

An interesting revelation of table 2 is that orange is a common crop among the top three combinations in ranking. The ranking of other two crop combinations containing orange as one of the crops are at 5^{th} and 6^{th}(one of the two under this rank) in order.

The analysis of Table 2 clearly infers that:

1. The sample gardens cultivating orange are gaining more in factors' productivity.
2. The minimum gain in productivity is under crop combination 'Tea+Areca-nut.

Prospect based on Return on Investment (ROI)

As presented in Table 3, the crop-combination wise comparison of ROI between mono-crop(tea only) and multi-crop(all crops) reveals that when only tea is cultivated, the ROI ranges between 16.04% to 103.88%; while in case of multi-cropping, the ROI ranges from as high as 139.16% to 210.50% at different degrees under various crop combinations. As corollary to this, as the table 3 shows, the gain in ROI due to the practice of multi-cropping is tremendous.

It is interesting to find from Table 3 that when all crops under multi-cropping practice are taken into account, every crop combination ensures more than 100percent ROI; the highest ROI(210.50%) is obtained in case of crop combination 'Tea+Areca-nut+Pepper+Betel-vine' followed by 'Tea+Areca-nut+Betel-vine'(202.54%) and 'Tea+Areca-nut+Pepper+Betel-vine+Orange'(184.42%). The crop combination 'Tea+Areca-nut' shows lowest ROI(139.16%). among all crop combinations. Another interesting fact revealed in this context is that the lowest ROI is registered where only 2 crops are combined followed by combination of 3 crops. In case of crop combinations having 4 to 5 crops, ROI is seen to be generally higher.

The gain in ROI due to multi-cropping practice as compared to mono cropping (tea only) is also shown in Table 3 in order of ranks. The table denotes that barring only two crop combinations of Tea+Areca-nut(58.45%) and Tea+Areca-nut+Pepper(67.65%), in all other crop combinations gain in ROI is more than 100percent. The highest gain being obtained from the crop combination 'Tea+Areca-nut+Pepper+Betel-vine+Orange'.

Prospect based on capacity utilization of land holding

Determination of capacity utilization of a farm practicing multi-cropping is a complex phenomenon, since the farmers are at their liberty to utilize their available land with variety of cash crops. The main cash crops of the sample gardens cultivating tea are areca-nut and orange. The plant population of tea in the sample gardens is found to be more or less at par with the standard norms of 6400 plants per acre. From growers' experience on multi-cropping ventures, ideal plant population of areca-nut and orange are taken as 550nos. per acre and 160nos. per acre respectively. However, the cultivators are found to be planting both areca-nut and orange in their tea plantation areas and no established or recommended norm could be found for the proportion of areca -nut and orange plantation while both are combined on the same plot of land. As such, in order to determine the optimum capacity utilization level, 50percent of areca-nut(275nos.) and 50percent of orange plants(80nos.) are being considered as ideal plant population for the sample gardens cultivating both areca-nut and orange with tea.

Two other crops usually seen in the multi-cropping ventures are pepper and betel-vine. Plantation of these crops is solely dependent on the number of areca-nut plants available in the garden, as these climbers are generally planted with areca-nut trees only. Again, choice of plant population of pepper and betel-vine also depends on the cultivators and hence it is very difficult to determine the ideal plant population when both of these vines are combined in a single garden. Therefore, for the purpose of the present study, 50 percent(275nos.) of the total number of areca-nut plants per acre is taken as standard norms for plantation of each of the two vines. However, when areca-nut, orange, pepper and betel-vine are combined with tea in the same plot of land, betel-vine and pepper can be creped only with areca-nut plants. In such cases, the proportion of land on which orange is planted has to be deducted to find the standard number of areca-nut plants that can be planted at 550 plants per acre basis. For example, if 80 orange plants are planted in a plot of 1.0 acre of land against the standard norm of 160 plants per acre, 50percent land remains for plantation of areca-nut. This means that 275 areca-nut plants (standard norms being 550 plants per acre) can be planted on the remaining portion of the plot; but if a planter plants 125 areca-nuts in this plot, his percentage of capacity utilization for areca-nut becomes 45.45percent. Now considering need for full capacity utilization of the remaining plot of land with areca-nut, the total number of pepper and betel-vine that can be planted is 275 only. Considering 50: 50 basis, the number of each of the vines that can be planted comes to around 137. Now, if a planter plants 100 vines of pepper and 125 plants of betel-vine, the level of capacity utilization for each of the plants becomes 72.99percent and 91.24percent respectively.

