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Factors Affecting Mechanization Index and Farm Power Availability in Guntur District of Andhra Pradesh

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ABSTRACT

Background: Agriculture is the most vital sector of the Indian economy. In 2020, India's population was 1.38 billion, with a projected growth of 1.80 billion by 2050. As a result, more food must be produced to meet the demands. Mechanization is recognized as an important input for increasing agricultural production. It assures timely field operations, improves product quality and quantity, improves input-use efficiency and reducing labour costs and drudgery.

Methods: Randomly, 5 Mandals are selected; within each Mandal, 5 villages are chosen randomly; and from each village, 20 farmers are chosen at random. For the survey, a sample of 500 farmers from 25 villages was selected to examine the mechanization index and farm power availability by considering factors such as social status, landholding and economic status of farmers.

Result: According to the study's findings, that the average mechanization index and average farm power availability were 68% and 1.64-kW ha^{-1}, respectively. The influencing factors that observed from the study was lack of knowledge about how to use farm machines and implements, lower annual income of farmers and marginal farmers who cannot afford to buy expensive machinery and implements. The mechanization index and farm power availability increase linearly with the farmer's economic status.

Key words: Economic status, Farm power availability, Mechanization index, Size of landholding, Social status.

INTRODUCTION

Agriculture is the most vital sector of the Indian economy. In 2020, India's population was 1.38 billion, with a projected growth of 1.80 billion by the year 2050 (Anonymous, 2020). As a result, more food must be produced to meet the demands of an expanding population. Energy has long been a vital component in servicing daily human requirements (Maria *et al.,* 2020). Human belief that availability of energy in ancient times had only two options to carrying out any operation: one was to use energy from human muscle and the other was use energy from animal muscle. The use of energy for human needs is used to define the degree of civilization (Minjie *et al.,* 2020 and Charles *et al.,* 2009) and mechanical energy was later introduced to carry out agricultural activity or operation, which is highly reliant on energy availability.

Andhra Pradesh is typically an agrarian state with 10 million ha of geographical area and 8.09 million ha of net sown area; at present, farm power availability is below 1.66 kW ha^{-1} and the national average farm power availability is 2.03 kW ha^{-1}. This report covers the monitoring, concurrent evaluation and impact assessment of the sub-mission on agricultural mechanization. Mechanization and Technology Division, Ministry of Agriculture and Farmers Welfare**,** Department of Agriculture, Cooperation, Government of India, 2018, reported a low level of farm mechanization. There is a numerous scope for development in farm mechanization for crop production to improve productivity and it greatly depends on farm power availability (Singh *et al.,* 2015 and Emami *et al.,* 2018). There are two ways to increase productivity: one is to produce a high-yield varieties of crops and the other is to improve agricultural mechanization through better machines and implements. One of the most important inputs for crop production is mechanical energy in the form of mechanization. It ensures timely field operations to improve production, reduce crop losses and improve product quality and quantity. It also improves land use and input-use efficiency, labour productivity and drudgery reduction (Ram Nath *et al.,* 2019a and Jens Anue *et al.,* 2017). Farm mechanization eliminates labour and animal drudgery by allowing activities to be completed in the shortest period of time (Ram Nath *et al.,* 2019b).

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Precision in metering and placing inputs, as well as timelines for the efficient use of various crop inputs such as land preparation, seeding, spraying, fertilizer, irrigation water, *etc*., were reported by Tiwari and Jaga (2012). The ultimate focus of farm mechanization is to increase productivity and production by lowering production costs, (Surendra *et al.,* 2014). Mechanization in India may have to be done at various levels, broadly, it can be done in three different ways: firstly, by introducing improved agricultural implements on small-size holdings operated by bullocks. The second is by using small tractors, tractor-drawn machines and power tillers on medium-size holdings and the third is by using large tractors and machines for large holdings. Mechanization development varies substantially depending on the social status of farmer as well as the size of their landholdings (Kaler *et al.,* 2017) and their economic status. To increase crop productivity through mechanization, we must first understand the current status of farm power availability and then determine to what extent it can be improved. By keeping all the above factors in view, the present study was carried out to collect and analyse data from farmers, to assess the mechanization index of Guntur district and to assess the farm power availability of Guntur district, Andhra Pradesh.

