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ECONOMIC LOSSES OF WHEAT CROPS INFESTED WITH YELLOW RUST IN HIGHLAND BALOCHISTAN: SURVEY RESULTS

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ECONOMIC LOSSES OF WHEAT CROPS INFESTED WITH YELLOW RUST IN HIGHLAND BALOCHISTAN: SURVEY RESULTS

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ABSTRACT: A survey of yellow rust (YR) infestation in wheat crops was carried out in the districts of Loralai, Kalat and Khuzdar in highland Balochistan at the end of the 1989/90 growing season. The objectives of the survey were to determine the disease intensity in different representative districts and to obtain information about its associated economic losses. Ninety-nine percent of the farmers in the surveyed areas (comprising more than 123,000 ha) were found growing local wheat varieties which are susceptible to YR infestation under both irrigated and rainfed conditions. Field measurements indicated that grain losses were 88, 77 and 58 percent in Loralai, Khuzdar and Kalat, respectively. Gross revenue losses for grain and straw were calculated using actual field quantification of disease damage as well as secondary data on ha cultivated to wheat. Estimated gross revenue losses for the three districts were Rs 200 million. Even though the highest proportion of infested crops occurred in Loralai, 74 percent of the total economic losses over the three districts occurred in Khuzdar and Kalat due to the larger area cultivated to wheat. These heavy losses affected farmers with small land holdings, low land productive potential and with crop-livestock production systems.

Key Words: Wheat (disease survey); Yellow rust; Highland Balochistan; Economic losses; Gross revenue.

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INTRODUCTION

In the highlands of Balochistan, wheat is the main dual-purpose cereal crop, and is cultivated under both rainfed and irrigated conditions. The available local wheat landraces are well adapted to the harsh, arid and very variable environmental conditions of Balochistan, but they are highly susceptible to yellow rust (Puccinia striiformis) infestation (henceforth abbreviated as YR). These YR epidemics occur in two or three years out of ten, and cause great losses in gross revenues to farmers. The occurrence of these epidemics depends upon the presence of high atmospheric humidity, which occurs in years when the rainfall exceeds the normal average of 250-300 mm. The probabilities of getting annual precipitation exceeding 300 mm are depicted in Figure 1 (Kidd et al., 1988). In the northeastern areas bordering the Punjab Province the probability of exceeding 300 mm is as high as 90 percent, while further west (Loralai) and south (Khuzdar) the probability is somewhere between 10 and 30 percent, and in Kalat it is less than 10 percent.

Above average rainfall (>300 mm) in the 1989/90 season caused a serious epidemic of YR. Many farmers in Balochistan requested technical assistance in assessing the damages and losses to the wheat crop, and therefore a disease incidence survey was carried out during the summer of 1990 in Loralai, Kalat and Khuzdar districts. The survey team consisted of agricultural economists, breeders and pathologists from the Arid Zone Research Institute (AZRI) and Provincial

Agricultural Research Institute (ARI). The objective of the study was twofold: to determine the disease intensity in different areas and to obtain information about the associated economic losses.

SURVEY PROCEDURES

The wheat disease survey was conducted in three representative districts of highland Balochistan (Loralai, Kalat and Khuzdar) during May and June of 1990. Fifty farmers were interviewed from the Duki and Mekhtar areas of Loralai district, and 30 farmers each from Kalat and Khuzdar districts. Duki and Mekhtar were surveyed to obtain information from predominantly irrigated and rainfed conditions, respectively, in order to determine the disease intensity and losses under these two different moisture regimes. Villages, and farmers within the villages, were selected at random. Farmers with infested and those with non-infested crops were interviewed. In addition, field measurements were conducted to evaluate the severity of infestation. Three random crop samples of one square meter from each respondent farmer were also collected. These samples were dried and threshed, and grain yields were calculated for comparison with the farmers expected yield losses. In the absence of exact figures for the area cultivated to wheat in the 1989/90 season for each district, the number of ha cultivated to wheat in the previous season (1988/89) was used to estimate farmers' gross revenues and losses.

FARMING SYSTEMS

Nearly all the farmers practice mixed crop-livestock farming systems to reduce the risks associated with frequent crop failures caused by erratic and uncertain rainfall. In Khuzdar, 93 percent of the respondent farmers raise livestock along with rainfed crops compared with 90 percent in Loralai. Also, lower rainfall conditions are expected by farmers in the southern areas while higher precipitation is expected in northern areas (Figure 1).

Farmers prefer to grow wheat on most of their crop land to try to ensure their own food security (Rees et al., 1989a). Grazing during the early vegetative stage of the wheat crop is practiced in this area due to animal feed shortages in the winter months, and also to avoid lodging due to excessive growth in more favorable years (Abdul Salam Baloch, Director of Agricultural Extension, Ranibagh, Quetta, personal communication). In the Middle East, sheep may be turned in to graze mature grain crops in years when rainfall is very low and it is not economic to harvest then for grain; the decision-making processes under these conditions have been documented by Nordblom (1985) and Hughes et al. (1990).

