ECONOMICS OF PRECISION AGRICULTURE FOR WHEAT AND BARLEY CULTIVATION IN HAMEDAN, WESTERN IRAN

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ABSTRACT

Precision agriculture can influence agricultural operation economics. In this study, minimum economical farm sizes for producing irrigated/dry wheat and barley in Hamedan have been estimated considering extra input consumed and the technology implementation costs. The areas were estimated to be 694, 975, 1361, and 420 hectares respectively for irrigated wheat, dry wheat, irrigated barley, and dry barley.

Keywords: Precision agriculture (PA), economical area, wheat, barley, farm size.

INTRODUCTION

Hamedan state producers' average owned land is about 7 ha and each producer provides 14 individuals' agricultural based requirements (HDA, 2007). Wheat and barley conventional cultivation approaches cause the input application to be more than what is needed; that is, extra costs due to excessive input application.

Table1. Recommended and consumed inputs (Source: HAD, 2008)

Crop	Seed				Nitrogen				Phosphorous				Input excessive costs* ($/ha)	Cultivated area (ha)	Total excessive costs** ($)
	Recommended amount (kg/ha)	Unit costs ($/kg)	Applicated amount (kg/ha)	Extra costs ($/ha)	Recommended amount (kg/ha)	Unit costs ($/kg)	Applicated amount (kg/ha)	Extra costs ($/ha)	Recommended amount (kg/ha)	Unit costs ($/kg)	Applicated amount (kg/ha)	Extra costs ($/ha)			
Irrigated Wheat	180	0.29	227.22	13.60	130	0.10	161.79	3.12	90	0.09	144.71	4.65	21.66	97196	2105265
Dry Wheat	80	0.27	132.32	14.23	50	0.08	55.36	0.45	50	0.08	58.93	0.67	15.38	303245	4663908
Irrigated Barley	180	0.29	210.13	8.59	130	0.08	129.97	0.00	90	0.08	120.04	2.25	11.11	36745	408237
Dry Barley	80	0.27	175.09	25.96	50	0.12	92.58	5.11	50	0.11	91.80	4.68	35.75	28141	1006041

Input excessive costs = (Applicated amount –Recommended amount) × Unit cost, **Total excessive costs = Input excessive costs × Cultivated area*

METHODOLOGY

PA can be defined as appropriate amount of inputs according to plants' needs. Table 1 shows the recommended and applicated amounts. Consequently, excessive costs would be calculated. Table 2 shows costs needed to equip current machines with PA.

$$Machine\ Field\ capacity = Machine\ practicable\ width \times Work\ speed^{1}$$

Table2[*]. Precision farming equipment costs ($) (Source: Stombaugh et al, 2003).

Machinery	C (ha/hr)	Number	PC	YM	GPS	GIS	Sensors	Total
Sprayer	3	1	1000/3		2500	1000/3	200	3366.67
Planter and Fertilizer	1.5	2	1000/3		2×2500	1000/3	200	5866.67
Combine	3	1	1000/3	4000	500	1000/3	600	5766.67
Total	3		1000	4000	8000	1000	1000	15000

[*] Field Capacity (C), Personal Computer (PC), Yield Monitor (YM), Global Positioning System (GPS), Geographic Information System (GIS)

RESULTS

According to Table2, application of precision farming equipments for cereals cost 15000$ for field capacity of 3 ha/hr. Thereby, the minimum economical farm land area for precision agriculture technologies application can be estimated as follow:

Number of needed systems (N) = Total excessive costs / Precision farming equipment costs
Minimum economical farm sizes (ha) = (Total cultivated area / N)

Table3. Estimation of minimum economical farm sizes

Crop	Total cultivated area	Number of needed systems	Minimum economical farm sizes
Irrigated Wheat	97196	140	694
Dry Wheat	303245	311	975
Irrigated Barley	36745	27	1361
Dry Barley	28141	67	420

CONCLUSIONS

Regarding to eq.1&2, minimum economical farm sizes for application of precision agriculture are estimated 694, 975, 1361, and 420 hectares respectively for irrigated wheat, dry wheat, irrigated barley, and dry barley. As a result, dry barley cultivation is preferred to be equipped with precision farming technology, whilst this is not recommended for irrigated barely.

The average of minimum economical farm sizes for cereal cultivation in Hamedan would be 546 hectares and this farm size typically involves 78 utilizer-owned lands. Number of utilizers makes problems for precision farming extension unless they form some farm institutes to provide appropriate services.

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1 - Lak and Boluki (2008) estimated the machine field capacity to be equal to 3 ha/h.

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