MATERIALS AND METHODS

Study area

The study was conducted over a period of 12 months during 2020-2021 in the Guntur district (latitude of 16.39°N and longitude of 80.00°E) of Andhra Pradesh. The farmers are chosen randomly from five Mandals, such as Ponnur, Nagaram, Rentachintala, Vinukond and Piduguralla, in the Guntur district; again, from each Mandal, five villages are selected randomly. The complete work was carried out at Dr. NTR College of Agricultural Engineering, Bapatla. The map of Guntur district with selected Mandals is shown in the following Fig 1.

Method of data collection

The farmers are chosen at random from five Mandals, such as Ponnur, Nagaram, Rentachintala, Vinukond and Piduguralla, in the Guntur district of Andhra Pradesh, with each Mandal selecting five villages randomly and 20 farmers are chosen at random from each village. For the survey, a sample of 500 farmers from 25 villages was selected. The following primary data were collected from the farmer's investigation; social status, size of landholding and economic status of the farmers. The questionnaire type data was collected to cover aspects like general information of the farmer, name, social status, size of landholding, economic status, number of drought animals, number of farm machines, number of implements, number of tractors, number of power tillers, the average number of human works, number of electric motors and number of the diesel engines, *etc*.; these were also collected from each farmer. The data were tabulated and then calculated using standard formulas such as the mechanization index and farm power availability.

Mechanization index

The mechanization index was calculated as proportion of machine work in comparison to the sum of human, animal and machine work, mechanization index is expressed in percentage (Shivani *et al*., 2021; Radhey and Manoj, 2017).

$$MI = \frac{E_m}{E_H + E_A + E_M}$$

Where,
MI= Mechanization index, %.
E_M= Machine work, kW ha^{-1}.
E_H= Human work, kW ha^{-1}.
E_A= Animal work, kW ha^{-1}.

Farm power availability

The data obtained from the source of power for farm operations, right from tillage to harvesting, was used to estimate farm power. The information was gathered from farmers who owned or rented land in ha, tractor (HP), power tiller (HP), engine (HP), motor (HP/kW), animal power, human power for farm work. As a result, total landholding and farm power are available for all the farmers surveyed in each community. The following formula was used to calculate farm power availability (Mehta *et al.,* 2014; Singh *et al.,* 2015).

$$\text{Farm power availability (kW ha}^{-1}) = \frac{\{(\text{Number of agricultural Workers} \times 0.05) + (\text{Number of draught animals} \times 0.38) + (\text{Number of tractors} \times 26.1) + (\text{Number of power tillers} \times 5.6) + (\text{Number of electric motors} \times 3.7) + (\text{Number of diesel engines} \times 5.6)\}}{\text{Available cultivated land in ha.}}$$

Social status of farmer

Farm machinery and farm equipment availability among specific farmer categories is determined by the social status of the farmers. Farmers in India are classified into four social categories, such as scheduled caste (SC), scheduled tribes (ST), other backward class (OBC) and open category (OC). For evaluation, the number of farmers in each category from each village is considered.

Landholding of farmer

Based on the size of a farmer's agricultural land, the landholding of a farmer is divided into the three categories below. Farmer's landholding is also an important component for development of farm mechanization and enhancing farm power availability; the size of the landholding from each farmer in all villages is taken into consideration for evaluation (Prem *et al.,* 2020). The classification of the farmer based on the size of the landholding is shown in the following Table 1.

Economic status of farmer

The socioeconomic status of the farmer includes measurement of revenue from various sources such as

income from agriculture, income from wages and salaries, livestock income, *etc*. (Hitesh *et al*., 2020; Pankaj *et al*., 2017), which is a crucial component in improving mechanization and farm power availability. The total annual household income is calculated by adding income from all the sources a farmer has. For evaluation, all the farmer's data from each village is considered. The farmer's economic situation is evaluated based on the five economic classifications listed below in Table 2.

