Comparative economics of mechanical and manual dehusking of Arecanut

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Abstract

Objectives: This research was undertaken to examine the economic benefit of mechanization in dehusking arecanut. Methods/Statistical analysis: A sample consisting 15 each of pre-harvest contractors, arecanut farmers using machines of different capacities for dehusking were randomly selected. The economic viability of mechanization was assessed using partial budgeting technique. Findings: The results of the study indicated that the cost of dehusking one quintal of arecanut using machine was ₹141 as compared to manual method (₹276) in case of pre-harvest contractors. The per quintal cost of dehusking of own arecanut produce came to Rs.78 as against manual method(Rs.277) in case of farmers who used the machine for dehusking of their own arecanut produce and rental purpose. Application/Improvements: The study suggested that marginal farmers should use two gear machine, small farmers four gear machine and large farmers six gear machine to economize dehusking their own farm produce and earning rental income

Keywords: Mechanization; Arecanut dehusking; economic evaluation; horticulture

1 Introduction

Arecanut is an important commercial plantation crop of India. India occupies first position with respect to area and production of arecanut in the world. The area and production of arecanut in India during 2019-20 was 5.13 lakh hectares and 8.28 lakh tonnes, respectively.(1,2) Though, the cultivation of crop is scattered in many states but it is mainly concentrated in the states of Karnataka, Kerala and Assam which together accounts for 88 percent of the total area and 87 percent of the total production in the country. In India, Karnataka alone accounts for 2.71 lakh hectares and 5.77 lakh(1-5). Arecanut enterprise contributes eight percent to the state GDP. Besides, it provides livelihood security to three million farmers. Due to physical and economic scarcity of labour in the state, the maintenance of arecanut garden has become an onerous task. Physical scarcity is reflected by non availability of labour to perform agricultural operations and economic scarcity is reflected in manifold rise in wages of labour(6). Skilled labour forms the major chunk of cost in maintenance of arecanut garden required to harvest raw
arecanut and process to dry nuts\(^1\). Dehusking of raw arecanut with manual labour constituted more than 20 percent of the total cost\(^2\). Dehusking of arecanut during the period of labour scarcity can be effectively done by mechanical means. Hence, an attempt was made to assess the economic viability of mechanical dehusking over manual method.

The specific objectives of the study are: To estimate the cost of dehusking of arecanut using machine and manual labour; To assess the economic viability of mechanization in arecanut dehusking. The above objectives were accomplished considering three situations viz., 1) pre-harvest contractor 2) arecanut growers using machine for dehusking of their own produce 3) arecanut farmers using machine for dual purpose such as dehusking of their own produce and renting to other needy farmers.

2 Material & Methods

Sampling
The study was undertaken in Channagiri taluk of Davanagere district as it has substantial area under arecanut. Of late, it has been found that large number of arecanut growers in the study area have gone in for mechanical dehusking. In order to meet the needs of such farmers interested in mechanization of arecanut, few industries have come up manufacturing dehusking machines. This development indeed is a boon to farmers cultivating arecanut in view of acute shortage of labour. A sample consisting 15 each of pre-harvest contractors, arecanut farmers using machine for dehusking of own farm produce and for dehusking of own farm produce as well as providing machine on rent were selected. Another sample with the same number of pre-harvest contractors and arecanut farmers dehusking manually were selected for the purpose of comparison.

Data
Sample farmers were found to use machines of different capacities viz., two gears, four gears and six gears. Accordingly, economics was worked out separately for each of these capacities. The capacity of the machine was assessed based on its capacity to dehusk produce in an hour. A machine consisting of two gears was considered to be of low capacity with dehusking capacity of 8 tins of dehusked nuts or 3.2 qtls of fresh arecanut fruits per hour. A machine consisting of four gears was considered as moderate capacity with dehusking capacity of 15 tins of dehusked nuts or 6 qtls of fresh arecanut fruits per hour. A machine with six gears was considered as high capacity machine with dehusking capacity of 22 tins of dehusked nuts or 8.8 qtls of fresh arecanut fruits per hour. To accomplish objectives, the requisite data on investment on machine and its accessories, quantity of produce dehusked, time required for dehusking, fuel/electricity consumption, labour used for operating machine and economics thereof were collected from both farmers and pre-harvest contractors through personal interview method. The data were analyzed using simple statistical measures such as averages, ratios and percentages. Economic viability of the machine was assessed using partial budgeting technique.

