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Original Article

Influence of Meteorological Parameters on Suitable Workdays and Timeliness Cost in Sugarcane Harvesting Operation

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ABSTRACT

Accurate information on the days suitable for field operations is important in the design, development, and selection of efficient machinery systems for crop production. The amount of working days in some important relations used in agricultural mechanization and as one of the effective factors needed to calculate for determining the optimum size of machines, the capacity of existing farm machinery and calculating timeliness costs. Most important limiting factor for sugarcane harvesting operation is soil moisture conditions. For his propose obtain 12 years ago metrological data from metrological synoptic station in Amir Kabir sugarcane Agro-Industry which conducted in 45 km south of Khuzestan province Amir kabir Agro-industry (31º03´N 48º14´E). data analyzed by Microsoft Excel verion10 and results show December month have minimum but November & March maximum probably field day work is available in total period of harvesting sugarcane operation (from November to March) and The average field work day probably for total period of sugarcane harvesting obtain 0.68 also timeliness costs according to λo=2 is 336$/ha.
Key words: sugarcane harvesting, suitable field workday, timeliness cost

INTRODUCTION

Probability of a working day (PWD) is the fraction of workable days to all days in a work season, which often is used in management of agricultural mechanization. For example it is used to determine timeliness cost, optimum capacity of a machine and the required machine capacity [1]. Accurate information on the number of suitable days for field operations is important in design, development, and selection of efficient machinery systems for crop production [2]. In order to predict the amount of work that can be accomplished, the time available within the optimal period for the required operation must be known. The time available varies considerably from year to year as weather conditions vary. Selection of the optimal machinery set for long-term production on the farm depends upon accurate assessment of the days available for performing each field operation [3]. The most restrictive factor for sugarcane harvesting operation is the soil moisture.

MATERIAL AND METHODS

This field study was conducted in Amir Kabir Agro-industry (31º03´N, 48º14´E) 45 km south of Khuzestan province; Figure 1 shows the location of the field study. This region has a mean annual rainfall of about 147.1 mm, air temperature is 25 C, soil temperature at 50 cm depth is 21.2o C and Average elevation is 7m above sea level [4].

By collecting meteorological data along 12 years in Amir Kabir agro-industry Synoptic weather stations data calculate restrictive factors ass follow:

Restrictive factors

1- Temparture: the optimum range of temperature to doing farm operation is 2-30 C. days were conduct at this range calculated as workday.

2- Relative Humidity: suitable range of humidity for farm operation is between 45-85%. Days were conduct at this range calculated as workday.

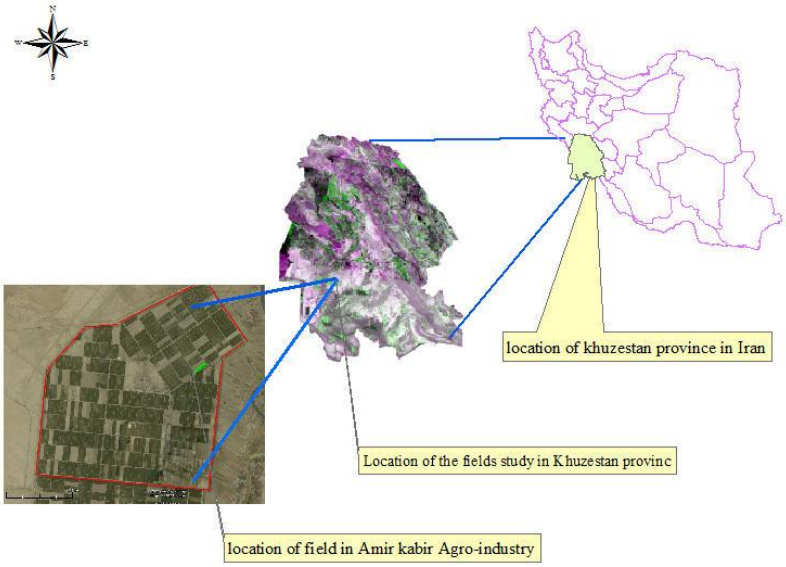


Fig 1. Location of the fields study in south of Ahwaz, Khuzestan province, Iran

3- Precipitation: most important district factor in sugarcane harvesting is rainfall and leads to increase in timeliness cost and soil compaction by agricultural machinery traffic. According to quantity of precipitation calculates suitable workday for days which have ≤2mm precipitation and for increase in each 1mm days after rainfall is unsuitable workday.

4- Evaporation: With increasing rainfall and decreasing temperature during the harvest season, we see a reduction in evaporation which leads to delay sugarcane farm soil humidity reach at field capacity for workability.

Table 1. Average daily temperature in 2007-2010 [5]

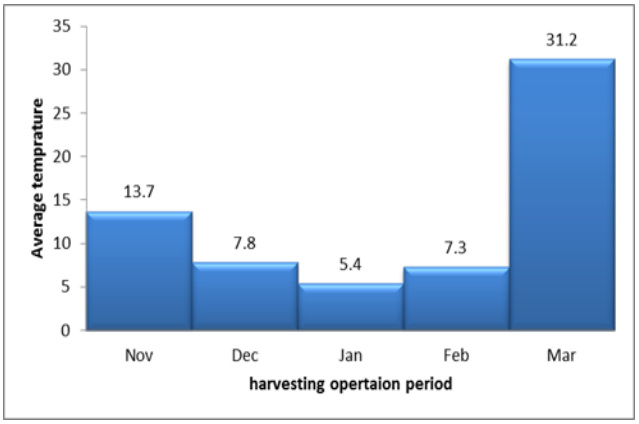


Table 2. Average RH% in Amir Kabir agroindustry [5]