Table 4 shows the utilization of capacity of land by the sample gardens. The percentage of capacity utilization of the sample gardens for each of the 5 crops viz., tea, areca-nut, orange, pepper and betel-vine is shown in the table against total number and percentage of sample gardens falling under each range of capacity utilization. In computing the level of capacity utilized, ideal crop population per acre of land for each of the 5 crops as discussed above is considered.

The table shows that the level of capacity utilization for tea in case of 97.32percent (436nos.) of the sample gardens is 90percent or more which implies that most of the sample growers are utilizing almost full capacity of their garden lands for plantation of tea.

However, the table presents a different picture in case of level of capacity utilization of other crops. For example, it is clear from the table that out of 441 sample gardens cultivating areca-nut with tea, 286(64.85 %) are utilizing less than 50 percent of available land resource of the sample gardens. Only 33(7.48%) sample gardens are seen to be utilizing more than 90 percent of available capacity of the gardens. The table depicts a different picture in case of cultivation of orange. As depicted in the table, out of total 141 sample gardens cultivating orange with tea, 62(43.97%) are utilizing less than 50percent of available land resource of the sample gardens.

However, 56(39.72%) sample gardens are seen to be utilizing more than 90 percent of available land holding capacity of the gardens which is quite encouraging and this may be a possible reason for exhibiting higher ROI by the crop combinations consisting Orange in Table 4.

Table 4 however depicts a grim picture so far as the level of capacity utilization for pepper and betel-vine are concerned. It may be viewed from the table that in case of 36(27.07%) sample gardens cultivating pepper and 26(27.96%) sample gardens cultivating betel-vine, level of capacity utilization is less than 10 percent. In case of 112(84.21%) out of 133 sample gardens cultivating pepper, level of capacity utilization is less than 50 percent. Only 8(6.01%) sample gardens are seen to be utilizing more than 90percent of land holding capacity while cultivating pepper. Among 93 sample gardens cultivating betel-vine, 71(76.35%) are seen to be utilizing less than 50percent of land holding capacity in their multi-cropping ventures and only 13(13.98%) are utilizing more than 90 percent of the land holding capacity.

Prospect of multi-cropping with ideal crop combination

In order to explore the prospect of multi-cropping ventures with optimum utilization of land resource through cultivation of ideal crop combination, Table 5 is constituted and presented here. Although the crop population may vary in practical combination, the table shows 50 percent share of available resources while combining the crops. Three years' (2010-11, 2011-12, 2012-13) average yield of various crops are considered for calculation of yield generated by each crop. The revenue that can be earned in a year from a garden of holding size 1.0 acre is calculated on the basis of average yield at 2012-13 price level and average yearly investment incurred per acre by the sample growers under different crop combinations are considered on the basis of three years' (2010-11, 2011-12, 2012-13) average expenditure data at 2012-13 price level and 10 percent depreciation value of fixed capital. Table 5 shows that under different crop combinations, ROI vary from 281.23 percent to 881.79 percent with average of 489.22 percent while ideal crop combination is adopted. It is clear from the table that maximum return is envisaged from the crop combination 'Tea+Areca-nut+Betel-vine'(881.79%). The lowest ROI is envisaged from the crop combination 'Tea+Orange'(218.18).

On the basis of prospect of multi-cropping with ideal plant population i.e. optimum utilization of land resources, various crop combinations are ranked according to expected ROI as follows:

(1) Tea+Areca-nut+Betel-vine, (2) Tea+Areca-nut+Pepper+Betel-vine, (3) Tea+Areca-nut+Pepper, (4) Tea+Areca-nut+Betel-vine+Orange, (5) Tea+Areca-nut+Pepper+Orange, (6) Tea+Areca-nut (7) Tea+Orange.