Partial budgeting
As said earlier of-late the arecanut growers have been using mechanical devices for dehusking in place of manual labour. The new practice is evaluated for its economic ability to increase or decrease the farm business income. New technologies often result in increase in income and/or reduction or elimination of costs. The net impact of these effects is the difference between the positive financial changes and the negative financial changes. The resulting net effect indicates decision making towards adoption of new technology: the positive net shows the increase in farm business income due to the new technology, while the negative net shows the reduction in farm business income due to adoption of new technology\(^6,9\).

Accordingly, there are four components in partial budgeting. (1) the added costs due to mechanization comprises of electricity charges, depreciation on machine, interest on investment and annual repairs. (2) reduced returns is in the form of reduced yield mechanization in relation to manual dehusking. Both these add to the ‘costs side’ or debit side of the partial budget. (3) reduced costs mechanization over the manual method includes reduction of certain expenses such as labour and number of baskets. Farmers could save on labour on account of mechanical dehusking. (4) added returns mechanization over the manual method by way of improving grade quality. The third and fourth components add to the ‘returns side’ or the credit side of the partial budget. If the difference between credit and debit is positive, then the mechanization is profitable and vice-versa.

3 Results and discussion

Pre-harvest Contractor
Pre-harvest contractor is one who procures and process arecanut on large scale. The capacity utilization of machine in the study area was found maximum in case of pre-harvest contractors since they had sufficient quantity of produce to dehusk. The details of cost incurred by the pre-harvest contractors to dehusk one quintal of fresh arecanut fruits using machine and manual labour are given in the Table 1.
Pre-harvest contractors could dehusk 4752 quintals of fresh arecanut or 11880 tins of dehusked nuts (1 qtl fresh fruit is equivalent to 2.5 tins of dehusked nuts) with six gear machine. A four gear machine dehusks 3240 quintals of fresh arecanut and a two gear machine dehusks 1728 quintals of fresh fruits. The total labour cost incurred towards dehusking of above mentioned quantities using six gear, four gear and two gear machine comes to ₹4,51,800, ₹3,33,000 and ₹2,13,300, respectively. Of this, ₹1, 62,000, ₹1, 35,000 and ₹1, 08,000 was spent for feeding fresh fruits to machine and collection of dehusked nuts. About 50 percent of the dehusked nuts had floss adhered to them which had to be removed manually employing women labour. The amount towards deflossing came to ₹99,800, ₹68,000 and ₹36,300 in case of six gear, four gear and two gear machines, respectively. The undehusked nuts by the machine required manual dehusking with an expenditure of ₹1, 90,000, ₹1, 30,000 and ₹69,000 in case of six, four gear and two gear machines, respectively. The electricity charges required to run a six gear and four gear machine for 90 days say one arecanut season for six hours a day at three units per hour @ ₹5.75/unit came to ₹9315. It was ₹6075 in case of two gear machine. Annual repairs of ₹46,160, ₹30,440 and ₹16,720 in case of six gear, four gear and two gear machines was incurred. The annual repair includes replacement of blades, fibre cups and bearing balls. Among these, replacement of blades was expensive at ₹32,400, ₹21,600 and ₹10,800 in case of six gear, four gear and two gear machines. Frequent replacement of blades was essential as they worn out due to continuous usage. Another major item was depreciation on the machine, baskets and tins which together worked out to ₹46,243, ₹41,518 and ₹28,288 in case of six, four and two gear machines. The baskets were used for feeding of fresh fruit to the machine and for collection of dehusked nuts. The wages of women labour is paid on the basis of number of tins of dehusked nuts per day. Tins were supplied to the labour to stock the dehusked nuts and deflossed nuts, on the basis of which wages were paid to the labourers. Total cost of operating six gear, four gear and two gear machines inclusive of labour cost, electricity charges, annual repairs, depreciation and interest on fixed capital was in the order of ₹5, 83,758, ₹4, 41,363 and ₹2, 82,653. The cost of dehusking one quintal of fresh arecanut fruit came to ₹122.84, ₹136.22 and ₹163.57 in case of six, four and two gear machines. The cost of dehusking one quintal of fresh arecanut was minimum in case of six gear machine and maximum in case of two gear machine demonstrating the operation of economies of scale.

