MARA
Ministry of Agricultural and Rural Affairs
Republic of Turkey

ICARDA
International Center for Agricultural Research in the Dry Areas

CIMMYT
International Maize and Wheat Improvement Center

Adoption and Impacts of Improved Wheat Varieties in Turkey

Results and Perspective

Prepared by

Dr. Ahmed Mazid

Agricultural Economist – ICARDA

Ankara - June 2009

Outline

- Results
  1. Reasons for preferring the varieties
  2. Variety adoption (rate, degree)
     a. Variety diversity at household level
     b. Diffusion of the monitored varieties
     c. Adoption rates of wheat varieties by group classification
  3. Impact of the new varieties on productivity
     a. Comparison of wheat yields
     b. Comparative yield stability
  4. Production function analysis
     a. Multiple linear production function
     b. Cobb-Douglas production function
  5. Profitability of wheat production
  6. Income sources
  7. Impact on poverty
  8. Estimated total increase in national income
  9. Rates of return to research
- Conclusions
- Further work

Results

Characteristics of Wheat Varieties Preferred by Producers (% of Respondents)

Traits	Ceyhan-99	Karahan-99	Pehlivan	Saricanak-98
Better yields	91.1	81.8	65.8	100.0
Good market price	53.3	18.2	45.6	33.3
Locally adapted	31.1	18.2	22.8	66.7
Frost resistant	6.7	18.2	39.2	-
Good bread quality	37.8	-	17.7	-
Drought resistant	17.8	100.0	8.9	-

Farmers' Perception

- Producer preferences for variety characteristics are critical to adoption. Understanding these criteria allows breeders to effectively set priorities and target breeding strategies.

- Farmers' evaluations of new varieties are also useful to determine whether they have maintained their intrinsic characteristics, and if their agronomic as well as quality and price performances are satisfactory from the view of the end users.

Characterization of household Assets and Wealth Quartiles

Creating Wealth Index

- Wealth score for each household was created based on household assets (natural, physical, financial, human, and social capitals), then classified farmers into wealth quartiles

Farmers' Characteristics by Wealth Quartiles

Variables	Wealth quartiles			
	Lowest 25%	25%-50%	50%-75%	Highest 25%
Total holding area (ha)	14.4	19.8	27.5	51.1
Number of cars	0.0	0.2	0.4	0.6
Sheep and goats number	7	7	12	17
Total irrigated area in the farm (ha)	2.9	5.2	6.1	17.1
Area of land planted with trees (ha)	0.0	0.2	0.6	2.2
Number of tractors	0.4	0.8	0.9	1.3
No. of rooms in the house	2.9	3.5	3.9	5
Years of agricultural experience	23	31	33	36
Having university degree (%)	0	1	3	6
Years of education	0	0	3	4
Having a satellite dish (%)	49	68	78	85

Variety Diversity at Household Level

- Crop biodiversity of wheat was very high at country level (45 varieties were reported) but is relatively very low at the farm level (1 or 2 varieties)

Distribution of Producers by Number and Type of Wheat Varieties Grown

Number of varieties used	Producers (%)	Distribution by variety type (% of plots)		
		Monitored	Other new	Old improved
1	70.3	8.6	37.2	54.3
2	25.5	18.8	37.7	43.5
3	2.9	21.7	46.4	31.9
4	0.9	25.0	25.0	50.0
5	0.4	13.3	66.6	20.0
Total	**100.0**	**13.8**	**38.1**	**48.2**
Count	**781**	**146**	**403**	**510**

Distribution of Producers by Number of Varieties Grown and by Province (% of Farmers)

No of varieties	Province				
	Adana	Ankara	Edirne	Diyarbakir	Konya
1	81.5	81.5	62.2	63.8	65.8
2	15.4	18.5	33.3	30.0	28.6
3	3.1	0.0	2.2	3.8	4.0
4	0.0	0.0	1.1	2.3	1.0
5	0.0	0.0	1.1	0.0	0.7

Distribution of Producers by Number of Varieties Grown in Rainfed System

Number of varieties used	Producers (%)	Distribution by variety type (% of plots)		
		Monitored	Other new	Old improved
1	74.4	9.0	36.2	54.9
2	22.6	20.9	39.8	39.4
3	2.2	16.2	48.6	35.1
4	0.7	33.3	20.0	46.7
5	0.2	20.0	80.0	0.0
Total	100.0	14.1	38.0	47.9

Distribution of Producers by Number of Varieties Grown in Irrigated System

Number of varieties used	Producers (%)	Distribution by variety type (% of plots)		
		Monitored	Other new	Old improved
1	60.2	7.3	40.1	52.6
2	32.8	15.4	34.2	50.3
3	4.7	28.1	43.8	28.1
4	1.4	15.4	30.8	53.8
5	0.9	10.0	60.0	30.0
Total	**100.0**	**13.2**	**38.1**	**48.7**

Varieties Adoption

Adoption indicators

- Adoption is measured by
  - **Adoption rate** defined as the percentage of farmers using these varieties.
  - **Adoption degree**, as measured by the proportion of land under the new wheat varieties compared to the total area of wheat cultivated, and the
  - **Intensity of adoption**, which represents the product of adoption rate multiplied by the adoption degree

Adoption Rates of Some Wheat Varieties (%)

Variety	Year of variety release	Adoption (%)	
		Rate	Degree
Bezostaja-1	1968	23.1	28.0
Gerek-79	1979	9.7	9.1
Pehlivan	1998	8.2	9.4
Sagettario	2001	5.7	5.1
Adana-99	1999	5.4	4.2
Kiziltan-91	1991	5.2	3.3
Flamura	1999	4.1	2.0
Ceyhan-99	1999	3.5	4.0
Karahan-99	1999	0.9	1.0
Demir-2000	2000	0.7	0.5
Saricanak-98	1998	0.5	0.5

Adoption Rates of Wheat Varieties by Province and Production System

	No. of wheat plots	Variety classification (%)		
		Monitored	Other new	Old improved
Province				
Adana	158	8.2	91.8	0.0
Ankara	154	5.2	8.4	86.4
Edirne	131	32.1	62.6	5.3
Diyarbakir	188	27.7	43.6	28.7
Konya	428	7.2	18.9	73.8
Production System				
Rainfed	718	14.1	38.0	47.9
Irrigated	341	13.2	38.1	48.7
Region				
Plateau	582	6.7	16.2	77.1
Lowland	477	22.4	64.8	12.8

