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Evaluation of Mechanization Index of Vegetable Crops in Bandarawela, Srilanka

R. Bawatharani, K. A. D. P. Karunarachchi

Department of Agricultural Engineering, Faculty of Agriculture, Eastern University

***Corresponding Author**
Name: R. Bawatharani
Email: bavatharani@yahoo.com.sg

Abstract: This study was designed to determine the Mechanization Index (MI) of different up county vegetable crop cultivation in Bandarawela Divisional Secretariat(DS) division. The study was conducted using a sample of 100 farmers in five major vegetable cultivation GN divisions of Bandarawela DS division. Stratified random sampling technique was used to draw the sample. A pre-tested structured questionnaire, personal interviews and discussion with key informants were the methods used to collect the primary data. Secondary data were obtained from relevant articles, government centers and key organizations. Data was analyzed using statistical software of SPSS 19.0. Socioeconomic characteristics of vegetable cultivators, production and cultivation details, mechanization of vegetable cultivation, labour and machinery use hours were studied. The highest MI was determined as 2.29% for cabbage cultivation and low MI was obtained as 0.5% for tomato cultivation followed by which 1.44% for bean, 2.1% for carrot and 1.97% for potato cultivation which represents a relatively undesirable state of mechanization for vegetable cultivation in this region. The highest power per unit area was 1.12 hp/ha in cabbage cultivation and it was 0.72 hp/ha in potato cultivation, 0.97 hp/ha for beans, 1.02 hp/ha for carrot and 1.09 hp/ha for tomato cultivation.
Keywords: Cultivation, Divisional Secretariat, Machinery, Mechanization Index, Power

INTRODUCTION

The mechanization of agriculture has been considered to be a major factor in the development and sustainability of vegetable production. As far as the upland agriculture of SriLanka is concerned vegetables are the major crops, which have been mechanized at different levels, of which the tillage and the chemical application operations are the mostly mechanized activities. However, such operations are not in a satisfactory level because of the use of inappropriate/inadequate implements regardless of the tillage operation concerned and the lack of knowledge of farmers.

So far efforts taken in terms of mechanized cultivation in Bandarawela are not sufficient and development of new approaches to solve this problem is still under consideration. With the advent of mechanized agriculture, the importance of use of machinery has now been realized and well planned mechanization programs must be launched in order to achieve sustainability in vegetable production. But first the status of mechanization in the upland vegetable cultivation should be studied in planning the agricultural mechanization which will lead to increased farm productivity, increased farm yields and farm incomes. Therefore, the objectives of the study were to determine mechanization index of different vegetable crops in Bandarawela DS division.

MATERIALS AND METHODS

The population of the Bandarawela is about 67120 and the population of working men in the agriculture sector is about 56% (DS office Bandarawela). The total area of the cultivation is 1008.6 acres and 414.5 acres are utilized for vegetable cultivation. The GN divisions which have the top most vegetable growers such as Ambagamuwa, Bambaragamuwa, Aththalapitiya, Watagedara, and Liyangahawela were considered for this study as these are the predominant vegetable growing areas and the farmers with similar social and cultural conditions and facing similar constraints. In this study, carrot, potato, beans, cabbage and tomato were selected as dominant and strategic crops in terms of their productivity to farmers for investigation.

Primary data collection was done through administration of questionnaire, interview and field, observations. Respondents were randomly selected from the selected GN divisions in the study area through stratified random sampling method. The stratification was made based on the type of vegetable that the farmers grow. In each GN division, about 10% of the farm families were randomly selected as sample. Structured questionnaires were designed to collect required information and selected respondents were interviewed at their doorsteps and field observations were also be made. Secondary data were collected from Department of Agriculture, Agrarian service centers,

Machine manufacturing companies, department of census and statistics and Divisional secretariat of Badulla. Data were analyzed using SPSS 19.0 software.