Table 2 shows the details of cost of dehusking of same quantity of arecanut with manual labour as in case of mechanical method i.e., 4752 qtls, 3240 qtls and 1728 qtls. The women labour required to dehusk above mentioned quantities of fresh arecanut fruits was 3960, 2700 and 1440 women-days. The expenditure on account of this came to ₹11, 88,000, ₹8, 10,000 and ₹4, 32,000 at the rate of ₹30/women-day. In addition, women labourers were also supplied with meals and tea @ ₹30/ women-day amounting to ₹1, 18,000, ₹81, 000 and ₹43,200 during dehusking. Labour had to be booked in advance by paying a nominal advance of ₹1786 for dehusking every 100 quintals of fresh arecanut fruits. The interest @ 7 percent per annum apportioned for four months on the amount advanced towards dehusking under three situations worked out to ₹1,960, ₹1,350 and ₹720, respectively. Depreciation on baskets, tins and knives used during the process of dehusking was estimated to be ₹2, 133. The total cost of dehusking 4752 qtls was ₹13, 10,893, ₹8, 94,483 for 3240 qtls and ₹4, 78,053 for 1728 qtls of fresh arecanut fruits. The average cost of dehusking fresh arecanut fruits was ₹276/qtl. Thus, it may be inferred that cost of manual dehusking (₹276) was more expensive as compared to mechanical method (₹141). About ₹135 per quintal could be saved by adopting to mechanical method of dehusking. The results were in line with the findings of Rajkumar et al. (10), wherein they indicated that cost of dehusking arecanut using machine is more economical than manual method.

### Table 1. Cost of dehusking of arecanut using machines of different capacities by pre- harvest contractors

| Sl. No. | Particulars                                      | 6 gear dehusker (4752 qtl) | 4 gear dehusker (3240 qtl) | 2 gear dehusker (1728 qtl) |
|--------|-------------------------------------------------|-----------------------------|-----------------------------|-----------------------------|
| 1.     | Labour cost                                      | 4,51,800                    | 3,33,000                    | 2,13,300                    |
|        | a. labour to feed fresh fruits to the machine and to collect the dehusked nuts | 1,62,000                    | 1,35,000                    | 1,08,000                    |
|        | b. labour to remove adhered floss on the dehusked nuts | 99,800                     | 68,000                      | 36,300                      |
|        | c. labour to manually dehusk fully ripened fruits | 1,90,000                    | 1,30,000                    | 69,000                      |
| 2.     | Electricity charges                              | 9,315                       | 9315                        | 6075                        |
| 3.     | Repairs                                          | 46,160                      | 30,440                      | 16,720                      |
| 4.     | Depreciation                                     | 46,243                      | 41,518                      | 28,288                      |
| 5.     | Interest on fixed capital @ 12 per cent per annum | 30,240                      | 27,090                      | 18,270                      |
| 6.     | Total cost of dehusking                          | 5,83,758                    | 4,41,363                    | 2,82,653                    |
| 7.     | Cost of dehusking/quintal of fresh nut           | 122.84                      | 136.22                      | 163.57                      |

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Table 2. Cost of dehusking of arecanut using manual labour in case of pre-harvest contractors

| Sl. No. | Particulars | Cost incurred to dehusk 4752 qtl | Cost incurred to dehusk 3240 qtl | Cost incurred to dehusk 1728 qtl |
|--------|-------------|----------------------------------|----------------------------------|----------------------------------|
| 1.     | Labour cost | 11,88,000 (3960)                 | 8,10,000 (2700)                  | 4,32,000 (1440)                  |
| 2.     | Incidental charges in the form of tea and meals @ ₹30/women day | 1,18,800 | 81,000 | 43,200 |
| 3.     | Interest on advance amount paid to labourers to dehusk arecanut @ 7% p.a. for four months | 1,960 | 1,350 | 720 |
| 4.     | Depreciation on basket, measuring tins and knives | 2,133 | 2,133 | 2,133 |
| 5.     | Total cost of dehusking | 13,10,893 | 8,94,483 | 4,78,053 |
| 6.     | Cost of dehusking/quintal of fresh nut | 275.86 | 276.08 | 276.65 |

Figure in the parentheses indicates women labour days required to dehusk arecanut.