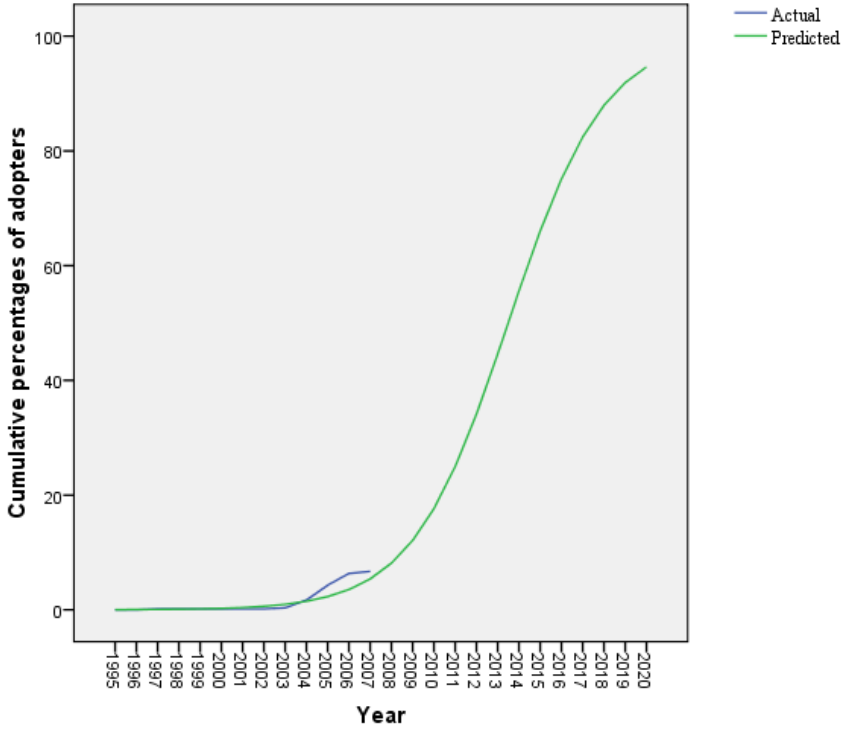
Adoption Degree of Wheat Varieties by Province and Production System

	Total Wheat Area (ha) in the sample	Adoption Degree by Variety type (%)		
		Monitored	Other new	Old improved
Province				
Adana	1790	16.8	83.2	0.0
Ankara	3037	1.8	10.3	87.8
Edirne	885	35.7	60.0	4.4
Diyarbakir	3769	30.0	49.6	20.4
Konya	4598	8.1	17.3	74.7
Production System				
Rainfed	9414	16.3	33.5	50.1
Irrigated	4665	13.6	39.4	46.9
Region				
Plateau	7635	5.6	14.5	79.9
Low land	6444	27.1	60.4	12.5
Average	14079	15.4	35.5	49.1

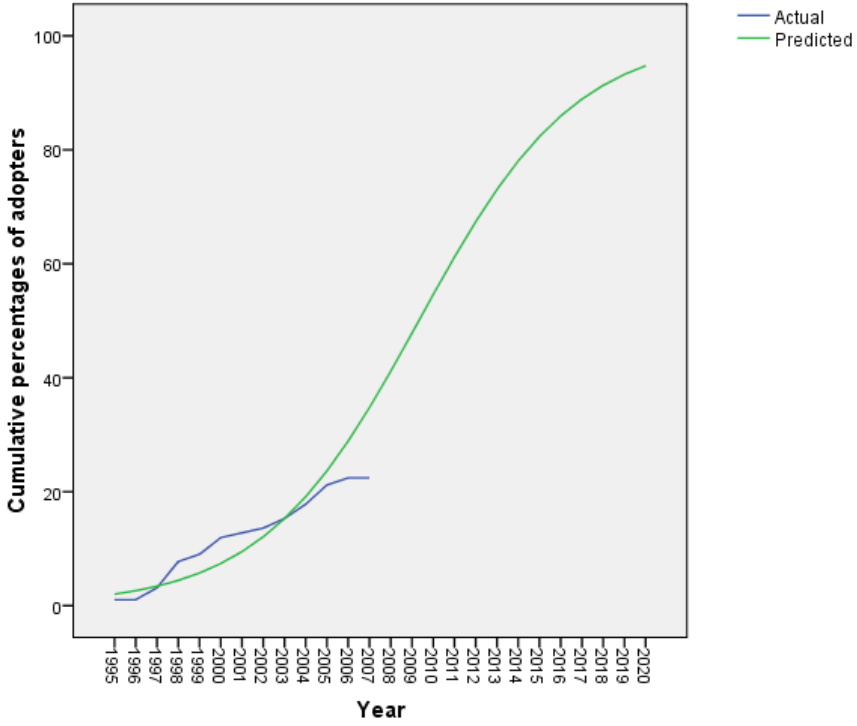
Adoption *(rate and degree)* by Wealth Quartiles *(%)*

Wealth Quartiles	Variety Classification	Adoption Rate	Adoption Degree
Lowest 25%	Adopters monitored varieties	12.8	17.4
	Adopters other new varieties	38.7	36.9
	Adopters old improved varieties	48.5	45.8
25-50%	Adopters monitored varieties	12.4	9.3
	Adopters other new varieties	33.9	38.8
	Adopters old improved varieties	53.8	51.9
50-75%	Adopters monitored varieties	10.8	8.9
	Adopters other new varieties	42.5	35.4
	Adopters old improved varieties	46.7	55.6
Top 25%	Adopters monitored varieties	18.2	21.1
	Adopters other new varieties	37.3	33.7
	Adopters old improved varieties	44.6	45.2