Determination of Average Energy Input by Human Labour

Number of working population in each vegetable cultivation was considered. It was taken into account that a normal person can produce on average about 0.1 hp during a working day [1].The average energy input of work provided exclusively by human labour per hectare was calculated as reported by Nowacki, 1974;

$$LH = 0.1\, N_{H.} \frac{T_H}{A} \text{ …….. Equation 1}$$

LH = Average energy input or work provided per hectare by human labour kWh/ha
NH = Average number of labor employed
TH = Average rated working time devoted to manual operation
0.1= Theoretical average power of an average man working optimally
A = Area of land cultivated (ha)

Determination of Average Energy Input by Machinery

Number of days of machinery use during a cropping year was noted according to the calendar. Average energy input by motorized machinery was calculated as reported by Nowacki, 1974.

$$LM = 0.2 \cdot N_M \cdot TM/A \text{ …… Equation 2}$$

LM = Average energy input or work per hectare by motorized machines
0.2 = Corrector co- efficient of the tractor-powered machine
NM = Rated working power of the tractor (kW)
TM = Rated working time of the motorized energy source, h/ha
A = Area worked in hectare by motorized machines

Determination of Mechanization Index

It was calculated using the equation as suggested by Nowacki, 1974.

$$ME = \frac{LM}{LT} \cdot 100\% \text{ …….. Equation 3}$$

ME = Mechanization Index %
LM = Average sum of all mechanical operation work of the machine, kWh/ha
LT = Sum of all average work outlays by human and tractor powered machines, kWh/ha
LT = LM + LH

RESULTS AND DISCUSSION

Figure 1 shows Mechanization Index (MI) of different vegetables cultivation in Bandarawela. The highest index of mechanization was determined as 2.29% for cabbage cultivation and low MI was obtained as 0.5% for tomato cultivation followed by which 1.44% for bean, 2.1% for carrot and 1.97% for potato cultivation which represents a relatively undesirable state of mechanization for vegetable cultivation in this region. The low mechanization index in the study areas may be attributed to the small size, irregular geometry and dispersal of vegetable plots. The high cost of machinery and technical issues associated with their operation, were found to be the other important barriers for development of mechanized vegetable cultivation in Bandarawela.

With 2.29% as the highest value in cabbage cultivation, it indicates that the level of involvement of farm machineries is relatively higher among the five GN divisions. According to the results, very lowest percentage of mechanization index of 0.5% was obtained for tomato cultivation. This reveals that the energy input per land area per hectare by human work is greater than the energy input of machine. This is because great work capacity and more time of utilization of the human work are involved in in tomato cultivation where the farmers use motorized machinery only for primary tillage practice only and all other practices are carried out manually. Most of the farmers use walking type tractors for primary tillage in the study area. The practice of selective mechanization was prominent in all the GN divisions due to deficient standardization and non-availability of mechanization inputs to serve the whole scale of production. The study revealed that low production efficiency, underutilization of mechanical power, and uses of old tractors with constant break down during operation, contributed to low mechanization index in the study area.

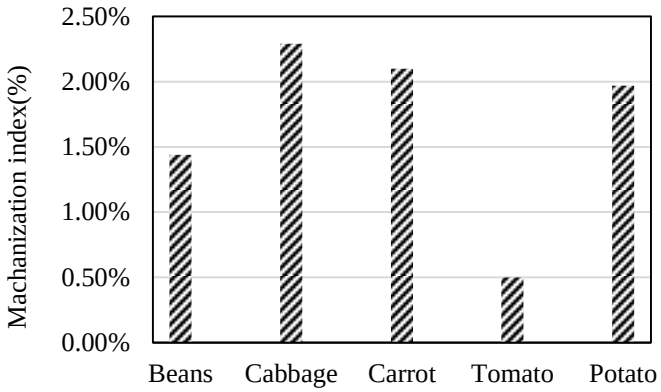

Fig 1: Mechanization index of different vegetable crops

Olaoye and Rotimi in 2010 [2], Fadavi *et al.;* in 2010 [3] and Fadavi *et al.;* in 2012 [4] reported that by increasing mechanization index only, energy consumption will not decrease necessarily, and suggested that management of input consumption is more important. Mechanization index has not shown a proper significance and acceptability attitudes towards the usage of modern machinery in the vegetable farms of Bandarawela and some operations were carried out manually and even the only available farm machinery does not receive better attention in terms of maintenance since most of them are owned by individual contractors, enough capital could not be raised from hiring purpose and for this reason subsequent routine maintenance cannot be carried out.