Economic viability of mechanical dehusking in case of pre-harvest contractors was examined using partial budgeting technique. The additional costs included depreciation on the machine, annual repairs, interest on investment and electricity charges to run machine which together worked out to ₹1,31,075 in case of six gear machine, ₹1,10,480 in case of four gear machine and ₹69,470 in case of two gear machine. Depreciation on machine was worked out using straight line method assuming life span of five years. It came to ₹45360, ₹40635 and ₹27405 in case of six gear, four gear and two gear machines, respectively. Annual repairs comprises of replacement of blades, fibre cups and bearing balls. Blades numbering 72, 48 and 24 were replaced twice in a season at ₹225/blade which worked out to ₹12400, ₹21600 and ₹10800 in case of six gear, four gear and two gear machines, respectively. Due to intense use, fibre cups also wear and tear necessitating replacement 144, 96 and 48 cups in case of six gear, four gear and two gear machines at ₹20 per fibre cup worked out to ₹5760, ₹3840 and ₹1920, respectively. Replacement of bearing balls along with labour charges came to ₹8000 in case of six gear and four gear machines while it was ₹5000 in case of two gear machine. Thus, the total annual repairs came to ₹46160, ₹33440 and ₹17750 for six, four and two gear machines. The interest on investment made on the dehusking machine estimated at the rate of 12 percent worked out to ₹30240, ₹27090 and ₹18270 in case of six, four and two gear machines. The other additional expenditure was on electricity for the duration of 540 hours consuming three units of electricity per hour at ₹5.75/unit in case of six and four gear machines worked out to ₹9315. In case of two gear machine, electricity charges was estimated for the same duration consuming 3 units/hour at ₹3.75 per unit came to ₹6075.

The reduced costs on account of using machine for dehusking arecanut included savings on labour and savings in the use of baskets. Savings on the labour was arrived at by deducting labour cost incurred in mechanical dehusking from labour cost of dehusking by manual method. It came to ₹856960, ₹559350 and ₹262620 in case of six, four and two gear machines, respectively. Savings also resulted in reduced use of 15 baskets at ₹250/basket worked out to ₹3750 across machines of different capacities. The total of above worked out to be ₹860710, ₹563100 and ₹266370 in case of six, four and two gear machines, respectively.

The economic worthwhileness of dehusking machine of three different capacities was examined by taking the difference between credit and debit. All the three capacities were found to be economically viable resulting in net returns of ₹7, 29,635, ₹4, 52,620 and ₹1, 96,900 in case of six, four and two gear machines, respectively (Table 3).

Table 3. Economic viability of dehusking machine using partial budgeting technique in case of pre-harvest contractors

| Machine | Debit | Credit |
|---------|-------|--------|
|         | Additional costs | Value (₹) | Reduced costs | Value (₹) |
| Six Gear | Depreciation | 43630 | Savings on labour cost | 856960 |
|         | Annual repairs | 46160 | Savings in use of baskets | 3750 |
|         | Interest on investment | 30240 | |
|         | Electricity charges | 9315 | |
|         | Total | 131075 | 860710 |
|         | Reduced returns | | |
|         | Total of additional costs & reduced returns | 131075 | 860710 |
|         | Economic worthiness | 729635 | |

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## Table 3 continued

| Particulars       | Four Gear | Savings on labour cost | Five Gear | Additional returns | Six Gear | Total of reduced costs and additional returns |
|-------------------|-----------|------------------------|-----------|--------------------|----------|-----------------------------------------------|
| Depreciation      | 40635     | 559350                 | 33440     | 3750               | 27090    | 563100                                        |
| Annual repairs    | 33440     | 27090                  | 27090     | 27090              | 27090    | 563100                                        |
| Interest on investment | 9315   | 9315                   | 9315      | 9315               | 9315     | 563100                                        |
| Total Reduced returns | 110480  | 110480                 | 110480    | 110480             | 110480   | 563100                                        |
| Economic worthiness | 452620  | 452620                 | 452620    | 452620             | 452620   | 563100                                        |