Diffusion of Wheat Monitored Varieties



Plateau



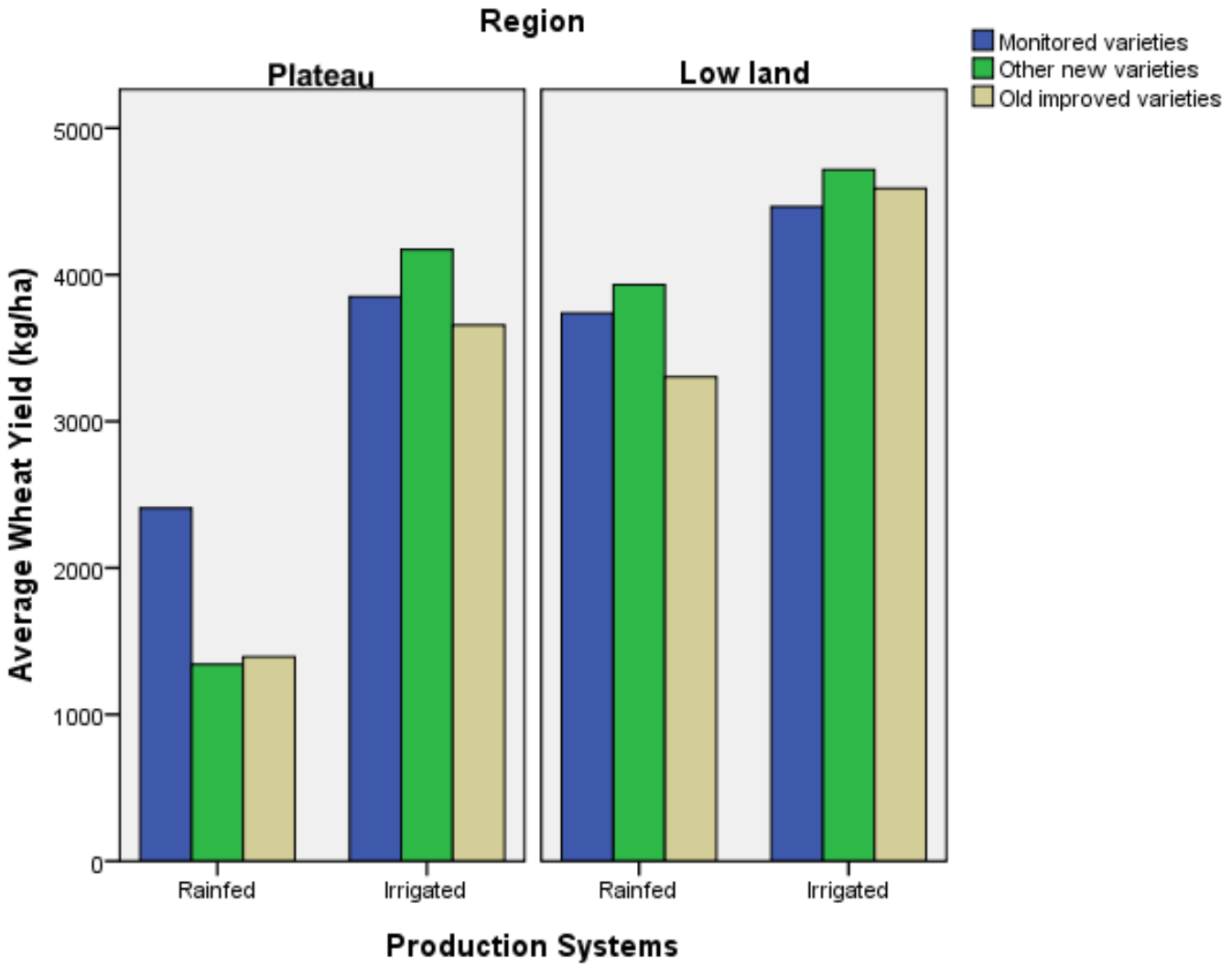
Lowland

Impact Indicators

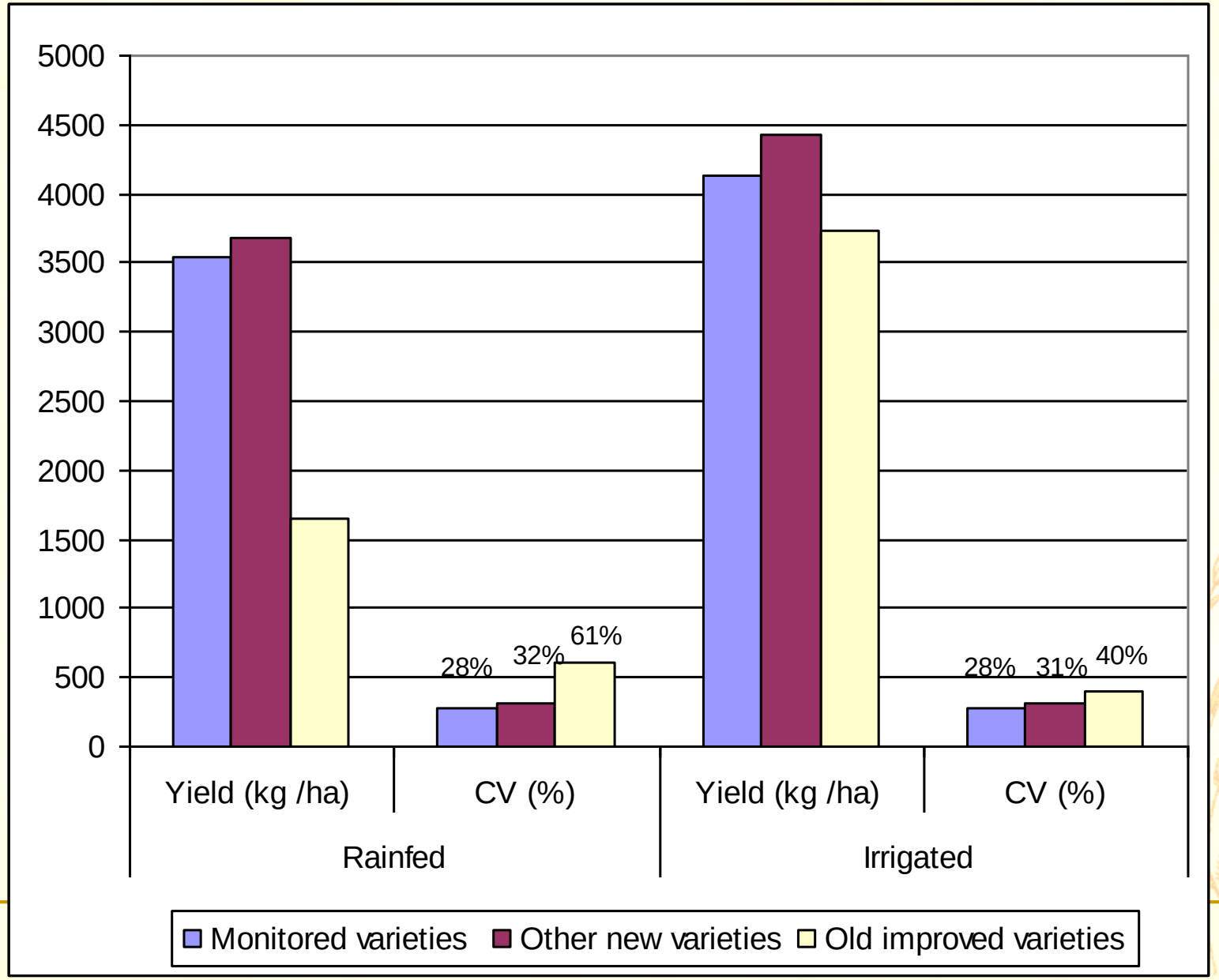
- Technical and economic indicators of impacts use in this study include:
  - **Crop productivity,**
  - **Yield stability,**
  - **Profitability** is measured by the gross margin generated per unit of land by wheat variety;
  - **Household income from wheat** and compared between adopters and non-adopters
  - **Poverty** by comparing per capita income between adopters and non-adopters.
  - Estimated total **increase in national income** from adopting of new varieties

