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Computer programme for selecting farm machinery for tomato crop in central region of Madhya Pradesh

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Abstract
As a major sector, agriculture continues to be the life line for millions of farmers in Madhya Pradesh, India. A computer programme has been developed in order to aid decision making in tractor and implement selection for the small farm in Central region. The application of decision support system was demonstrated in the paper to select tractor power. The selection of tractor power in the study area. Through model a linear relationship was found between the optimum PTO power of tractor selected and the farm size. The unit power requirement followed an inverse relationship with the farm size. Initially it decreased rapidly from 1 to 5 ha of farm size and thereafter it tended to be asymptotic with the farm size. The programme able to handle a wide range of tractor and working condition because of its datafiles structure.

Keywords: Tomato vegetable crop, Farm mechanization, Computer programme, Madhya Pradesh

Introduction

History indicates that the Technology and machinery enhanced the ability, quality, accuracy and efficiency of the human being. Development in farm mechanization is very closely related to the shortage of human labour and industrial development in India and abroad. The existing belief of surplus labour and work animals in the country is not correct. As a result of higher rates of daily wages in the nearby cities, the agricultural labour seeks employment there. There is now, in fact, a growing shortage of agriculture labour in the country side. There is a gradual movement of village population to the cities and industrial towns. Since the entire Indian agriculture cannot be mechanized very soon, the labour population displayed from agriculture due to mechanization is being absorbed in the industries producing tractors and other farm machines, and other service sectors. It is quite true that the Indian farmers have the lowest earnings per capita because of the low yield per hectare they get from their holdings. One of the few important means of increasing farm production per hectare is to mechanize it. The effective mechanization contributes to increasing production in two major ways: firstly, the timeliness of operation and secondly the good quality of work. The requirement of power for certain operations like seedbed preparation, cultivation and harvesting becomes so great that the existing human and animal power in the country appears to be inadequate Ref [1]. The average yield of per unit area in Madhya Pradesh is quite low as compared to the other states of India and need to be enhanced through the proper and appropriate modernization of agricultural technology.

Tractor and machinery selection are important part of machinery management in any farm enterprise, as power and machinery jointly represent the largest single item of expenditure constituting about 60 per cent of the total farm investment on a farm. The size or capacity and number of equipment should match the power required by the various sequences of cropping operations that must be performed within specified time periods. The main aim of tractor and machinery selection studies is to complete the field operations during the specified time at minimum cost. Since, the capacity or size of the power-machinery system is directly proportional to their costs, the appropriate selection of these components is important for determining the profitability of the given farming system. Over sizing of the power sources and machinery helps to reduce the labour cost as well as timeliness cost.

Selection of optimum size farm machinery is quite critical, not only because of the high proportion of total cost attributed to machinery but also due to the infrequency and irrevocability of such decisions. Modern farming systems require large capital investment, complex economic decisions and higher levels of technical management to minimize cost of production and maximize profit.

Hence, selection of proper size farm power and equipment to permit economic production in a farm is of paramount important area. Several models have been developed to simulate field machinery selection, Selection criteria in those models are based on a combination of economic analysis and life, operational requirements timeliness of operation and machine reliability and least cost technique. Most of these models are suitable for use of the research workers for a particular crop rotation Ref [2]. A few location specific studies have been conducted in India for the selection of power and machinery for different farm sizes. Generally, farmers do not have sufficient time for field preparation and sowing/planting of vegetable crops. Hence, timeliness of operation is very important for vegetable crops. In this paper we are going to research on the selecting farm machinery for tomato with use of computer model in central region of Madhya Pradesh.