## Table 4. Cost of dehusking own produce using machine by arecanut growers

| Particulars | 6 gear arecanut dehusker (440 qtl) | 4 gear arecanut dehusker (300 qtl) | 2 gear arecanut dehusker (160 qtl) |
|-------------|-----------------------------------|-----------------------------------|-----------------------------------|
| 1. Labour cost | 34,994                            | 26,745                            | 17,596                            |
| a. labour to feed fresh fruits to the machine and to collect the dehusked nuts | 19,994                           | 12,495                            | 9,996                             |
| b. labour to remove adhered floss on the dehusked nuts | 10,000                           | 6,750                             | 3,600                             |
| c. labour to manually dehusk fully ripened fruits | 10,000                           | 7,500                             | 4,000                             |
| 2. Electricity charges | 562.50                           | 562.50                            | 281.25                            |
| 3. Repairs | 2,880                             | 1,920                             | 960                               |
| 4. Depreciation | 45,360                           | 40,635                            | 27,405                            |
| 5. Interest on fixed capital @ 12 per cent per annum | 30,240                           | 27,090                            | 18,270                            |
| 6. Total cost of dehusking | 1,13,536.50                      | 96,952.50                         | 64,512.25                         |
| 7. Cost of dehusking/quintal of fresh nut | 258                              | 323                               | 403                               |

### Dehusking of arecanut by farmers owning machines

Farmers used dehusking machine to dehusk their own arecanut produce of 440 qtls, 300 qtls and 160 qtls. The cost of labour cost employed to dehusk own produce in case of six gear, four gear and two gear machine worked out to ₹34,994, ₹26,745 and ₹17,596, respectively (Table 4). The electricity charges for the duration of 50 hours amounted to Rs. 562.50 at Rs.3.75/unit in case of six and four gear machines. The electricity charges in case of a two gear machine was ₹281.25. Annual repairs amounted to ₹2,880, ₹1,920 and ₹960 in case of six gear, four gear and two gear machines, respectively. The annual repair included the replacement of fibre cups and bearing balls due to intense use. Another major item was depreciation on the machine (₹45,360, ₹40,635 and ₹27,405) in case of six, four and two gear machines, respectively. The interest on investment was ₹30,240, ₹27,090 and ₹18,270 in case of six gear, four gear and two gear machines. Thus, the total cost of operating six gear, four gear and two gear machines came to ₹1,13,536.50, ₹96,952.50 and ₹64,512.25, respectively. The cost of dehusking one quintal of fresh arecanut fruits to ₹258, ₹323 and ₹403 in case of six, four and two gear machines.

The cost incurred to dehusk 440qtls, 300 qtls and 160 qtls of fresh arecanut fruits using manual labour was worked out and presented in Table 5. The women labour required to dehusk 440 qtls, 300 qtls and 160 qtls of fresh arecanut fruit was 367, 250 and 133 womandays. The wages at ₹300/womandays worked out to ₹1,10,000; ₹75,000 and ₹40,000, respectively. Women labourers were also provided with lunch and beverages spending ₹30 for each woman amounting to ₹11,000; ₹7,500 and ₹4,000 during dehusking (Table 5). As indicated earlier, advance money had to be given to book the labour in advance by paying an advance of ₹1786 for every 100 quintals of fresh arecanut fruits. Thus, the advance amount of ₹7858, ₹5358 and ₹2858 had to
be paid to book the required labour for dehusking of 440, 300 and 160 quintals. The interest on advanced amount worked out to ₹181, ₹124 and ₹66 at the interest rate of seven percent per annum for dehusking period of four months. Depreciation on baskets, tins and knives used during the process of dehusking was estimated using straight line method at ₹467. The total cost of dehusking 440 qtls was ₹1, 21,648; ₹83,091 for 300 qtls and ₹44,533 for 160 qtls of fresh arecanut fruits. The per quintal cost of dehusking fresh arecanut fruits was ₹277 in all the three cases.