Impact of the New Varieties on Productivity

Average Yields obtain by Farmers by Region and Wheat Production System in 2006/07



Average Yields and Coefficient of Variance by Variety Type and Production System



Production Function

Estimated Coefficients of Wheat Yield using a Multiple Linear Production Function

Variables	Coefficient	Standard error	t-statistic
(Constant)	-741.178***	154.087	-4.810
Rainfall rate (mm)	5.474***	0.401	13.638
Nitrogen added (kg/ha)	9.642***	0.790	12.201
Number of irrigation (times)	502.137***	32.532	15.435
Wheat area (ha)	0.299**	0.105	2.847
Monitored varieties (1=Yes) (0= otherwise)	231.453*	109.113	2.121
Durum wheat variety (1=Yes) (0= otherwise)	268.652*	109.835	2.446

Dependent variable: wheat grain yields (kg/ha)
Adj R-squared = 49. Coefficient is statistically different from zero at 0 (***), 1 (**), and 5(*) probability levels respectively.

Parameter Estimates for Determinants of Wheat Yield using the Cobb-Douglas Function

Variable	Coefficient	Standard error	t-statistic
Constant	0.293	0.634	0.462
LN-Rainfall	1.150***	.060	19.045
LN-Seed quantity	0.235*	.103	2.290
LN-Manure	0.020***	.005	3.796
LN-N fertilizer	0.029*	.013	2.250
LN-P fertilizer	-0.019(*)	.011	-1.754
LN- No. irrigations	0.063***	.004	17.742
Wealth index	0.148***	.038	3.903
Monitored varieties	0.164***	.052	3.187
Durum wheat	0.097*	.051	1.902

Adj R-squared equals 39.4. Coefficient is statistically different from zero at 0 (***), 1 (**), 5 (*), and 10 ((*)) probability levels respectively.

Estimated the Net Impact of Monitored Varieties

- The formula used:

  Net Impact = e^x - 1

  x = coefficient related to variety in Cobb-Douglas Model

- Yield gain due to adoption the monitored wheat varieties was 18% of obtained yield.