Statistical analysis

The data was analyzed using a web-based agricultural statistical software package (WASP 1.0) and a descriptive statistical method was used to determine the standard deviation (SD), standard error mean (SEm) and coefficient of variation (CV) of the mechanization index and farm power availability with the influence of social status, landholding and economic status of farmers.

RESULTS AND DISCUSSION

Effect of social status on mechanization index

The effect of the social status of farmers on the mechanization index was depicted in Fig 2. From graphical representation the highest mechanization index was observed in OC farmers as 87% and the lowest was reported by 52% of SC and 58% of ST farmers duly, moderate mechanization index as 75% for OBC Category farmers were reported. Effect of mechanization index is very low for SC and ST category because of small land holding, less annual income of the framers and the major reason is lack of knowledge to use farm machinery and implements. From the statistical analysis, the change of mechanization index among the social status shows the SEm±7.99, standard deviation (SD) is 15.98 and coefficient variation (CV) is 23.49.

Effect of landholding on mechanization index

The effect of landholding of the farmers on mechanization index is depicted in Fig 3. from graphical representation the mechanization index was observed high on large landholding farmers as 81% and the lowest was reported by 54% of marginal and mechanization index for small landholding farmer as 69%. The landholding of the farmers greatly affects the mechanization index, the less mechanization was found in the marginal farmers. Marginal landholding farmers are utilizing the more labour force for farming operations because a marginal farmer cannot afford to purchase the farm machinery, instead of purchasing the machinery they hired from the large landholding farmers to carry out the farming operations, which leads to an additional income to the large landholding farmer. From the statistical analysis, the change of mechanization index among the size of landholding shows the SEm±7.81, standard deviation (SD) is 13.53 and coefficient variation (CV) is 19.89.

Effect of economic status on mechanization index

The effect of the economic status of farmers on the mechanization index is depicted in Fig 4. From a graphical representation, the mechanization index was observed to be high, at 89% in >1.0 million economic class and the lowest was reported by 46% in <0.1 million economic class. The study indicates the use of mechanization in farm operation largely depends on the annual income of the farmers, as it indicated that the mechanization index increased linearly with increasing the farmer's socioeconomic status. The study indicated that overall average mechanization index is 68%. From the statistical analysis, the change of mechanization index among the economic status shows the SEm±7.50, standard deviation (SD) is 16.77 and coefficient variation (CV) is 24.67.

Effect of social status on farm power availability

The effect of the social status of the farmers on farm power availability is depicted in Fig 5. From the graphical representation, the highest farm power availability was observed in OC farmers at 1.88 kW ha^{-1} and the lowest was reported at 1.44 kW ha^{-1} for SC farmers and at 1.50 kW ha^{-1} for ST farmers. Moderate farm power availability at 1.74 kW ha^{-1} for OBC category farmers was also reported. Farm power availability is very low for SC and ST categories because of small landholdings and the lower annual incomes of the farmers. A small farmer cannot afford to purchase farm machinery; instead of purchasing the machinery, they hire it from custom hiring centres to carry out the farming operations. They also lack knowledge on the use of the farm machinery and implements for specific operations. From the statistical analysis, the change of farm power availability among social status shows the SEm±0.11, standard deviation (SD) is 0.21 and coefficient variation (CV) is 12.55.

Effect of landholding on farm power availability

The effect of the landholdings of the farmers on farm power availability is depicted in Fig 6. From the graphical representation, the highest farm power availability was observed on large landholding farmers at 1.9 kW ha^{-1}, the lowest was reported at 1.38 kW ha^{-1} of marginal farmers

Table 1: Classification of the farmer based on the size of the landholding.

Category	Landholding, Acre's	
	Dryland	Wetland
Marginal farmer	up to 2.5	1.5
Small farmer	up to 5	up to 2.5
Large farmer	More than 5	More than 2.5

Table 2: Economic class of farmers based on annual income.