The analysis of Table 5 clearly depicts that combination of betel-vine and pepper with areca-nut in the multi-cropping ventures bear high prospect of return. However, choice of crop largely depends on the agro-climatic condition of the garden, its locality and preference of individual grower.

Various crop combinations ranked on the basis of Gain in Productivity and ROI under Tables 2 and 3 are now compared with the ranking under Table 5 and presented in Table 6.

From Table 6, it is evident that the rankings based on gain in productivity and ROI, which are based on field survey data have shown analogous results. However, when ranking is done on the basis of expected ROI from optimum utilization of land capacity of the sample gardens through ideal crop population, a different picture has emerged. The most conspicuous difference observed between the empirical (gain in productivity and ROI combined) and hypothetical (expected ROI from optimum capacity utilization) ranking is that, whereas in empirical ranking, the top 3 positions were occupied by the crop combinations containing orange, in hypothetical ranking, these combinations have occupied 6^{th}, 4^{th} and 9^{th} positions respectively. The hypothetical ranking also shows that maximum return is expected when betel-vine is combined with areca-nut for multi-cropping with tea. One striking revelation of Table 6 is that the growers practicing multi-cropping with less than 3 crops gain minimal as compared to those practicing 3 crops or more (the crop combination 'Tea+Areca-nut+Orange' being exception).

The reason behind the difference in findings between empirical and hypothetical ranking can be explained with the help of Table 4. The table clearly indicates that a large majority of the sample growers cultivating areca-nut(64.85%), betel-vine(76.38%) and pepper(84.21%) are utilizing less than 50 percent of their land holding capacities. It can further be seen from the table that the level of capacity utilization is below 10percent in case of more than 27percent sample gardens cultivating pepper(27.07%) and betel-vine(27.96%), in comparison to only 3.55percent sample gardens cultivating orange. Moreover, 39.72percent of the sample growers cultivating orange are utilizing more than 90percent of land holding capacity, whereas, utilization of more than 90percent of capacity can be seen in case of only 6.01percent sample gardens cultivating pepper and 13.98percent sample gardens cultivating betel-vine.

Thus, it is evident that the level of land holding capacity utilization plays an important role in determining return on investment and thereby indicating a high prospect of multi-cropping with tea.
On the basis of above analysis, the following conclusions can be drawn:

1. By adopting the ideal plant population and thereby exercising optimum capacity utilization of land holding, the sample growers can enhance their return more than three times of their present return.
2. The choice of crop combination matching the agro-climatic condition of the locality would be an important factor for the multi-cropping ventures with tea towards earning satisfactory return.
3. The sample growers should go for cultivation of minimum three crops (other than 'Tea+Areca-nut+Orange') for generating satisfactory return from their multi-cropping ventures.
4. Pepper and betel-vine can be cultivated very easily in the sample gardens cultivating areca-nut. These two climbers do not need excessive post-plantation care and they have low gestation period, but the cultivators can expect very good return from these two crops.

Conclusion

The present study clearly demonstrates that multi-cropping with tea can be developed as a unique and innovative business model if practiced in right earnest. By now, it is observed, there has already been remarkable progress in the rural economies of the state where such ventures are in practice. A host of young rural boys, who otherwise find themselves unemployed and virtually fall prey of anti-social forces; are now busy thriving new heights in their small scale tea cultivation by introducing multi- cropping practices to ensure sustained income throughout the year. It is important to note that whatever achievements this enthusiastic new generation small tea growers have achieved, is without any state support and are beset with a lot of odds. Their long- standing grievances are just acquiring dust in the Govt. files. The most urgent need to give a real boost to this unique venture is to arrange adequate training facility for the planters. This undoubtedly will significantly help the growers in making optimum utilization of their available resources and gain the most out of their multi-cropping ventures. It

is certain that the practice of multi - cropping with tea, if done with right earnest, can change the very face of rural Assam which is already gifted with geo-climatic satiation suitable for tea plantation.