Table 5. Cost of dehusking of arecanut using manuallabour by arecanut grower (excludes the quantity of produce dehusked on rentalbasis)

| SI. No. | Particulars                                    | Cost incurred to dehusk 440 qtl | Cost incurred to dehusk 300 qtl | Cost incurred to dehusk 160 qtl |
|---------|-----------------------------------------------|----------------------------------|----------------------------------|----------------------------------|
| 1.      | Labour cost                                   | 1,10,000                         | 75,000                           | 40,000                           |
|         |                                               | (367)                            | (250)                            | (133)                            |
| 2.      | Incidental charges in the form of tea and meals @ ₹30/women day | 11,000                           | 7,500                            | 4,000                            |
| 3.      | Interest on advance amount paid to labourers to dehusk arecanut @ 7% p.a. for four months | 181                              | 124                              | 66                               |
| 4.      | Depreciation on basket and measuring tins     | 467                              | 467                              | 467                              |
| 5.      | Total cost of dehusking                      | 1,21,648                         | 83,091                           | 44,533                           |
| 6.      | Cost of dehusking/quintal of fresh nut       | 276.47                           | 276.97                           | 278.33                           |

Table 5. Cost of dehusking of arecanut using manuallabour by arecanut grower (excludes the quantity of produce dehusked on rentalbasis)

Economic viability of using a machine to dehusk farmer’s own produce was examined using partial budgeting technique (Table 6). The additional costs included depreciation on the machine, annual repairs, interest on investment and electricity charges to run machine, which together formed to ₹79,042.50 in case of six gear machine, ₹70,207.50 in case of four gear machine and ₹46,916.25 in case of two gear machine. Depreciation was estimated to be ₹45360, ₹40635 and ₹27405 across machines of different capacities. Annual repairs involving replacement of 144, 96 and 48 fibre cups (twice in a season) at ₹20/cup came to ₹2880, ₹1920 and ₹960 in case of six, four and two gear machines, respectively. The interest on investment at the rate of 12 percent per annum worked out to ₹30240, ₹27090 and ₹18270 in case of six, four and two gear machines, respectively. Electricity charges in case of machine with six and four gears came to ₹562.50 and ₹281.25 for two gear machine. Farmers could save labour worth of ₹86,187, ₹55,879 and ₹26,470 by dehusking their own produce with six gear, four gear and two gear machines, respectively as against manual dehusking. It was arrived at by deducting labour cost incurred in mechanical dehusking from labour cost of dehusking by manual method. A cursory look into the net benefits realized was apparent only in the case of six gear machine (₹7144.50) while it was negative in case of four and two gear machines. Thus, it could be inferred that six gear machine with high capacity was suitable for large arecanut growers with substantial quantity of produce. The owner-farmers of four and two gear machines could not utilize the capacity to the fullest extent nor rent out to other needy farmers to earn additional income. Hence, the net benefits accrued to farmers owning four and two gear machines have appeared negative.

Table 6. Economic viability of dehusking machine used for dehusking own produce by arecanut growers

| Machine | Debit | Credit |
|---------|-------|--------|
|         | Additional costs | Value (₹) | Reduced costs | Value (₹) |
| Six Gear | Depreciation | 45360 | Savings on labour cost | 86187 |
|         | Annual repairs | 2880 | | |
|         | Interest on investment | 30240 | | |
|         | Electricity charges | 562.5 | | |
|         | Total | 79042.5 | | 86187 |
|         | Reduced returns | Value (₹) | Additional returns | Value (₹) |
|         | Total of additional costs & reduced returns | 79042.5 | Total of reduced costs and additional returns | 86187 |
|         | Economic worthiness | 7144.5 | | |
| Four Gear | Additional costs | Value (₹) | Reduced costs | Value (₹) |
|         | Depreciation | 40635 | Savings on labour cost | 55879 |
|         | Annual repairs | 1920 | | |
|         | Interest on investment | 27090 | | |
|         | Electricity charges | 562.5 | | |
|         | Total | 70207.5 | | 55879 |