Economic class	Economic value, million
I	Less than 1
II	1 to 2.5
III	2.5 to 5.0
IV	5.0 to 10
V	More than 10

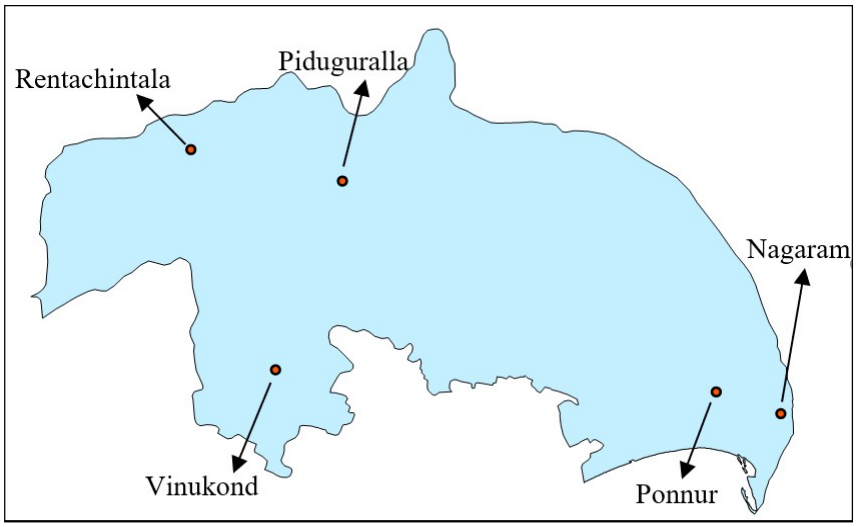


Fig 1: Map of Guntur district with the study area highlighted.

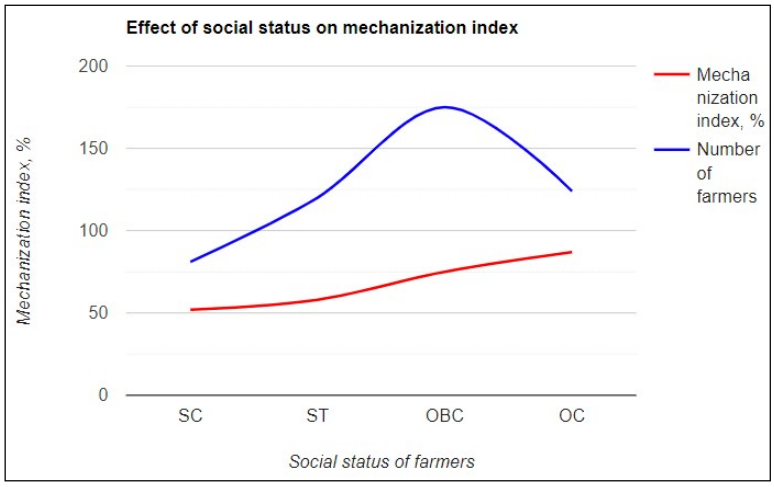


Fig 2: Effect of social status on the mechanization index.

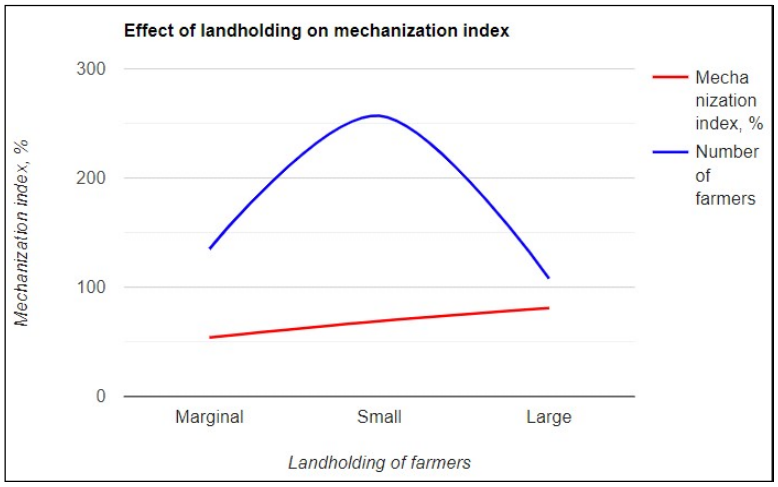


Fig 3: Effect of landholding on the mechanization index.