Ninety-nine percent of the farmers were growing local wheat landraces, which are white seeded, red seeded, or a mixture of red and white seeds. The local landraces are well adapted to the prevailing environmental conditions, and satisfy the local taste criteria. Also, they give a high yield of straw, which is important for livestock feed. In

contrast, very few farmers were growing improved varieties (Zarghoon, Pak 81, etc.). In Duki, where most of the farmers have access to irrigation, no farmers were growing any of the improved varieties developed for irrigated conditions.

GRAIN AND STRAW YIELD LOSSES

The weighted averages of infestation were 88, 58 and 77 percent in Loralai, Kalat and Khuzdar, respectively (Table 1). The lower infestation in Kalat could be related to late planting, which is the usual practice there, and to the lower temperatures associated with the higher altitudes in that area. The average calculated percentage of grain and straw of local wheat landraces from different sites and seasons varies from 21 to 23% and 77 to 79%, respectively (Rees et al., 1989b and Ahmad et al., 1990b). In contrast, the data in Table 2 can be used to show that the grain and straw percentage of diseased plants sampled in our survey was 11 and 89, 15 and 85, and 12 and 88% at Loralai, Khuzdar and Kalat, respectively. This data indicates that YR severely reduces grain yields but had relatively less effect on straw yields, hence the grain to straw ratios are significantly decreased. Such a result is expected since YR adversely affects photosynthetic and metabolic processes, thereby reducing the number of spikes per plant, the number of grains per spike, and kernel weight.

ECONOMIC LOSSES

In the three districts surveyed, the estimated grain gross revenues without infestation (i.e., potential production under

good rainfall conditions as in 1989/1990) were Rs 244 million compared with estimated straw gross revenues of Rs 238 million (Table 3). This shows that straw is almost as valuable as grain for the farmers. In Loralai, in the absence of YR infestation, the estimated gross revenues from straw were about two thirds of the gross revenues from grain. In contrast, in Khuzdar and Kalat the gross revenues from straw were slightly above those from grain. These differences are due to differentials in farmgate prices of grain and straw. In Khuzdar and Kalat, where farmers encountered harsher rainfall conditions, the value of grain was 2.50 Rs/kg while in Loralai it was 3.0 Rs/kg. Correspondingly, the farmgate price of straw was 0.69 Rs/kg in Khuzdar and Kalat while it was 0.56 Rs/kg in Loralai. Higher demand for straw in the lower rainfall areas possibly contributed to higher prices, but there are no data on price elasticity of grain and straw in this area for predicting the behavior of farmers demanding these commodities.

The estimated grain gross revenues with infestation in the three districts were Rs 123 million with corresponding estimated straw gross revenues of Rs 161 million (Table 3). Infestation of YR caused lower harvest indices (averaging 13 percent) and lower total dry matter production (Table 2). Two factors complicated the assessment of the farmgate price differentials of grain and straw with and without infestation: 1) Many farmers indicated that the straw of infested crops is not suitable for fodder due to its bitter taste and low

palatability. However, they did not indicate by how much the farmgate price was decreased by lower palatability. Some farmers also stated that rain washed the YR spores off the leaves and then the livestock did not find the material so unpalatable. 2) Due to severe infestation, most of the farmers in the surveyed areas decided to allow their livestock to graze the crops, because they anticipated little or no grain production and estimated that the labor charges for harvesting and threshing would be higher than the gross revenues from grain. In these cases the market value assigned to grain and straw ignored the absence of harvesting costs.

Estimated total losses in Khuzdar were almost double those in Kalat due to higher infestation and a larger area planted to wheat. Total losses in Loralai and Kalat were similar: Kalat had a lower infestation rate but had a larger area of wheat, while Loralai had a higher infestation rate but a lower area. Total losses across districts in grain gross revenues were 62 percent while the losses in straw gross revenues were 38 percent. Losses per hectare were higher in the areas with more favorable rainfall (i.e., Loralai). Even though total wheat losses per farm were larger in Loralai (average of 48 ha cultivated wheat per farm in the 1989/90 growing season) compared to Khuzdar and Kalat (average of 15 and 18 ha per farm, respectively), the number of farms affected by YR infestation was larger in Khuzdar and Kalat.