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### Table 6 continued

|                      | Reduced returns Value (₹) | Additional returns Value (₹) | Economic worthiness (₹) |
|----------------------|---------------------------|-----------------------------|------------------------|
| Total of additional  | 70207.5                   | 55879                       | -14328.5               |
| costs and reduced    |                           |                             |                        |
| returns              |                           |                             |                        |
| Economic worthiness  | -14328.5                  |                             |                        |

#### Two Gear

|                      | Reduced returns Value (₹) | Additional returns Value (₹) | Economic worthiness (₹) |
|----------------------|---------------------------|-----------------------------|------------------------|
| Depreciation         | 27405                     |                             | 26470                  |
| Annual repairs       | 960                       |                             |                        |
| Interest on investment | 18270                  |                             |                        |
| Electricity charges  | 281.25                    |                             |                        |
| Total                | 46916.25                  |                             | -20446.25              |
| Reduced returns      |                           |                             |                        |
| Total of additional  | 46916.25                  |                             |                        |
| costs and reduced    |                           |                             |                        |
| returns              |                           |                             |                        |
| Economic worthiness  | -20446.25                 |                             |                        |

### Arecanut growers employing machine for dual purpose

Few farmers have used the dehusking machine for dehusking of their own farm produce as well as rented out to other needy farmers to earn extra income. The six gear machine could dehusk 2200 quintals inclusive of own produce and produce of others (440+1760). The four and two gear machines could dehusk 1500 and 800 quintals of fresh arecanut fruits. The cost of labour for feeding of arecanut to the machine and collection came to ₹34,994, ₹26,745 and ₹17,596. The electricity charges in case of six gear machine and four gear machines for 250 hours @ ₹5.75/unit came to ₹4312.50. Similarly, electricity charges in case of two gear machine was 2812.50. Annual repairs came to ₹25,960, ₹17,640 and ₹9,320 in case of six gear, four gear and two gear machines, respectively (Table 7). Depreciation amounted to ₹45,360, ₹40,635 and ₹27,405 in case of six, four and two gear machines, respectively. The total cost of dehusking with six gear, four gear and two gear machines was in the order of ₹1, 40,866.50, ₹1, 16,422.50 and ₹75,403.50, respectively. The average cost of dehusking one quintal of fresh arecanut fruits came to ₹64, ₹77.62 and ₹94.25 in case of six, four and two gear machines, respectively.

### Table 7. Cost of mechanical dehusking when machine is used for dual purpose (Renting out + dehusking own produce) by arecanut growers

| SI. No. | Particulars                                                                 | 6 gear dehusker (1760+440 qtl) | 4 gear dehusker (1200+300 =1500 qtl) | 2 gear dehusker (640+160 =800 qtl) |
|---------|-----------------------------------------------------------------------------|---------------------------------|--------------------------------------|-----------------------------------|
| 1.      | Labour cost                                                                 | 34,994                         | 26,745                               | 17,596                            |
|         | a. labour to feed fresh fruits to the machine and to collect the dehusked nuts | 19,994                         | 12,495                               | 9,996                             |
|         | b. labour to remove adhered floss on the dehusked nuts                       | 10,000                         | 6,750                                | 3,600                             |
|         | c. labour to manually dehusk fully ripened fruits                            | 10,000                         | 7,500                                | 4,000                             |
| 2.      | Electricity charges                                                          | 4,312.50                       | 4,312.50                             | 2812.50                           |
| 3.      | Repairs                                                                     | 25,960                         | 17,640                               | 9,320                             |
| 4.      | Depreciation                                                                | 45,360                         | 40,635                               | 27,405                            |
| 5.      | Interest on fixed capital @ 12 per cent per annum                           | 30,240                         | 27,090                               | 18,270                            |
| 6.      | Total cost of dehusking                                                      | 1,40,866.50                    | 1,16,422.50                          | 75,403.50                         |
| 7.      | Cost of dehusking/quintal of fresh nut                                       | 64                             | 77.62                                | 94.25                             |
to ₹30240, ₹27090 and ₹18270 across six, four and two gear machines, respectively. Dehusking machine is electricity driven requiring an expenditure on electricity @ 3 units per hour for 250 hours in case of six and four gear machines estimated to be ₹4312.5 at ₹5.75 per unit of electricity. The expenditure on electricity for two gear machine came to ₹2812.50. Farmers could save ₹86,187, ₹55,879 and ₹26,470 by dehusking their own produce using six gear, four gear and two gear machines, respectively as against manual method. In addition, farmers could earn additional returns by lending machine to needy farmers on rental basis by charging a nominal charge of ₹87.5 per quintal. Thus, additional returns realized by farmers on renting machine for dehusking additional quantity of 1760 quintals, 215 1200 quintals and 640 quintals of fresh arecanut fruits of other farmers was ₹1, 54,000, ₹1, 05,000 and ₹56000 in case of six gear, four gear and two gear machines, respectively. The total net benefits (Credit - Debit, Table 8) realized by farmers by providing machine for dual-purpose was ₹1, 34,314.50, ₹71,201.50 and ₹24,662.50 in case of six gear, four gear and two gear machines, respectively. This clearly demonstrated the economic viability of dehusking machine when used for dual purposes. It may be inferred that arecanut growers capable of buying machine could not only use the machine to dehusk their own produce but also rent out the machine to other fellow arecanut growers to earn extra income.