TABLE 1

PRODUCTIVITY OF LAND, LABOUR, CAPITAL AND GAIN IN PRODUCTIVITY OF LAND, LABOUR, CAPITAL ACCORDING TO CROP COMBINATION

Crop Combination	Productivity of Land (Rs.per acre)		Gain in Productivity of Land (Rs.per acre)	Productivity of Labour (Rs.per Person day)		Gain in Productivity of Labour (Rs.per Person day)	Productivity of Fixed Capital		Gain in Productivity of Fixed Capital	Productivity of Working Capital		Gain in Productivity of Working Capital
	Tea only	All Crops		Tea only	All Crops		Tea only	All Crops		Tea only	All Crops	
A	B	C	D=B-C	B	C	D=B-C	B	C	D=B-C	B	C	D=B-C
Tea+Areca-nut	86366.17	114496.41	28130.24	235.22	311.84	76.61	1.88	2.50	0.61	7.98	10.58	2.60
Tea +Orange	82363.80	153648.27	71284.46	158.33	295.37	137.03	1.99	3.72	1.73	5.73	10.69	4.96
Tea+Areca-nut+Orange	83155.12	138044.42	54889.30	228.62	379.54	150.91	1.62	2.68	1.07	7.41	12.31	4.89
Tea+Areca-nut+Pepper	88558.49	118032.60	29474.11	245.41	327.09	81.68	2.08	2.77	0.69	9.03	12.04	3.01
Tea+Areca-nut+Betel-vine	81726.34	139501.00	57774.65	215.31	367.53	152.21	1.79	3.06	1.27	7.87	13.43	5.56
Tea+Areca-nut+Pepper+Betel-vine	87190.92	132318.22	45127.30	231.12	350.74	119.62	2.82	4.28	1.46	8.82	13.39	4.57
Tea+Areca-nut+Pepper+Orange	80979.83	132356.98	51377.15	218.33	356.84	138.52	1.93	3.16	1.23	7.58	12.38	4.81
Tea+Areca-nut+Betel-vine+Orange	72049.68	152592.88	80543.21	182.08	385.63	203.54	1.75	3.71	1.96	5.76	12.20	6.44
Tea+Areca-nut+Pepper+Betel-vine+Orange	67110.03	170434.84	103324.81	132.67	336.92	204.26	1.46	3.71	2.25	4.85	12.32	7.47
OVERALL	83171.71	129309.54	46137.83	216.32	336.31	120.00	1.83	2.85	1.02	7.49	11.65	4.16

Source : Compiled from field survey inputs (Considered yield pertaining to average of three consecutive years and price level of 2013)

TABLE 2

RANKING OF DIFFERENT CROP COMBINATIONS ACCORDING TO THEIR GAIN IN PRODUCTIVITY

Crop combination	Rank according to gain in productivity of					Cumulative rank	Overall rank
	Land	Labour	Fixed capital	Working capital	Productive capital		
Tea+Areca-nut	9	9	9	9	9	45	8
Tea+Orange	3	6	3	4	3	19	3
Tea+Areca-nut+Orange	5	4	7	5	7	28	5
Tea + Areca-nut+ Pepper	8	8	8	8	8	40	7
Tea+Areca-nut+Betel-vine	4	3	5	3	5	20	4
Tea+Areca-nut+Pepper+Betel-vine	7	7	4	7	4	29	6
Tea+Areca-nut+Pepper+Orange	6	5	6	6	6	29	6
Tea+Areca-nut+Betel-vine+Orange	2	2	2	2	2	10	2
Tea+Areca-nut+Pepper+Betel-vine+Orange	1	1	1	1	1	5	1

Source : Derived from Table 1here above.