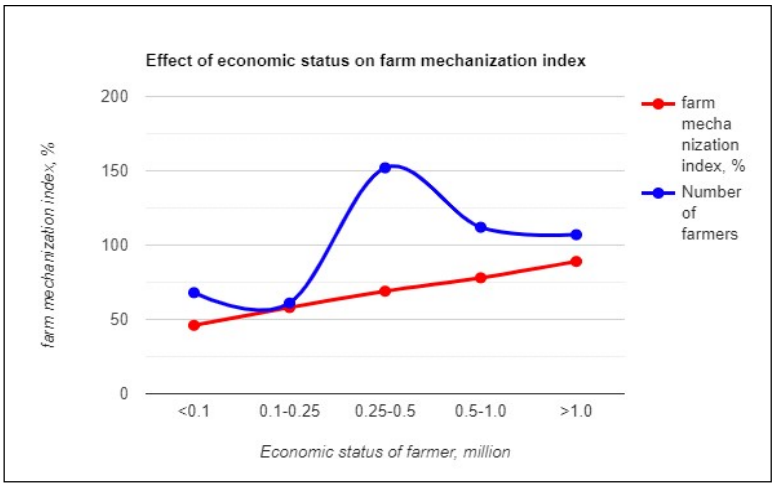


Fig 4: Effect of economic status on mechanization index.

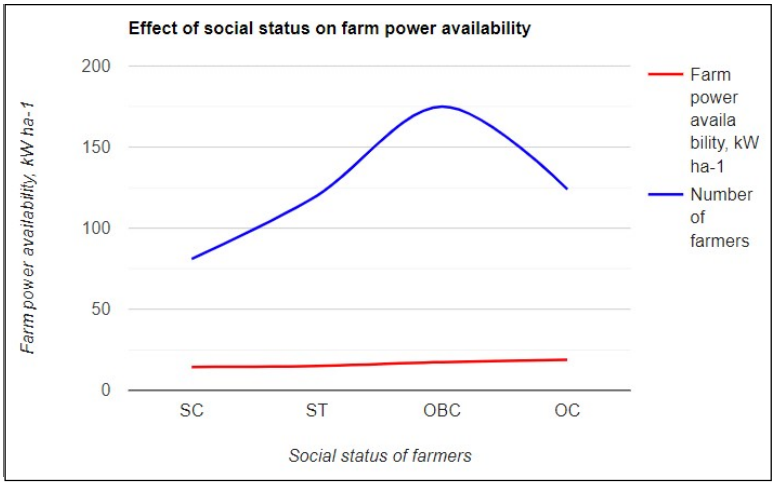


Fig 5: Effect of social status on farm power availability.

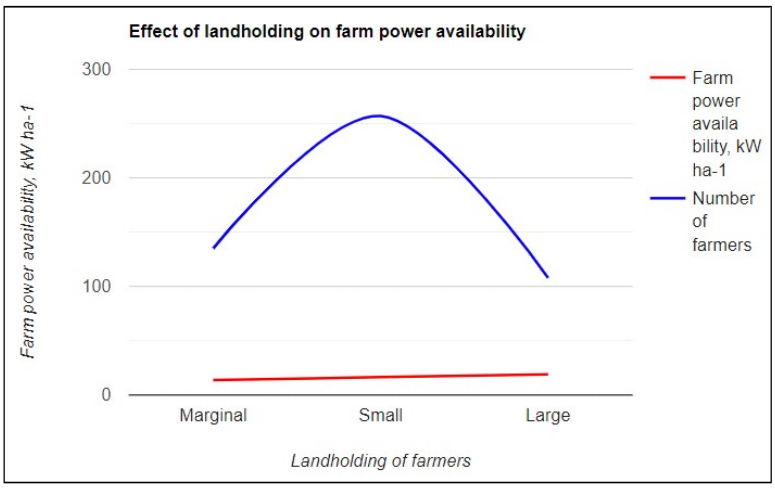


Fig 6: Effect of landholding on farm power availability.