Material and method

Development procedure for the programme

The computational work involved in getting useful information from those models was complex and time consuming. The accuracy and speed of calculation and sensitivity of the models to change in various input parameters could be conveniently accomplished with the use of computers A computer program, named "Farm Mechanization Optimization Software" (FMOS) was developed to implement those models. Optimum size of tractor and name of the model available based upon the selected power by programme were computed in that program. The computer program was divided into series of sub modules to maintain the flexibility and user friendliness

Microsoft Visual Basic 6.0 is a powerful object oriented programming language. Visual Basic implements graphical user interface that allows the use of graphics for different applications. It provides visual interactive windows with user, like Dialogue box for (color, font ...), Input box, and Output box. Also it is able to create menu to simplify user application. Visual Basic provides the user with a complete set of tools to simplify rapid application development Ref [3]. The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen The "Basic" part refers to the BASIC (Beginners All-Purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the history of computing. When basic is opened, you see the screen shown in figure. Click open and will see the window for writing programs. BASIC will provide two windows for programming. The fist window is used to write the code of the programme. The second window is called a form that is used to display the output when the program is run. When we choose open with standard. EXE highlighted we see the two windows as shown in figure. The problem at this point is that these are just templates for our use and not windows in which we can actually write code or display output. Visual Basic has evolved from the original BASIC language and now contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI. It is easy to modify the programme by any user by just learning a few of the keywords, yet the power of the language allows professionals to accomplish anything that can be accomplished using any other Windows programming language.

The developed programme "Farm Mechanization Optimization Software (FMOS)" is based on the cycle given in Fig 1. The cycle has mainly five steps viz. planning, building the programme, testing, compiling and distributing.

Building the program

Building a windows-based application with Visual Basic 6.0 involves four programming steps:

1) Create the interface; that is, generate, position, and size the objects.
2) Set properties; that is, set relevant properties for the objects.
3) Write the code that executes when the events occur.
4) Saving a project.

Result and discussion

Logical sequence for optimum size of tractor selection

The model contained build on data related to the implement and tractors with their available power, soil conditions, soil types, speeds, field efficiency, the energy required by the implements and unit width of machinery.

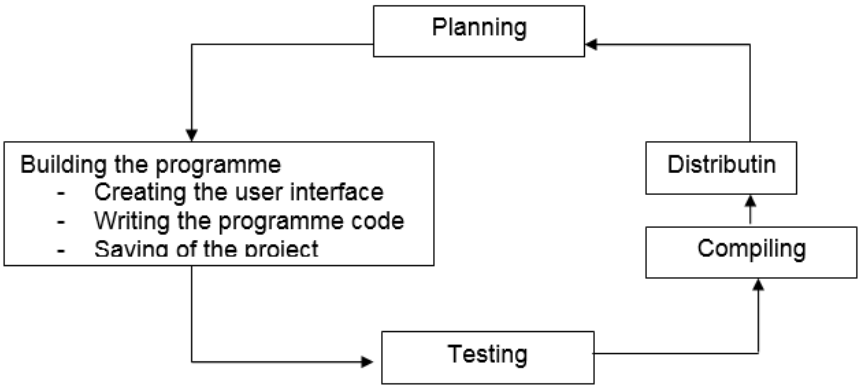


Fig 1: Software development cycle

The input data contains farm size for which the optimum size of the tractor to be calculated. With the data input and default data, the tractor power was calculated and nearest commercially available tractor range was suggested by the program. The programme starts by initializing all properties, limits and constants and input variables desired for computation of optimum width. Fig.2 shows the display screen for tractor selection module. After identifying a clear goal for the program FMOS (Farm Mechanization Optimization Software) as depicted it's important to think