TABLE 3

COMPARISON OF ROI BETWEEN 'TEA ONLY' AND 'ALL CROPS COMBINED' OF THE SAMPLE GARDENS

Crop Combination	No. of sample gardens	Tea only				'All crops combined'				Gain in ROI (%)	Ranking
		Average yearly investment (Rs.)	Average yearly gross return (Rs.)	Average yearly net return (Rs.)	ROI (%)	Average yearly investment (Rs.)	Average yearly gross return (Rs.)	Average yearly net return (Rs.)	ROI (%)		
a	b	c	d	e =d-c	f = e/c*100	g	h	i=h-g	j=i/g*100	k=j-f	l
Tea+Areca-nut	226	56017.70	101229.47	45211.77	80.71	56112.65	134200.82	78088.17	139.16	58.45	9

Tea+Orange	7	63136.32	89462.86	26326.54	41.70	66922.03	166891.43	99969.40	149.38	107.68	4
Tea+Areca-nut+Orange	51	114822.76	195120.98	80298.22	69.93	117357.50	323917.06	206559.56	176.01	106.08	5
Tea+Areca-nut+Pepper	46	87873.79	179154.35	91280.56	103.88	87938.57	238780.65	150842.08	171.53	67.65	8
Tea+Areca-nut+Betel-vine	20	44551.47	79025.00	34473.53	77.38	44586.47	134890.00	90303.53	202.54	125.16	3
Tea+Areca-nut+Pepper+ Betel-vine	15	77401.48	158529.67	81128.19	104.81	77481.48	240579.67	163098.19	210.50	105.68	6
Tea+Areca-nut+Pepper+ Orange	25	77440.95	137064.00	59623.05	76.99	79465.31	224023.40	144558.09	181.91	104.92	7
Tea+Areca-nut+Betel-vine+Orange	11	61656.03	83363.64	21707.61	35.21	62656.21	176554.55	113898.34	181.78	146.58	2
Tea+Areca-nut+Pepper+ Betel-vine+Orange	47	90911.92	105497.87	14585.96	16.04	94201.06	267925.85	173724.79	184.42	168.38	1
Total*/Average	448*	71292.99	122671.46	51378.47	72.07	72182.08	190720.98	118538.90	164.22	92.16	

Source :Compiled from field survey inputs(price level of 2013 is considered)

Table 4
UTILIZATION OF LAND HOLDING CAPACITY BY THE SAMPLE GARDENS

Level of capacity utilization %	Number and percentage of sample gardens cultivating different crops									
	Tea (nos.)	% of total samples (448)	Areca-Nut (nos.)	% of total samples (441)	Pepper (nos.)	% of total samples (133)	Betel-vine (nos.)	% of total samples (93)	Orange (nos.)	% of total samples (141)
Below 10	0		24	5.44	36	27.07	26	27.96	5	3.55
10 - 20	0		54	12.24	27	20.30	20	21.51	14	9.93
20 - 30	0		84	19.05	27	20.30	12	12.90	8	5.67
30 - 40	0		55	12.47	14	10.53	4	4.30	15	10.64
40 - 50	0		69	15.65	8	6.02	9	9.68	10	7.09
50 - 60	2	0.45	68	15.42	4	3.01	7	7.53	10	7.09
60 - 70	2	0.45	23	5.22	2	1.50	0	0.00	10	7.09
70 - 80	3	0.67	18	4.08	4	3.01	0	0.00	11	7.80
80 - 90	5	1.12	13	2.95	3	2.26	2	2.15	2	1.42
90 - 100	34	7.59	5	1.13	1	0.75	0	0.00	6	4.26
100 and above	402	89.73	28	6.35	7	5.26	13	13.98	50	35.46
Total	**448**	**100**	**441**	**100**	**133**	**100**	**93**	**100**	**141**	**100**

Source : Compiled from field survey inputs

TABLE 5
CROP COMBINATION WISE EXPECTED YIELD, REVENUE AND RETURN ON INVESTMENT FROM MULTI CROPPING WITH IDEAL PLANT POPULATION

Crop combination	Crop	No. of plants per acre	Yield per plant	Unit of measure of yield	Total yield per acre	Rate of sale per unit(Rs.)	Revenue per acre(Rs.)	Total revenue per acre(Rs.)	Average yearly investment per acre(Rs.)	Profit per acre(Rs.)	Return on investment %	Ranking
a	b	c	d	e	f=cxd	g	h=fxg	i	j	k=i-j	l=k/jx100	m
Tea+Areca-nut	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	175394.66	46007.47	129387.19	281.23	8
	Areca-nut	550	3.57	Pun	1963.50	53.73	105498.86					
Tea+Orange	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	178622.20	56138.18	122484.02	218.18	9
	Orange	160	557	No	89120.00	1.22	108726.40					
Tea+Areca-nut+Orange	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	177008.43	48879.97	128128.45	262.13	7
	Areca-nut	275	3.57	Pun	981.75	53.73	52749.43					