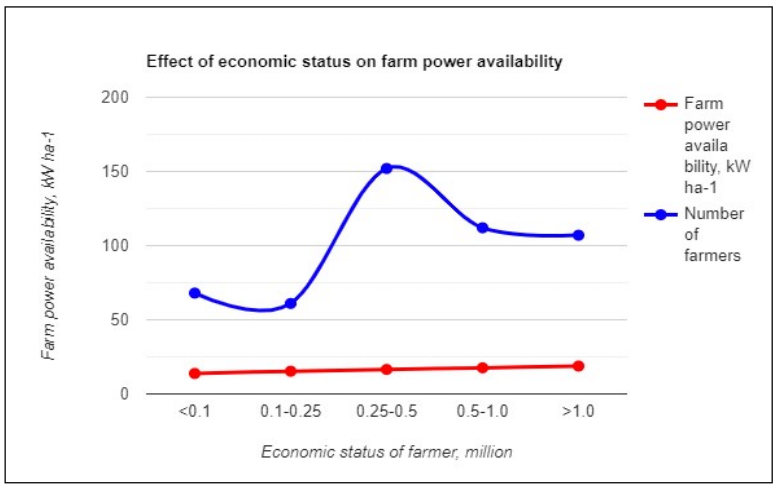


Fig 7: Effect of economic status on farm power availability.

and for small landholding farmers it was 1.64 kW ha^{-1}. The landholding of farmers greatly affects availability of farm power and less farm power was observed in marginal farmers. Marginal landholding farmers are utilizing power in the form of human sources to carry out the farming operations because a marginal farmer cannot afford to purchase the farm machinery, instead of purchasing the machinery they hired from the large landholding farmers to carry out the farming operations. From the statistical analysis, the change of farm power availability among the size of landholding shows SEm±0.15, standard deviation (SD) is 0.26 and coefficient variation (CV) is 15.85.

Effect of economic status on farm power availability

The effect of the economic status of farmers on farm power availability is depicted in Fig 7. From the graphical representation, the highest farm power availability was observed in the >1.0 million economic class at 1.88 kW ha^{-1} and the lowest was reported in the <0.1 million economic class at 1.38 kW ha^{-1}. The study indicates the availability of farm power in farming operations largely depends on the economic status of farmers, as it indicated that availability of farm power increased linearly with increasing farmer's economic status. The study indicated the overall average farm power availability as 1.64 kW ha^{-1}. From the statistical analysis, the change of farm power availability among the economic status shows the SEm±0.08, standard deviation (SD) is 0.19 and coefficient variation (CV) is 11.87.

Conclusion

The following results were derived from the aforementioned study: Mechanization index: High and low social status was observed as OC-87% and SC-52%. High and low values of landholding were observed at 81% for large farmers and 54% for marginal farmers, respectively. High and low economic class was found to be 89% in >1.0 million and 46% in <0.1 million. Farm power availability: High and low social status were observed at OC-1.88 kW ha^{-1} and SC-1.44 kW ha^{-1}. High and low values of landholding was observed as 1.9 kW ha^{-1} for large farmers and 1.38 kW ha^{-1} for marginal farmers. High and low economic class was found to be 1.88 kW ha^{-1} in >1.0 million and 1.38-kW ha^{-1} in <0.1 million. The overall average mechanization index and farm power availability was found to be 68 % and 1.64 kW ha^{-1}. The major factors influencing social status, size of landholding and economic status of the mechanization index and farm power availability were due to a lack of awareness and knowledge about the utilization of farm machinery and implements. Because marginal farmers cannot afford to purchase farm machinery, they hire it from custom hiring centres or from large farmers to carry out farming activities.

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Conflict of interest

The authors have declared that no conflict of interests exists.

References

Anonymous (2020). Population Projections, Government of India. Available at https://www.indiastat.com.