Around 2.29% of mechanization index was obtained for 4.6 ha of total bean cultivation and lowest mechanization index of 0.5% was obtained in tomato cultivation with 4.1 ha of total cultivation area. Rasoul *et al.;* in 2014 [5] also found, that lands between 2 - 3 ha had the highest Mechanization index (0.93) due to least human labour energy per hectare, lands of less than 1ha had 0.86% MI, lands of greater than 3 ha had 0.74% MI and lands between 1 – 2 ha had the least mechanization index of 0.6%. It has also been reported that the Mechanization index at an all-India level was only 14.5%, and it varied from 8.2% for sorghum and paddy to a highest value of 29% for wheat.

Power per unit area

According to Figure 2 highest level of power per unit area was 1.12 hp/ha in land area used for cabbage cultivation were lower than compared to other crops. Low value obtained was 0.72 hp/ha in potato cultivation because potato land area used for potato cultivation were higher than compared to other crops followed by which 0.97 hp/ha for beans, 1.02 hp/ha carrot, 1.09 hp/ha tomato cultivation. According to the Figure 2 highest power per unit area was observed in cabbage cultivation (1.12 hp/ha) while lower level of mechanization was observed in potato cultivation (0.72 hp/ha). Total available tractor power was 6 hp and power per unit area was calculated in primary tillage practice. Results from 4 ha of cabbage cultivation and 6.2 ha of potato cultivation reveal that vegetable cultivation was more labour intensive than cultivation of other types of crops and requires more power.

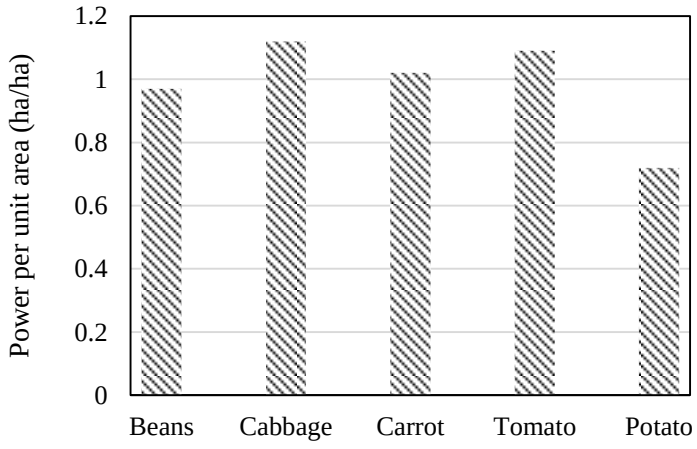

Fig 2: Power per unit area

CONCLUSIONS

- Mechanical operations were restricted only to tillage operations in Bandarawela. Other operations like planting, weeding, fertilizer/herbicide application and harvesting are manually done. This is because of the subsistent level of agricultural production practiced in the area. The vegetable farmers carry out the tillage operations with walking type tractors most of which are on custom hiring basis. The energy input for the agronomic practices are from both family as well as outside labourers.

- The highest mechanization index 2.29% was obtained for cabbage, followed by which 2.1%, 1.79% 1.44% and 0.5% for carrot, potato, beans and tomato respectively. These lower values imply that energy input per land area in hectare by human work is greater than the energy input of machine. This is because great work capacity and more time of utilization of the human work. Therefore, increasing the machinery available for other operations needs to be given the topmost priority for mechanization of vegetable cultivation in Bandarawela.

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