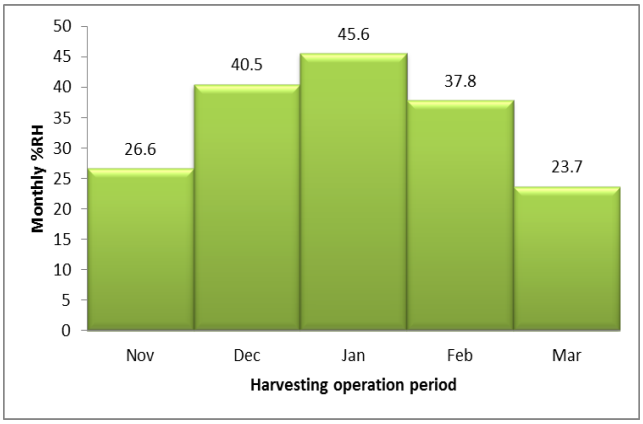


Table 3. Average Precipitation in Amir Kabir agroindustry [5]

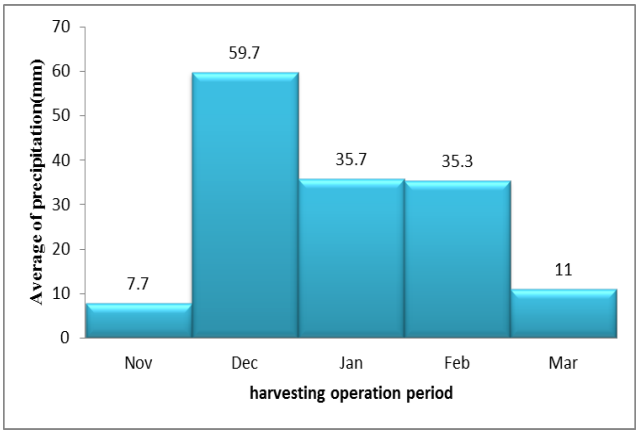
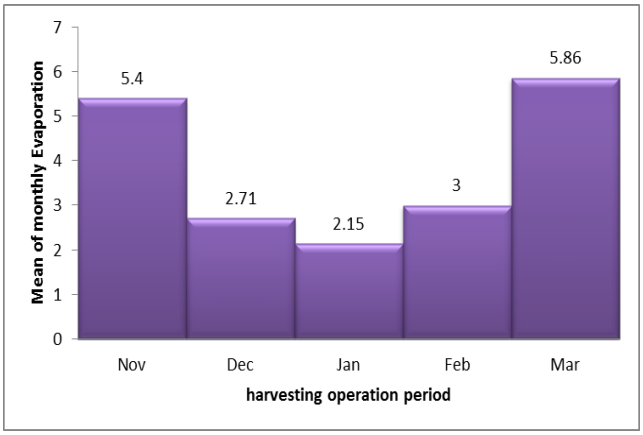


Table 4. Average monthly Evaporation in Amir Kabir agroindustry [5]



Probability of workdays: by review meteorological data and analyse them obtain table 5 and by using Equation (1) [6] calculate (Pwd) in each month and total harvest season.

Table 5. The average number of sunny, semi cloudy and full cloudy days [5].

Situation	Harvest Season					Sum
	November	December	January	February	March	
Sunny	17.6	14.3	15.1	15.5	16	78.5
Semi Cloudy	8.2	9.5	8.1	7.7	8.5	42
Full Cloudy	4.2	6.2	6.8	6.8	5.5	28.5

$$pwd = \frac{\frac{1}{8}\text{full cloudy days} + \frac{1}{2}\text{semi cloudy days} + \text{total sunny days}}{\text{Total suitable days for operation}} \quad (1)$$

Table 6. Segregate (Pwd) in each month and average total (Pwd) into harvest season

Month	November	December	January	February	March	Total Season
Pwd	0.74	0.66	0.67	0.70	0.71	0.68

Timeliness cost: by little change in ASAE EP496.2 [7] recommended the annual timeliness cost for an operation can be estimated by Equation (2) [8].

$$TC = \frac{K_t.A.Y.V}{\lambda_O.T.C_a.P_{wd}} \quad (2)$$

Ct= timeliness cost ($/ha)

[K]Timeliness coefficient= A factor used to estimate the reduction in crop return (quantity and quality) due to lack of timeliness in performing an activity [9].

A= area (hectare/year)

Y= yield per area (ton/ha)

V= value per yield ($/ton)

λo = if start and end operation doing in unsuitable time =2

λo = if start and end of operation doing in suitable time =4

T= expected time available for field work each day (hr/day)

Ca= machine capacity (ha/hr)

Pwd= probability of a working day (decimal)

RESULTS

Average yield of sugarcane per hectare in Amir kabir agro industry is 77.7ton/ha which only 10% of harvested cane produce sugar 7.77 ton and each white sugar world price is 452 $.

Table 7. Result of timeliness cost formula calculate factor for sugarcane agro industry

Factor	T	Pwd	Ce	λo	K_t(day)	Value	Y (ton/ha)	A(ha)
Quantity	24	0.68	*0.4	*2	0.0025	452	77.7	50

*according to [6]

So quantity of timeliness cost during harvest season obtains as follow:

$$TC = \frac{0.0025 \times 50 \times 77.7 \times 452}{2 \times 24 \times 0.4 \times 0.68} = 336\$/ha$$

DISCUSSION

results show December month have minimum but November & March maximum probably field day work is available in total period of harvesting sugarcane operation (from November to March) and The average field work day probably for total period of sugarcane harvesting obtain 0.68 also timeliness costs according to ?o=2 is 336$/ha. It is suggested to consider calculate timeliness cost for all area under cultivation and all farm machinery operation, reliability of machinery and repair and maintenance cost of new machinery so will take decision about replacement, buying and adding new machinery for doing operation in optimum time.

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