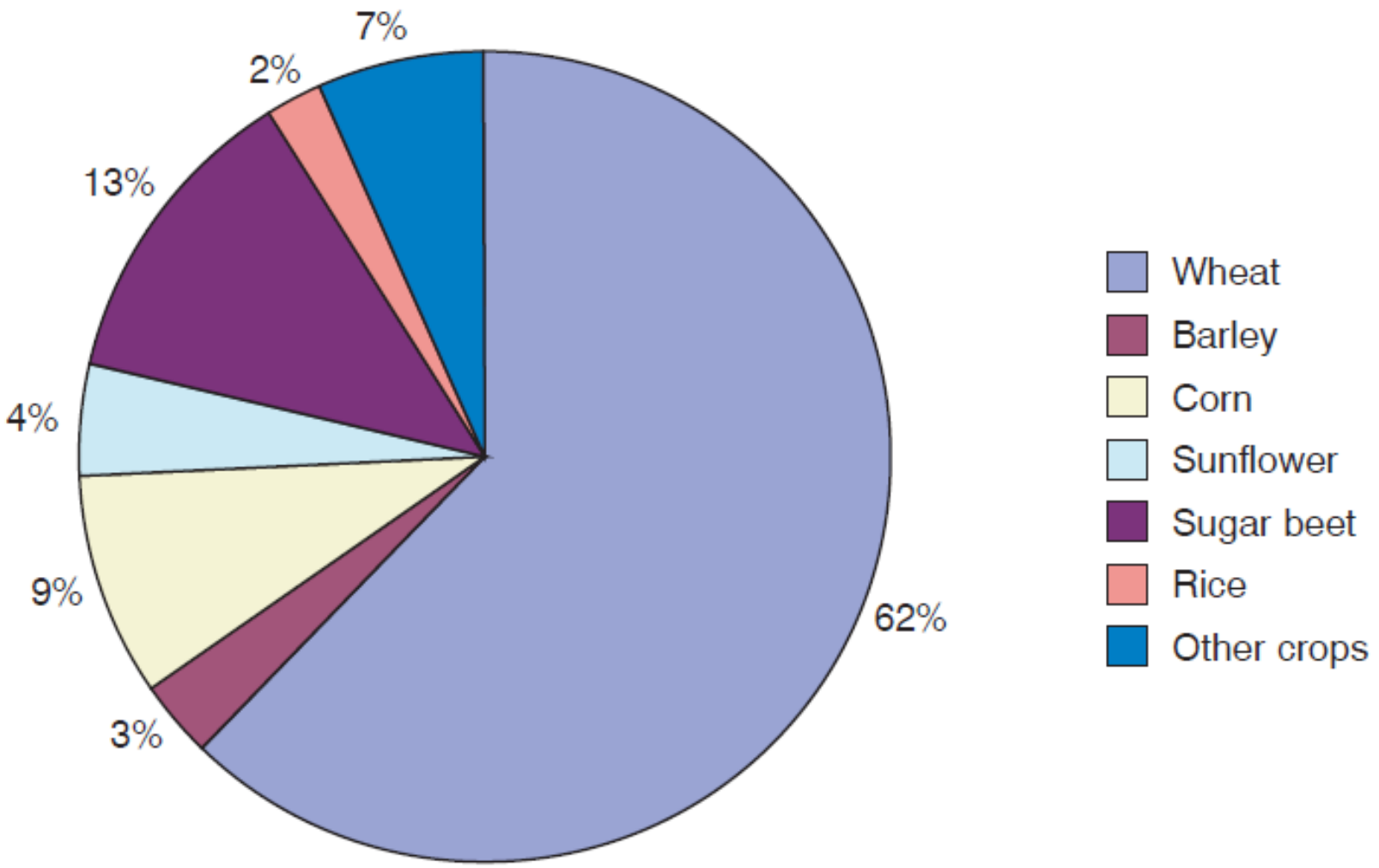
Impact on Profitability

Estimated Revenues, Costs and Gross Margin of Wheat Varieties (TL/ha)

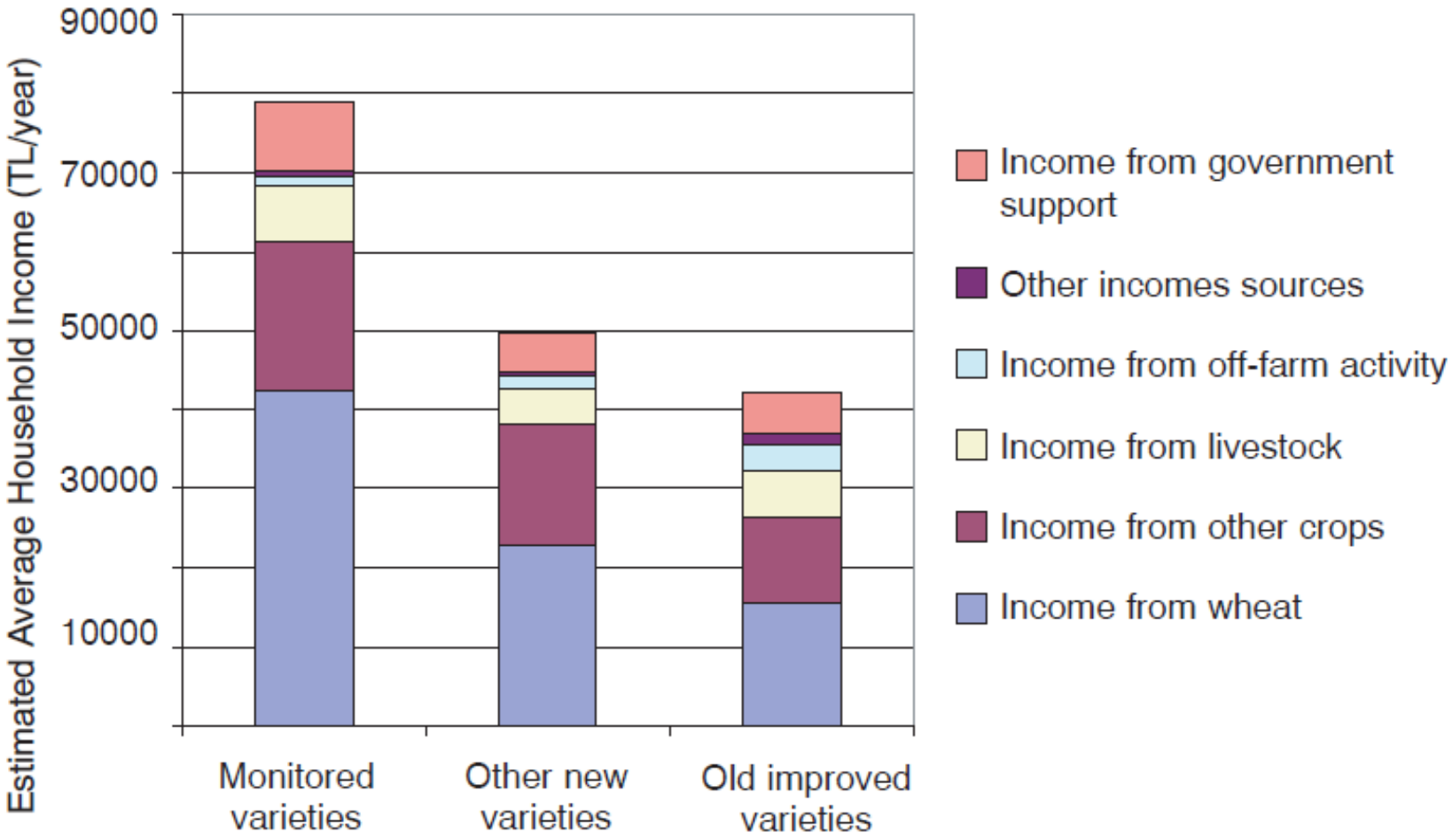
Item	Monitored Varieties						Other New Varieties	Old Improved Varieties
	Ceyhan-99	Demir-2000	Karahan-99	Pehlivan	Saricanak-98	Mean		
Revenue (Grain and straw value)	2067	1102	1152	1542	1841	1637	1687	1161
Total cost	1175	1170	885	896	926	980	1025	986
Gross margin	892	-68	267	646	915	657	662	175
Gov. support	390	304	293	355	381	370	367	299
Gross margin (with Gov. supp.)	1282	236	561	1000	1296	1027	1029	474