The share of total losses of Loralai was only 26 percent compared to 47 and 27 percent for Khuzdar and Kalat,

respectively (Table 3). Khuzdar and Kalat accounted for 70 percent of the grain and 78 percent of the straw losses of gross revenue. A feed deficit of 130,000 tons of straw (straw losses in Rs divided by straw farmgate prices, Table 3) in a year with high production expectations may have caused earlier than normal sales of livestock with a corresponding penalty for selling small lots of animals, with low weights, in poor condition. Further research is required to quantify (or estimate) the effects on sheep and goat sales of such feed deficits. The interplay of average land cultivated to wheat, potential land productivity (i.e., expected precipitation), susceptibility of the local landraces to YR infestation and the role of livestock production in the household economy, determined the distribution of losses in highland Balochistan. The corresponding potential benefits to farmers are considered in the next section.

POTENTIAL RETURNS TO GERMPLASM RESEARCH IN RAINFED AREAS

Evaluation and introduction of disease resistant wheat varieties is the only way to decrease these economic losses in this area. Even though the chances of getting above 300 mm rainfall are low in the area, the possibility of suffering such severe infestations poses a continuous risk to wheat crops every year. The 1982/83 growing season was the wettest year ever experienced in Balochistan (910 mm), and there was a YR epidemic. The disease intensity and grain yield losses were approximately the same as in the 1989/90 season (Irshad Begum, Scientific officer, Germplasm evaluation section, AZRI,

personal communication). Nagy et al., (1989) have reported that in the last decade two severe outbreaks of YR have occurred in upland Balochistan. Assuming that YR infestation occurs once every five years, with estimated gross revenue losses of Rs 200 million in these three districts, financial support for germplasm research to develop YR resistant varieties could be justified for up to Rs 10 million per year over a five year period, with a benefit-cost ratio of 4:1. In fact, the benefits of such research would be even greater because YR epidemics cause damage in a larger area than just the three sampled districts of highland Balochistan.

Of the farmers interviewed, 96% were in favor of adopting wheat varieties resistant to YR but they did not know where to obtain such varieties. The tenant farmers the surveyed areas depend on their

land-owners to make the decision to adopt improved disease resistant varieties. In contrast, farmers who cultivate their own land face the financial problem of buying new varieties of seed with their own resources. Our survey results showed that most of the farmers who have irrigation facilities did not know about the recommended improved varieties such as Zarghoon and Pak-81, which have proved to be cost effective under irrigated conditions (Bashir et al., 1989).

The rainfed areas require new resistant varieties, along with improved technology, to cope with production risk. However, the quick spread of improved varieties will depend on good seed production capabilities under rainfed conditions.

At present, the farmers have no alternative variety resistant to cold and drought, with high straw production and good bread-making qualities, and resistance to YR. It is hoped that in the near future AZRI germplasm scientists will be ready to release an improved disease resistant variety suitable for crop-livestock production systems (Ali et al., 1989; and Ahmad et al., 1990a).

The main conclusion from the survey is that there a very strong case for allocating more resources to germplasm research, to develop disease resistant varieties suitable for the rainfed areas of Balochistan.

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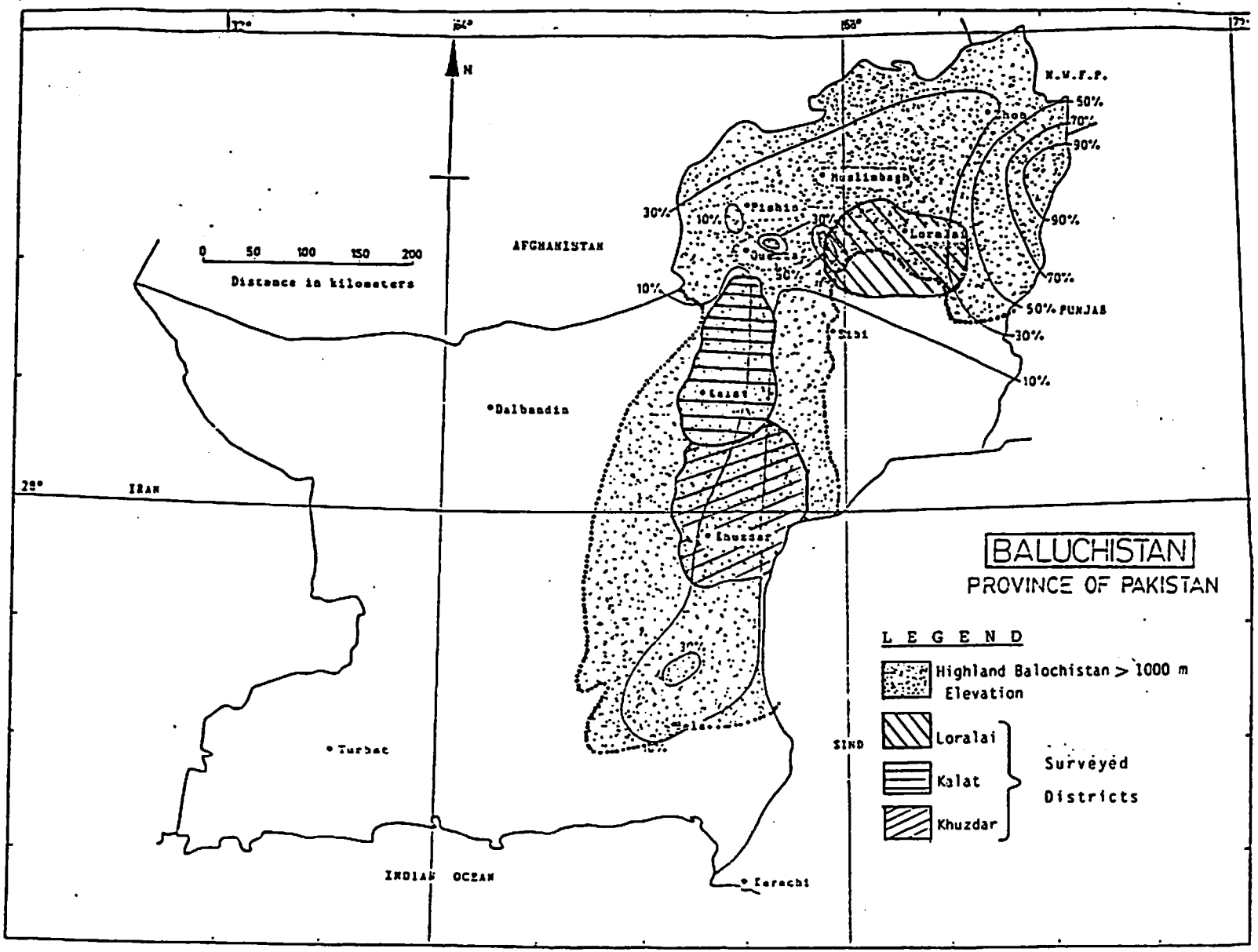