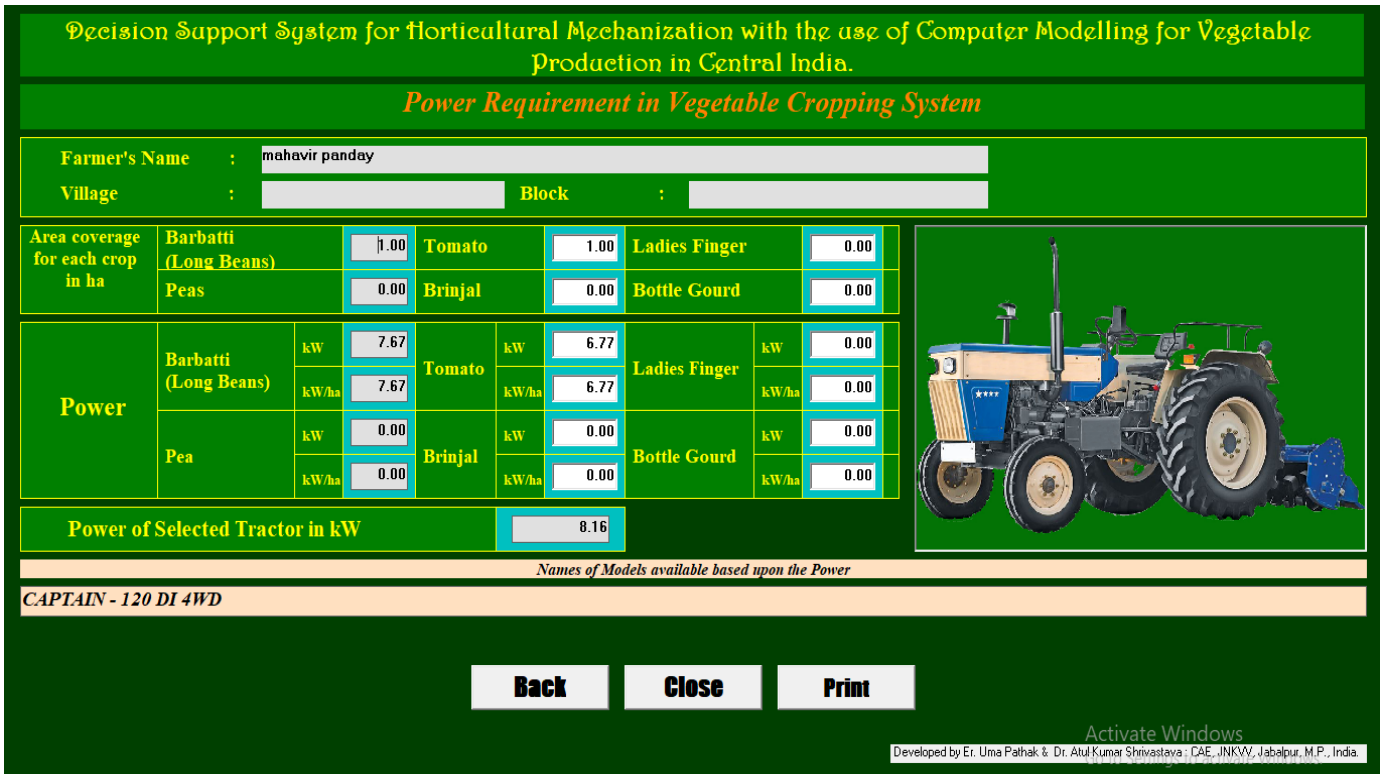
about how it will look and how it will process information. flow chart (Fig.3) were prepared for the development of programme.

Prediction of the size of tractor by program FMOS

The program calculates the energy for tomato crop. The higher energy was selected and show on the screen. Prediction of power of the tractor in terms of tractor PTO power for a given size of farm stepwise procedure is displayed in fig. 4. The personal data of the farmers like a village, block and districts along with his land holding has got to entered in the applicable box given in the screen. The program wants two seconds to calculate the required tractor PTO power and show it on screen as like in step–II (Fig. 4). According to the tractor PTO power, programme show tractor availability in the market within a range was also display. It was selected as per the commercially available power rating of different models of tractor available in the market.

Fig 2: Display screen for tractor selection module

Step I: Enter the data of farmers and his farm size, ha



Step II: Output data display by the program on selection of tractor PTO power (kW and kW/ha)

Fig 4: Steps for selection of tractor PTO power in computer

Table 1 show that output of the program for various farm size. Firstly, farm size entered after that output is given in screen. The power required by selected tomato crops and the predicted PTO power by the program are given in the table 1. The data inferred that the highest available size of kW of tractor was selected for the farm size 20ha.

The most minimal tractor accessibility by the program was 8.16 kW and was chosen for land having a farm size of 1 ha. The tractor choice is enhanced step by step as we tend to raised the farm size. The program responds the up to a limits of 80 ha land. Beyond this land size the program suggested the power more than 90.66 but at same time it suggested for two tractors and display a massage "*suggested for selection of more than one tractor. Divide lands into more than one sub plot and try again*". The user should divide the lands in blocks and should try it again to find appropriate tractor size.