Impact on Household Income

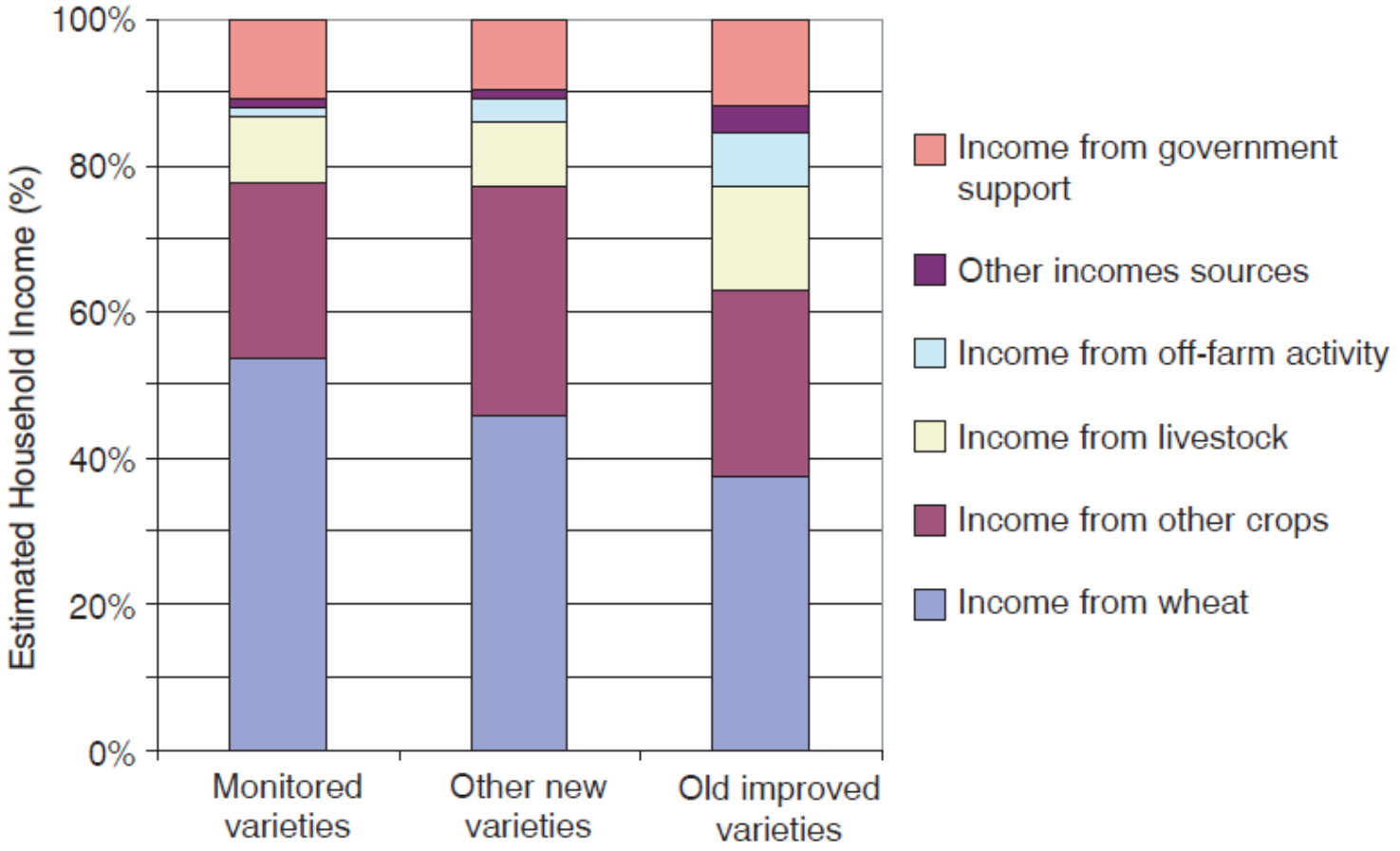
Income Sources



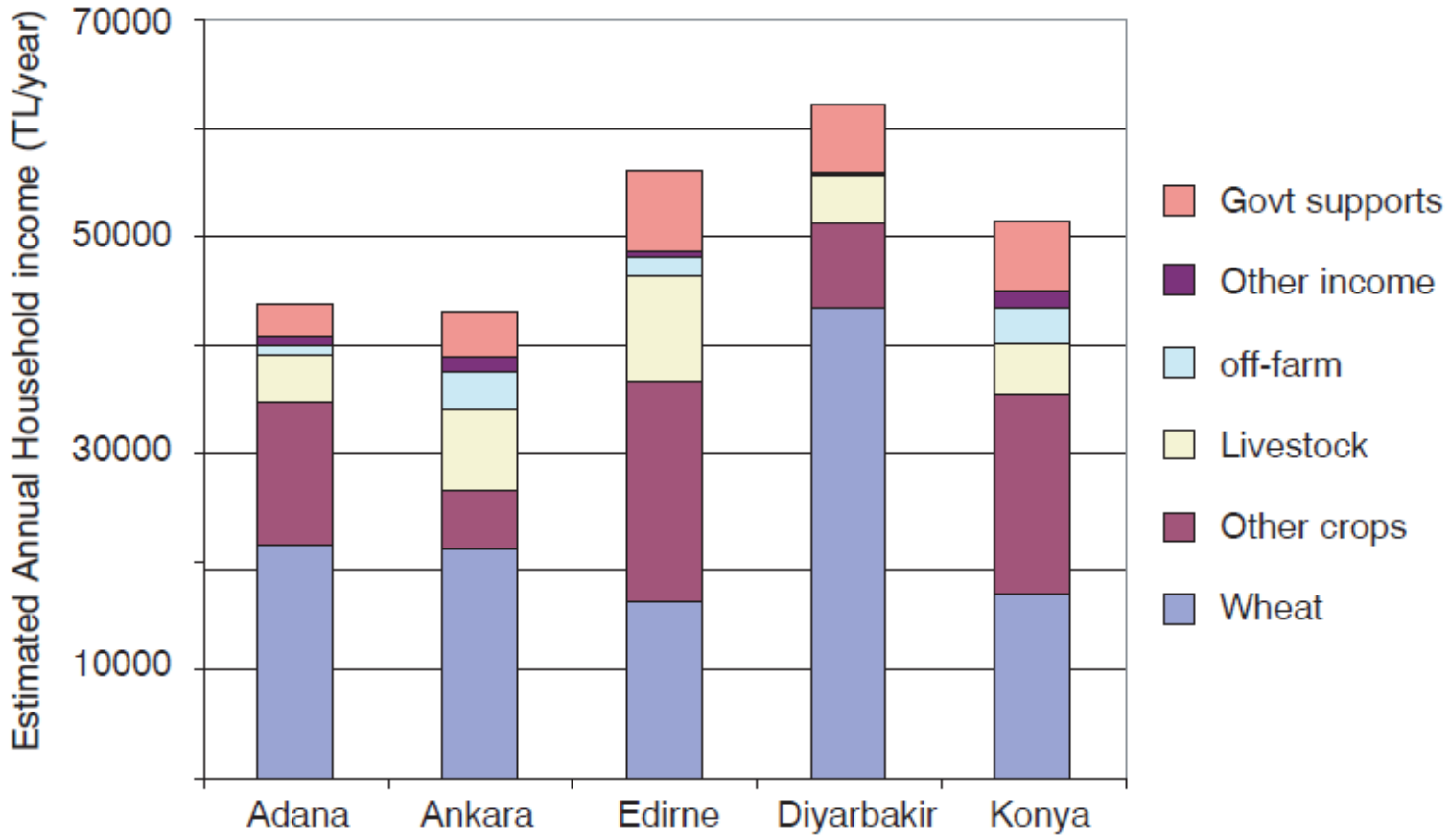
Estimated Income by Sources and Variety Classification