### Table 8. Economic viability of dehusking machine employed for dual purpose (Renting out + dehusking own produce)

| Machine | Debit | Credit |
|---------|-------|--------|
| Six Gear |       |        |
| Additional costs | Value (₹) | Reduced costs | Value (₹) |
| Depreciation | 45360 | Savings on labour cost | 86187 |
| Annual repairs | 25960 | | |
| Interest on investment | 30240 | | |
| Electricity charges | 4312.5 | | |
| Total | 105872.5 | | |
| Reduced returns | Value (₹) | Additional returns | Value (₹) |
| Renting | 86187 | | |
| Total of additional costs and reduced returns | 105872.5 | Total of reduced costs and additional returns | 240187 |
| Economic worthiness | 134314.5 | | |
| Four Gear |       |        |
| Additional costs | Value (₹) | Reduced costs | Value (₹) |
| Depreciation | 40635 | Savings on labour cost | 55879 |
| Annual repairs | 17640 | | |
| Interest on investment | 27090 | | |
| Electricity charges | 4312.5 | | |
| Total | 89677.5 | | |
| Reduced returns | Value (₹) | Additional returns | Value (₹) |
| Renting | 55879 | | |
| Total of additional costs and reduced returns | 89677.5 | Total of reduced costs and additional returns | 160879 |
| Economic worthiness | 71201.5 | | |
| Two Gear |       |        |
| Additional costs | Value (₹) | Reduced costs | Value (₹) |
| Depreciation | 27405 | Savings on labour cost | 26470 |
| Annual repairs | 9320 | | |
| Interest on investment | 18270 | | |
| Electricity charges | 2812.5 | | |
| Total | 57807.5 | | |
| Reduced returns | Value (₹) | Additional returns | Value (₹) |
| Renting | 26470 | | |
| Total of additional costs and reduced returns | 57807.5 | Total of reduced costs and additional returns | 82470 |
| Economic worthiness | 24662.5 | | |

### 4 Conclusion

Arecanut, being the vital commercial plantation crop, is facing the brunt of economic and physical scarcity of labour. Dehusking of freshly harvested fruits is labour intensive which accounts for more than 20 percent of the total cost of cultivation. In order to overcome the labour scarcity, of late, farmers and pre-harvest contractors have shown inclination towards mechanization of dehusking. Cost of dehusking of one quintal of raw arecanut using dehusking machines was estimated capacity-wise and compared with manual method. Accordingly, pre-harvest contractors could save ₹135 per quintal. Those farmers who used machine for rental income and for self-use could save ₹200/qtl. Economic viability of mechanical dehusking was assessed using...
partial budgeting technique for pre harvest contractors and arecanut growers. The partial budgeting analysis indicated economic worthiness by generating positive benefits ranging from ₹196900 to ₹729635 in case of pre harvest contractors and ₹24662.50 to ₹134314.50 in case of those farmers who used machine for self-use and renting. The study suggested deployment of six gear machine is advantageous to pre-harvest contractors and large farmers who have large quantities of arecanut produce for dehusking. The small and marginal arecanut growers could invest on four and two gear machines, respectively to make use of them for both self-use and renting.

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