The linear relationship between the optimum PTO power of tractor selected and the farm size shown in fig.5 tomato crops. The regression equation for the selected tractor power and the farm size was given by Equation1:

$y = 1.2963x + 8.3625$……(Eq.1)

$R^2 = 0.9817$

Where,

Y = Selected PTO power of tractor, kW; and

X= Farm size, ha.

The high value of coefficient of determination (0.9817) shows the results are authenticated. The unit power requirements for different farm sizes were also calculated and are presented in Fig.6. An inverse relationship with the farm size was obtained with the unit tractor PTO power (kW/ha). Initially it decreased rapidly from 1 to 5 ha of farm size, and thereafter, it tended to be constant with the farm size. The power regression relationship between the unit power requirement in farm and the farm size was found to be of the following form as in equation 2.

$y = -0.177x + 4.522$……. (Eq.1)

$R^2 = 0.679$

Where,

Y= Unit PTO power of tractor, kW/ha; and

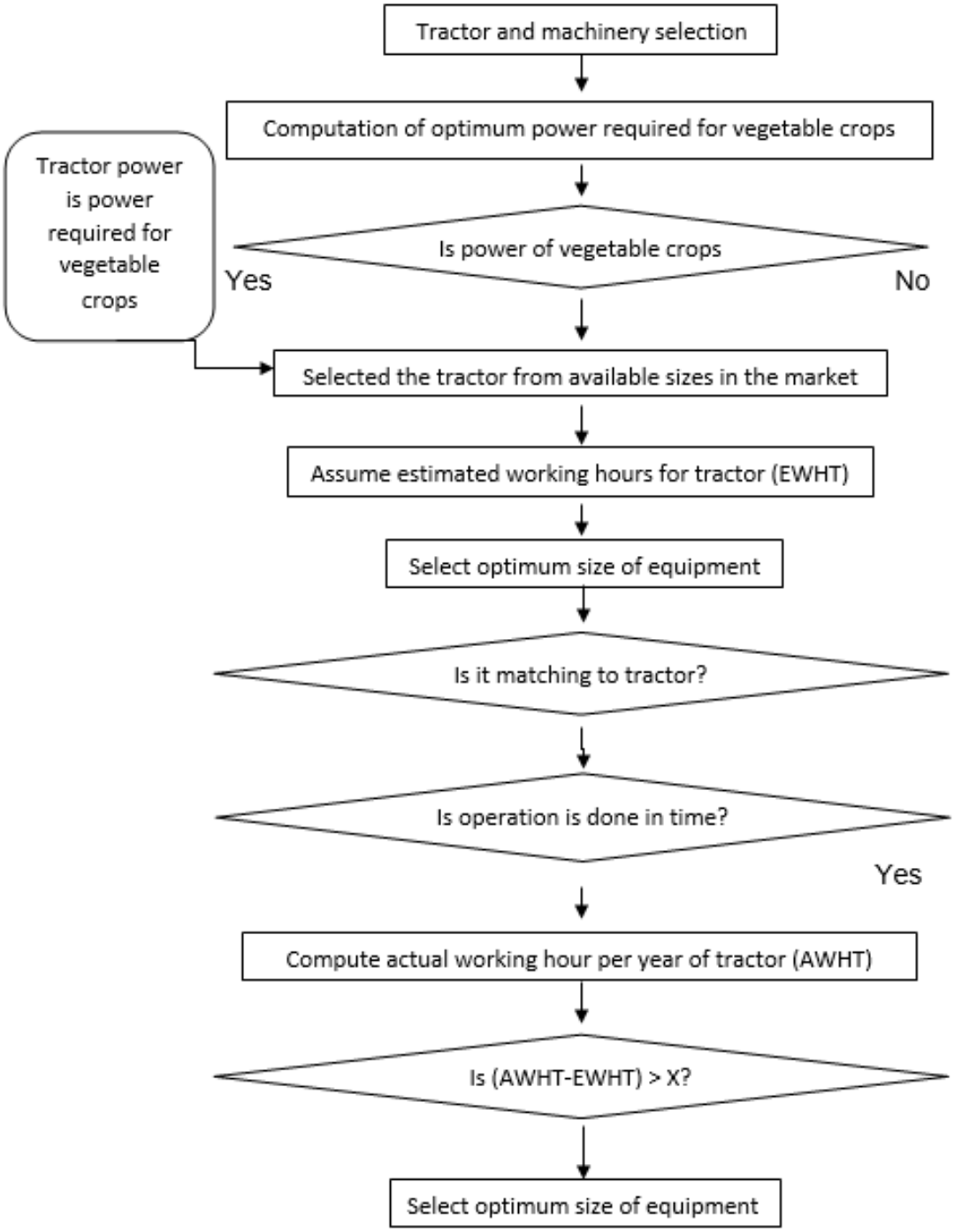
X= Farm size, ha

Its revels that model sensitivity/validity is very good for calculating the tractor PTO power for different farm size which can help for economic way of horticulture mechanization. Some other research Ref [4] and Ref [5] also agree with this statement.

Table 1: Power required by the tomato crop and predicted by the program

Farm Size(ha)	Power Requirement (kW)	Kw/ha	Power of Selected Tractor (Kw)
1	6.77	6.77	8.16
2	9.62	4.81	9.65
3	11.83	3.94	11.97
4	13.73	3.43	15
5	15.42	3.08	16.5