	Orange	80	557	No	44560.00	1.22	54363.20					
Tea+Areca-nut+Pepper	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	323696.66	44355.13	279341.53	629.78	3
	Areca-nut	550	3.57	Pun	1963.50	53.73	105498.86					
	Pepper	550	1.80	kg.	990.00	149.80	148302.00					
Tea+Areca-nut+Betel-vine	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	419887.81	42767.47	377120.33	881.79	1
	Areca-nut	550	3.57	Pun	1963.50	53.73	105498.86					
	Betel-vine	550	134.30	Guchi	73865.00	3.31	244493.15					
Tea+Areca-nut+Pepper+Betel-vine	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	371792.23	41184.26	330607.97	802.75	2
	Areca-nut	550	3.57	Pun	1963.50	53.73	105498.86					
	Pepper	275	1.80	kg.	495.00	149.80	74151.00					
	Betel-vine	275	134.30	Guchi	36932.50	3.31	122246.58					

Contd……

Crop combination	**Crop**	**No. of plants per acre**	**Yield per plant**	**Unit of measure of yield**	**Total yield per acre**	**Rate of sale per unit(Rs.)**	**Revenue per acre(Rs.)**	**Total revenue per acre(Rs.)**	**Average yearly investment per acre(Rs.)**	**Profit per acre(Rs.)**	**Return on investment %**	**Ranking**
a	b	c	d	e	f=cxd	g	h=fxg	i	j	k=i-j	l=k/j*100	m
Tea+Areca-nut+Pepper + Orange	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	251159.43	44394.13	206765.30	465.75	5
	Areca-nut	275	3.57	Pun	981.75	53.73	52749.43					
	Pepper	275	1.80	kg.	495.00	149.80	74151.00					
	Orange	80	557	No	44560.00	1.22	54363.20					
Tea+Areca-nut+Betel-vine+Orange	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	299255.00	50585.16	248669.84	491.59	4
	Areca-nut	275	3.57	Pun	981.75	53.73	52749.43					
	Betel-vine	275	134.30	Guchi	36932.50	3.31	122246.58					
	Orange	80	557	No	44560.00	1.22	54363.20					
Tea+Areca-nut+Pepper+Betel-vine+Orange	Tea	6000	1.03	kg.	6180.00	11.31	69895.80	274850.13	58501.77	216348.36	369.82	6
	Areca-nut	275	3.57	Pun	981.75	53.73	52749.43					
	Pepper	137	1.80	kg.	246.60	149.80	36940.68					
	Betel-vine	137	134.30	Guchi	18399.10	3.31	60901.02					
	Orange	80	557	No	44560.00	1.22	54363.20					
Average											489.22	

Source : Compiled from field survey inputs(yield pertaining to average of three consecutive years and price level of 2013 are considered)

TABLE 6
COMPARISON OF RANKINGS OF CROP COMBINATIONS ACCORDING TO DIFFERENT CRITERIA

Crop combination	**Ranking according to**			
	Empirical			**Hypothetical**
	Gain in productivity	**Return on investment (ROI)**	***Gain in productivity and ROI combined**	**Expected ROI by optimum capacity utilization**
Tea+Areca-nut	8	9	8	8
Tea+Orange	3	4	3	9
Tea+Areca-nu +Orange	5	5	4	7
Tea+Areca-nut+Pepper	7	8	7	3
Tea+Areca-nut+Betel-vine	4	3	3	1
Tea+Areca-nut+Pepper + Betel-vine	6	6	5	2
Tea + Areca-nut + Pepper + Orange	6	7	6	5
Tea+Areca-nut+Betel-vine+ Orange	2	2	2	4
Tea+Areca-nut+Pepper+Betel-vine+Orange	1	1	1	6

Source : Derived from Tables 2,3and 5
*** Ranked on the basis of mean of the two previous columns.**