Estimated Percentage of Income by Sources and Variety Classification



Estimated Income by Sources and Provinces



Impact on Poverty

- Rural poverty has declined in Turkey over the past decade.
- In 2007, it was estimated that 0.63% of the Turkish population lived below the poverty line (US$2.15 per day) (Turkish Statistical Institute, 2008).

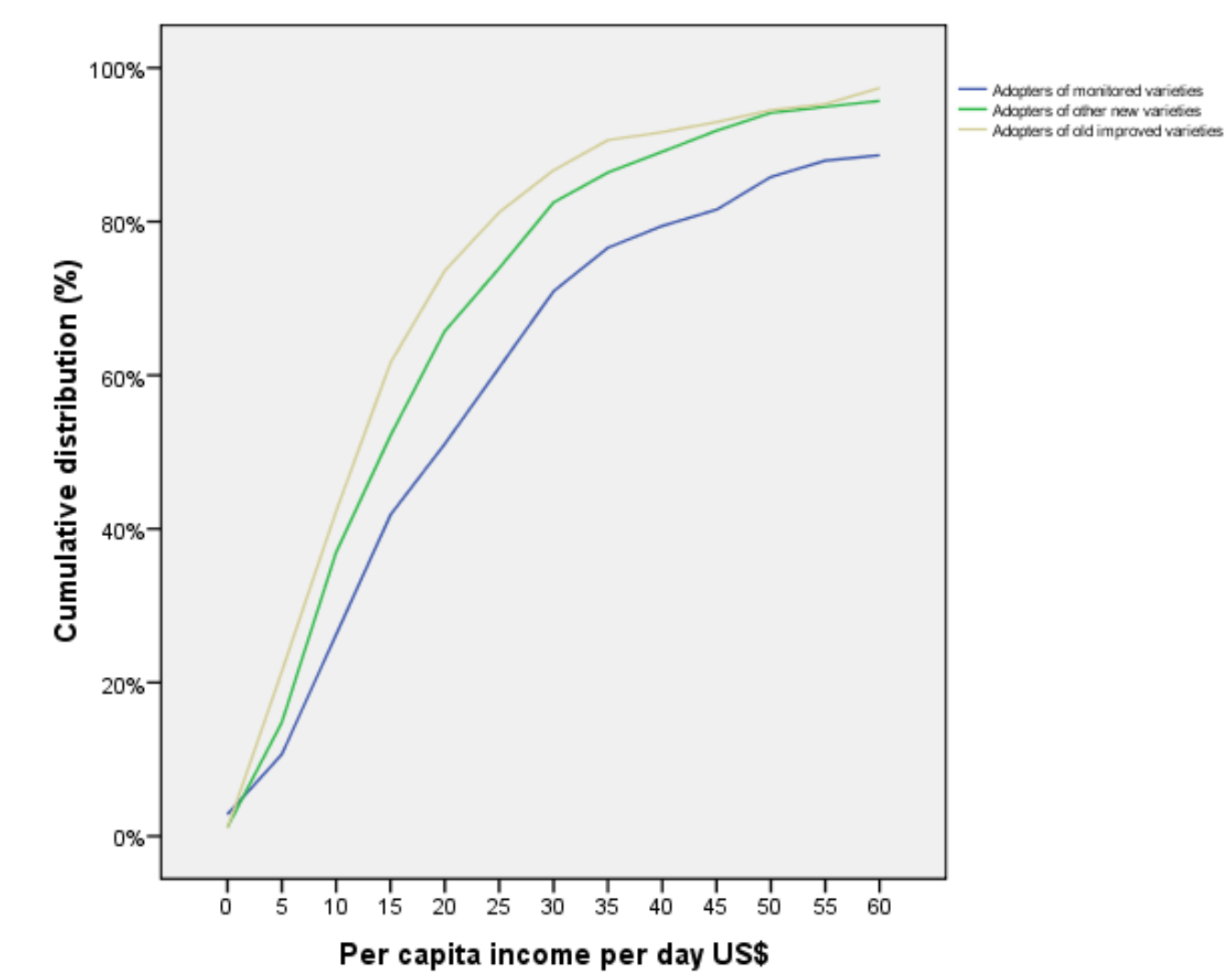
Household Income by Varieties Adoption and Regions