6	16.97	2.83	17.13
7	18.42	2.63	18.5

8	19.78	2.47	19.99
9	21.07	2.34	21.2
10	22.31	2.23	22.8
11	23.5	2.14	23.79
12	24.66	2.05	24.7
13	25.78	1.98	25.84
14	26.87	1.92	27
15	27.93	1.86	28
16	28.97	1.81	29.1
17	29.98	1.76	30
18	30.98	1.72	31
19	31.96	1.68	32
20	32.93	1.65	33.3



AWHT= Actual work hour/year for tractor
EWHT=Estimated work hour/year for tractor

Fig 3: Flow chart for model developed for selection of power and machinery

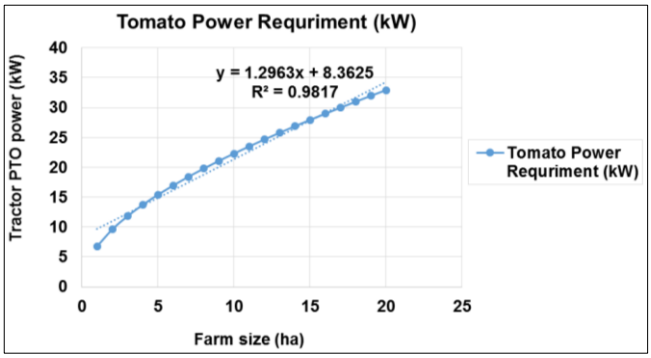


Fig 5: Relationship between tractor PTO power and farm size for tomato

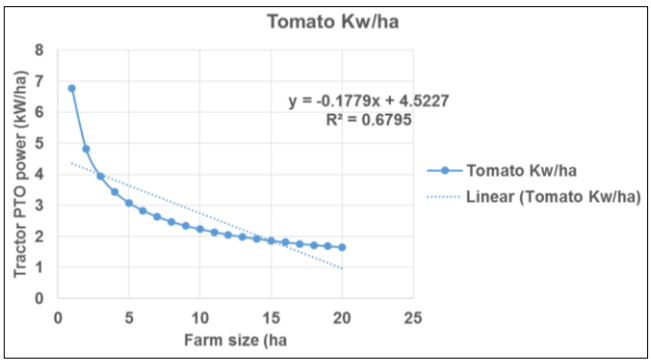


Fig 6: Relationship between unit tractor PTO power and farm size for tomato

Conclusions

1. The computer programme can handle a wide range of tractors and implements provide the technical information and the physical, agricultural and economic condition are properly supplied.
2. All the datafiles can be updated and simulations of tractor implement specifications can be made to predict the tractive performance and operating costs.
3. Optimum tractor power requirement was found to increased linearly with farm size, whereas, unit power requirement decreased initially with increase in farm size and thereafter, it became constant. The size of machinery was found to increase with the farm area.
4. The developed model is very useful in selection of tractor and machinery for tomato vegetable crop for farmers, researchers, bank employee for sanction of loan as well as to policy players and extension workers.

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