Anonymous (2020). Monitoring, Concurrent Evaluation and Impact Assessment of Sub-Mission on Agricultural Mechanization. Department of Agriculture, Ministry of Agriculture and Farmers' Welfare, Government of India. pp 1-4.

Charles Hall, A.S., Stephen, B. and David Murphy, J.R. (2009). What is the Minimum EROI that a Sustainable Society Must Have. Energies. 2: 25-47.

Emami, M., Morteza, A., Hossein, B. and Kalantari, I. (2018). Agricultural mechanization key to food security in developing countries: strategy formulating for Iran. Agriculture and Food Security. 24(7): 1-12.

Hitesh, S., Satya Narayan, S., Modi, V. and Patel, B. (2020). Status strategies and challenges for farm mechanization in Narmada district, Gujarat. Journal of Agri Search. 7(4): 247-250.

Jens Aune, B., Adama, C. and Giller, K.E. (2017). Precision farming for increased land and labour productivity in semi-arid West Africa. A review. Agronomy for Sustainable Development. 37(16): 1-10.

Kaler, N.S., Pant, K.S., Gupta, B., Bishisht, R., Attri, V. and Vipasha (2017). Economic analysis of prevailing agroforestry systems among different categories of farmers In Kangra Valley of Himachal Pradesh, India. International Journal of Bio-resource and Stress Management. 8(4): 510-513.

Maria, L.D., Claus, G.S. and Dionysis, B. (2020). Energy footprint of mechanized agricultural operations. Energies. 13: 1-15.

Mehta, C.R., Chandel, N.S. and Senthilkumar, T. (2014). Status, challenges and strategies for farm mechanization in India. Agricultural Mechanization in Asia, Africa and Lati America. 45(4): 43-50.

Minjie, J., Xinjie, H., Joseph, C., Ziyi, L. and Rilong, F. (2020). Does the popularization of agricultural mechanization improve energy-environment performance in China's agricultural sector. Journal of Cleaner Production. 276: 1-12.

Pankaj, K.M., Rajkumar, J.S., Muthu Lakshmi, B., Lego, I. and Monika, D.K. (2017). Study of socio-economic and psychological characteristics of farmers towards climate change. International Journal of Bio-resource and Stress Management. 8(6): 877-881.

Prem, K.S., Sarkar, B., Pawan, J., Sanjay, K.P., Anukul, P.A. and Upadhyaya, A. (2020). Dynamics of farm power sources and their availability in Bihar. Journal of Agri Search. 7(3): 128-131.

Radhey, S.S. and Manoj, K. (2017). Economic evaluation and mechanization index of selected cropping pattern in Madhya Pradesh. Economic Affairs. 62(3): 439-446.

Ram Nath, J., Shamshad, M.A. and Manish, T. (2019a). Evaluation of different wheat establishment methods at agricultural machinery testing and research centre, Nawalpur, Sarlahi, Nepal. International Journal of Bio-resource and Stress Management. 10(5): 567-574.

Ram Nath, J., Shamshad, M.A. and Manish, T. (2019b). Efficiency evaluation of different agricultural machinery in rice cultivation at agricultural machinery testing and research centre, Nawalpur, Sarlahi, Nepal. International Journal of Bio-resource and Stress Management. 10(6): 580-586.

Shivani, S., Ravinder, S., Kapil, D. and Samriti. (2021). Economic analysis and mechanization index of agricultural crops in Mandi district of Himachal Pradesh. Economic Affairs. 66(1): 169-174.

Singh, R., Gupta, O.P. and Patel, S.K. (2015). Energy use pattern and scenario change in sugarcane (ratoon) cultivation for Bhabar region of Uttarakhand, India. Journal of Agri Search. 2(2):119-125.

Surendra, S., Singh, R.S. and Singh, S.P. (2014). Farm power availability on Indian farms. Agricultural Engineering Today. 38(4): 44-52.

Tiwari, A. and Jaga, P.K. (2012). Precision Farming in India- A Review. Outlook on Agriculture. 41: 139-143.