	Variety classification	Per capita income US$/person/yr	Per capita income per person per day
Total (all areas)	Monitored varieties	9,329	25.9
	Other new varieties	6,559	18.2
	Old improved varieties	5,876	16.3
	Mean	6,723	18.7
Region			
Plateau	Monitored varieties	10,964	30.5
	Other new varieties	6,993	19.4
	Old improved varieties	5,952	16.5
	Mean	6,490	18.0
Lowland	Monitored varieties	8,763	24.3
	Other new varieties	6,454	17.9
	Old improved varieties	5,167	14.4
	Mean	7,012	19.5

Household Income by Varieties and Adoption by Wealth Quartiles

Variety classification	Wealth quartiles	per capita income US$/person	per capita income per person per day
Monitored varieties	Lowest 25%	5,363	14.9
	25-50%	8,160	22.7
	50-75%	8,188	22.7
	Top 25%	12,852	35.7
Other new varieties	Lowest 25%	4,543	12.6
	25-50%	6,471	18.0
	50-75%	7,387	20.5
	Top 25%	8,226	22.8
Old improved varieties	Lowest 25%	3,824	10.6
	25-50%	5,544	15.4
	50-75%	7,129	19.8
	Top 25%	7,168	19.9
Total sample	Lowest 25%	4,311	12.0
	25-50%	6,245	17.3
	50-75%	7,376	20.5
	Top 25%	8,999	25.0

Distribution per capita Income per day by Adoption



Estimated Increase in National Income due Adoption of Monitored Varieties in 2007

Province	Estimated cultivated area under monitored varieties (ha)		Estimated increase in gross margin over old varieties (TL)		Increase in national income (TL)
	Rainfed	Irrigated	Rainfed	Irrigated	
Adana	26,576	17,950	11,321,468	0	11,321,468
Ankara	8,866	457	3,227,238	249,421	3,476,659
Edirne	67,756	0	0	0	0
Diyarbakir	95,425	6,798	2,290,203	0	2,290,203
Konya	26,746	15,114	9,789,071	1,898,706	11,687,777
Total	**225,369**	**40,319**	**26,627,980**	**2,148,127**	**28,776,107**

Rates of Return to Research

- In assessing the rates of return from agricultural research and extension, specifically the adoption of new varieties, data on the cost of research are needed.
- This study generated primary indicators that can be used to estimate the rates of return to research.
- As a follow up, additional data need to be collected on the costs of research (labor, equipment, operations, etc.) incurred by all partners involved (CIMMYT, ICARDA, and the Wheat Research Program in Turkey) over the years of variety development.
- This task will be completed jointly with all partners involved in this study.

Conclusion

1. The ability of varieties to produce high yields, and their resistance to drought, their ability to demand a good market price, adaptation to local conditions, frost resistance, and good bread or durum quality are the most important characteristics indicated by farmers for adoption new wheat varieties.
2. Few constraints to the adoption of the monitored varieties were identified based on farmers' perceptions.
3. Crop biodiversity of wheat, although very high at country or province levels, is relatively very low at the farm level.
4. Among all varieties cultivated by the sampled producers, Pehlivan ranks third in terms of adoption rate (8.2%), after Bezostaja-1 (23%) and Gerek-79 (10%).

Conclusion *(Cont.)*

5. Among all 45 different varieties analyzed in the survey, the variety ranking according to adoption rate is 8th for Ceyhan-99, 20th for Karahan-99, 21st for Demir-2000, and 28th for Saricanak-98. There is a need for more extension efforts to disseminate, and increase the adoption rates of the monitored varieties.

6. Adoption of the monitored varieties is highest among more wealthy farmers, followed by the poor farmers. These varieties are reaching the poor as well as the more wealthy farmers. Given their high productivity levels compared to other varieties, they could contribute to poverty reduction better if promoted on a wider scale to reach more farmers and production systems.

Conclusion *(Cont.)*

7. Yield comparisons indicated that wheat productivity following the adoption of the monitored varieties was varied between regions. The analysis indicated that monitored varieties were only superior in the plateau region under rainfed conditions.
8. The monitored varieties and other new varieties give higher yields, on average, compared to old improved varieties in most situations. Overall, the adoption of the monitored varieties generated a net increase of 18% in total factor productivity of wheat among producers.
9. The increase in productivity is also accompanied by a substantial improvement in yield stability.

Conclusion *(Cont.)*

10. Ceyhan-99, Pehlivan and Saricanak-98 outperform all wheat varieties cultivated by farmers in terms of profitability, while Demir-2000 is the least profitable.

11. Estimated income for adopters of the monitored varieties is the highest and significantly different from that of non-adopters. The contribution of wheat to total household income is 54% for adopters of the monitored varieties as opposed to 46% for adopters of other new varieties, and 37% for adopters of old-improved varieties.

12. The monitored varieties contribute substantially to poverty reduction. The analysis by wealth quartiles shows that households which belong to the lowest wealth quartile (poor farmers) increased their per capita income to $14.9 per day through the adoption of the monitored varieties compared to those in the same wealth quartile using other new varieties ($12.6) or old-improved varieties ($10.6).

Conclusion *(Cont.)*

13. Preliminary estimates show an increase in the national income in 2007 of 28.8 million TL from the adoption of the monitored varieties in the target areas of the sampled provinces, and 21 million TL from the adoption of other new varieties. About 80% of these increases came from rainfed areas. The increase in the national income could be greater if new wheat varieties are adopted by the majority of farmers in its target area.

14. Adoption of agricultural technologies by farmers depends upon policy makers being aware of improved technologies, upon good linkages between research and extension work, and upon farmers participating in on-farm trials and demonstrations.

15. This study was conducted in five provinces for one year, but in order to confirm these findings it is recommended that additional studies are conducted in the same area as well as other wheat growing areas in other provinces.

Further Work is needed

- Survey results presented here suggest that the new wheat varieties are superior to the old varieties.
- Adoption has the potential to substantially improve household income. An analysis of the factors preventing a wider adoption of the new varieties is needed. This will include an identification of potential improvements in the seed production system and in the information dissemination process.
- Also, the scientific evidence behind farmers' perceptions of yield decline in relation to replacement rates, frost intolerance, susceptibility to diseases, and high seed prices have to be investigated.
- This future work is expected to help extend the benefits of new wheat varieties to other small-scale farmers and improve rural livelihoods in Turkey.

Team Work

Thank You

for your Attention