Appendix B

Adoption of MV Wheat by Mega-Environment

In this appendix we present our attempts to break down adoption of modern varieties (MVs) by mega-environment (ME). These data are based primarily on results of the 1997 wheat impacts study, although for Iraq, Saudi Arabia, and Libya we used earlier estimates from Dalrymple (1986) and Byerlee and Moya (1993). The results are probably more accurate for spring habit wheat (especially for MEs 1-4) than winter habit wheat. In fact, for both facultative and winter habit wheat we combined irrigated with high rainfall environments because of limited data that distinguishes between these two environments.

The ME 1-4 estimates, excluding China, can be compared almost directly with Table 32 in Byerlee and Moya (1993: 45), with the caveat that Table 32 combines bread and durum varieties. We can briefly summarize that comparison to characterize the environmental pattern of MV adoption between 1990 and 1997 for much of the spring wheat area in the developing world. Another caveat to bear in mind is that we define MVs as semidwarf. In a few cases (notably Brazil and Ethiopia), tall varieties, some of which have CIMMYT ancestry, continue to be widely used by farmers. In Brazil some of these tall varieties are of fairly recent origin. Although in these exceptional cases tall varieties may perform as well as semidwarfs, they are excluded as MVs for clarity of definition.

Adoption of MVs is almost universal in ME 1, the irrigated spring wheat environment. Adoption reached 100% in ME 1 in South Asia and Latin America and was almost universal in WANA by 1990. During the 1990s, adoption increased slightly in ME 1 in WANA, with higher adoption in bread wheat than durum wheat.[40] The almost universal adoption of MV wheat in ME 1 means that yields and production gains in this environment are almost all Stage II (varietal replacement by later MV generations) rather than Stage I (replacement of tall varieties by MVs) (Byerlee and Moya 1993).

By 1990 adoption of MVs was relatively high in ME 2 (high rainfall spring wheat environment) and increased between 1990 and 1997, although it has not reached 100%. Adoption was almost universal in Latin America's ME 2 by 1990 and increased to just under 100% in WANA during the 1990s. A comparison of Tables B.2 and B.3 with Table 32 (Byerlee and Moya 1993:45) reveals an apparent disadoption of MV wheat in ME 2 in sub-Saharan Africa between 1990 and 1997. This is probably an erroneous conclusion; rather, it is the result of the fact that MEs for sub-Saharan Africa have been more rigorously defined in the intervening period (Payne, Tanner, and Abdalla 1996). Over all spring wheat areas in sub-Sahara Africa, adoption of MVs did indeed increase between 1990 and 1997.[41] The percentage of MV adoption attributed to ME 2 in

[40] Adoption of MV wheat was also 100% in small irrigated spring wheat areas of sub-Saharan Africa.
[41] This is true even if South Africa, which was not part of the 1990 survey, were excluded.

sub-Sahara Africa by Byerlee and Moya (1993) was probably in reality the overall MV adoption percentage for 1990.[42]

Although some acid soil (ME 3) areas have been identified outside of Brazil, most of this ME is located in this country. Adoption of MVs actually appears to have fallen in this ME between 1990 and 1997. As noted, this is probably because wheat breeding programs in Brazil continue to release both semidwarfs and new tall varieties that are competitive in this environment.[43]

Drought-prone spring wheat areas have tended to have the lowest adoption rates among the four environmental types considered here. From 1990 to 1997, adoption in drought-prone areas of Latin America increased from just under 70% to just over 90%. In drought-prone areas of both WANA and South Asia, adoption appears to have more than doubled, from about one-fourth to just over one-half of all drought-prone area. In South Asia, some problems in defining MEs may affect this conclusion. In general, however, for drought-prone areas, yield and production gains from MV adoption are from both Stage I and Stage II adoption in the 1990 to 1997 period.

Table B.1. Adoption of spring bread wheat MVs, by mega-environment, 1997, including China.

Region	ME 1 Irrigated	ME 2 High rainfall	ME 3 Acid soils	ME 4A Drought (winter rain)	ME 4B Drought (winter drought)	ME 4C Drought residual moisture	ME 5 Hot	ME 6 High latitude	All spring bread wheat MEs
Sub-Saharan Africa	100-	49	100	100-			78		74
West Asia and North Africa	94	99		53					84
Asia	100	24				50	96	70	90
Latin America	100	100-	46		91		100		87
All regions	99	81	48	59	91	50	95	70	88

Note: 100-: very small amounts reported planted to tall varieties.

Table B.2. Adoption of spring bread wheat MVs, by mega-environment, 1997, excluding China.

Region	ME 1 Irrigated	ME 2 High rainfall	ME 3 Acid soils	ME 4A Drought (winter rain)	ME 4B Drought (winter drought)	ME 4C Drought residual moisture	ME 5 Hot	ME 6 High latitude	All spring bread wheat MEs
Sub-Saharan Africa	100-	49	100	100-			78		74
West Asia and North Africa	94	99		53					84
Asia	100					52	98		95
Latin America	100	100-	46		91		100		87
All regions	99	93	48	59	91	52	97		91

Note: 100-: very small amounts reported planted to tall varieties.

[43] Some of the older tall spring bread wheat varieties released in Ethiopia (ME 2) had some CIMMYT ancestry.
[44] Some of these new tall releases in Brazil had CIMMYT ancestry.

Table B.3. Adoption of MV spring durum wheat by mega-environment, 1997 (including or excluding China).

Region	ME 1 Irrigated	ME 2 High rainfall	ME 3 Acid soils	ME 4A Drought (winter rain)	ME 4B Drought (winter drought)	ME 4C Drought residual moisture	ME 5 Hot	ME 6 High latitude	All durum bread wheat MEs
Sub-Saharan Africa		20							20
West Asia and North Africa	82	99		66					75
Asia	100					56			58
Latin America		100	0		80				93
All regions	94	78		66	80	56			72

Table B.4. Adoption of MV winter bread wheat by mega-environment, 1997, including China.

Region	ME 7 / 8 Irrigated / high rainfall / facultative	ME 9 Drought / facultative	ME 10 / 11 Irrigated / high rainfall / winter	ME 12 Drought / winter	All facultative / winter bread wheat MEs
Sub-Saharan Africa		23			23
West Asia and North Africa	100	19	52	49	30
Asia	100	59	93	0	81
Latin America	72	100	100	100	85
All regions	100-	42	68	30	63

Note:100-: Very small amounts reported planted to tall varieties.

Table B.5. Adoption of MV winter bread wheat, by mega-environment, 1997, excluding China.

Region	ME 7 / 8 Irrigated / high rainfall / facultative	ME 9 Drought / facultative	ME 10 / 11 Irrigated / high rainfall / winter	ME 12 Drought / winter	All facultative / winter bread wheat MEs
Sub-Saharan Africa		23			23
West Asia and North Africa	100	19	52	49	30
Asia					
Latin America	72	100	100	100	85
All regions	83	22	53	49	31

Table B.6. Adoption of MV winter durum wheat by mega-environment, 1997 (including or excluding China).

Region	ME 7 / 8 Irrigated / high rainfall / facultative	ME 9 Drought / facultative	ME 10 / 11 Irrigated / high rainfall / winter	ME 12 Drought / winter	All facultative / winter durum wheat MEs
Sub-Saharan Africa					
West Asia and North Africa			84	0	10
Asia					
Latin America					
All regions			84	0	10