Fig. 1. Annual precipitation probability of exceeding 300 mm (normalized on 1901-1940) modified from Kidd et al., 1988.

Table 1. Severity of yellow rust infestation on wheat crops.

	District		
	Loralai	Kalat	Khuzdar
	------ Number of farmers (%) -------		
Severity of infestation			
Low: 5-25%	-	3(10)	2(7)
Moderate: 26-75%	-	18(60)	4(13)
Epidemic: 76-100%	50(100)	9(30)	24(80)
Total	50	30	30
	---------- % ----------		
Weighted average[1]	88	58	77

[1]low=15%, moderate=50% and epidemic=88%.

Table 2. Grain and straw yields with and without disease and the corresponding losses in the surveyed areas (grain and straw yields based on actual wheat crop cut samples).

District	Yields (kg/ha)		Losses[1] (%)	
	Grain	Straw	Grain	Straw
Loralai				
(a) Duki:				
Without disease[2]	980	3724		
With disease	140	1120	86	70
(b) Mekhtar				
Without disease[2]	630	2394		
With disease	200	1600	68	33
Khuzdar				
Without disease	800	3040		
With disease	205	1148	74	62
Kalat				
Without disease	750	2850		
With disease	285	2109	62	26

[1]Losses were calculated as the difference between yields without disease and yields with disease divided to the yields without disease.
[2]Values estimated with data from previous years in the same location (Ali et al., 1989; and Ahmad et al., 1990a).

Table 3. Estimated grain (straw) gross revenues and losses due to yellow rust infestation.

District	Degree of infest.[1] (%)		Gross Revenue: Without infest.[2] (A)	Gross Revenue: With infest.[3] (B)	Losses (A-B)	Grain and straw losses	Loss share (%)
			(Rs Millions)				
1) Loralai							
a) Duki	88	Grain	23.52	5.77	17.75		
		Straw	16.68	6.42	10.26	28.01	14
b) Mekhtar	88	Grain	30.62	12.23	18.39		
		Straw	21.72	15.38	6.34	24.73	12
2) Khuzdar	77	Grain	86.80	37.09	49.41		
		Straw	91.04	47.41	43.63	93.34	47
3) Kalat	58	Grain	103.50	66.28	37.22		
		Straw	108.55	92.18	16.37	53.59	27
	Total	Grain	244.44	123.37	123.07		
		Straw	237.99	161.39	76.60	199.67	100

Notes: In 1988/89 the cultivated area in Duki, Mekhtar, Khuzdar and Kalat was 8,000, 16,200, 43,400 and 55,200 ha, respectively (Government of Balochistan 1988/89). Grain (straw) farmgate prices were Rs 3.0/kg (Rs 0.56/kg) in Loralai district and Rs 2.5/kg (Rs 0.69/kg) in Khuzdar and Kalat districts.

[1]Weighted averages from Table 1.

[2]Grain (straw) yield without disease X cultivated area X farmgate price.

[3]Grain (straw) yield with disease X cultivated area X degree of infestation X farmgate price plus the value in column A for grain (straw) multiplied by the degree of non-infestation.