Appendix B
Note on Agronomic Practices for Increasing Crop Water Productivity

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Of the many measures described in this book, the field-level agronomic or cultural measures may appear to be the easiest to implement and to be the least likely to cause undesirable externalities. The purpose of this note is to summarize what is reported about them dispersed throughout this book, and to assess whether indeed these measures are ready to be adopted on a wider scale. Are the agronomic practices perhaps location-specific or only applicable for a limited set of soil and crop conditions? Many of them are also known to have trade-offs in terms of higher labour and management demands, and further studies may have to be done before scientists feel confident to recommend them for wide-scale application.

The agronomic practices that are mentioned in the chapters of this book and that have the potential for increasing crop water productivity are summarized in Table B.1. The selection of the appropriate cultivar with its specific length of growing season, harvest index, stress tolerance and disease resistance, although directly affecting crop yield and water productivity, is not included in the table. Here we are concerned with measures which the farmer can take and which affect especially the partitioning of rainfall or irrigation between infiltration and runoff and the partitioning of evapotranspiration between evaporation and transpiration. These two effects are often interactive, as any measure that maximizes infiltration of water into the soil also minimizes water losses through surface evaporation and runoff and reduces soil erosion.

The irrigation method determines to what extent it is possible to reduce evaporation from the soil surface while maintaining adequate soil moisture levels in the root zone to avoid crop stress. Precision application with drip or subsurface irrigation is the method of choice; surface irrigation on precisely levelled fields is a distant second.

Quite a few of the measures require additional expense, skills, time and machinery. It is not only for commercial farmers that these measures are still suitable. But, with small and resource-poor farmers, it is even more important to provide adequate training and advice and also to ensure that maintenance and spare parts for the machinery are available whenever needed.

Obviously, not all measures are suitable under all circumstances. The list of measures is not to be taken as a menu from which to choose at liberty. For example, minimum tillage may not work on soils that tend to form a surface crust or a hardpan. In

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Table B.1. A summary of the agronomic practices.

Category/item	Comments	Adoption
Water-related		
Alternate-row irrigation	Suitable for row crops, depends on irrigation system	Requires more labour and management than conventional furrow irrigation
Minimize preplanting irrigation	Requires control over irrigation supply	
Minimize time between preplanting irrigation and planting	Especially with rice; requires control over timing of irrigation	Constraints in water delivery, labour and farm machinery often interfere
Soil-related		
Reduced (or conservation) tillage	Requires farm machinery, such as shallow rotovator, inverted-T opener, combined with seed drill	Cost, availability and maintenance of machinery are constraints
Zero tillage	Placing seed on saturated soil without tillage	Unless the field is level, yields may be less
Raised beds	Requires tools to make the beds	Labour requirement if beds have to be remade each season
Broad beds and furrows	Requires tools to make the beds	As for raised beds
Row spacing and orientation	Affects interception of radiation and, if planting is on contours, reduces runoff	Requires flexible seed drill; may be more labour-intensive
Land levelling	Prevents ponding and unequal application of water	Requires skilled labour and machinery; needs to be repeated every 2–3 years
Mulching and residue management	Lowers evaporation from soil surface and reduces runoff	Gravel mulches, etc., are expensive
Application of organic matter (OM)	Increases water-holding capacity of soil; needs to be repeated often as OM in semi-arid tropics decomposes quickly	OM is scarce and often used for other purposes, e.g. as fuel
Plant-related		
Direct seeding of rice	Direct-seeded rice may have more diseases, insect and weed problems and, hence, give lower yields	Often done to reduce labour rather than for increasing WP; requires more weed control and pest control
Timely planting, etc.	Timely sowing, weed control, fertilizer application, nutrient management and best crop rotation raise yields	Requires good farming skills and extension services; labour-intensive

WP, water productivity.

general, a combination of measures may work best, such as combining laser levelling with minimum tillage and bed planting.

There are trade-offs between water conservation and yield, e.g. less frequent irrigation of grains, including rice, could lower yield, and also between water application and labour, e.g. excessive irrigation is often done to save the labour involved in levelling the fields. So much the more reason for being quite explicit with farmers about the consequences of adopting these water-productivity-enhancing measures. As mentioned by Barker *et al*. (Chapter 2, this volume), in promoting the adoption of new technologies, researchers and extension

agents often focus on the higher yield potential, but ignore the opportunity cost of family labour and the increased management requirements. As argued by Wani *et al*. (Chapter 12, this volume), low adoption of improved agronomic practices is because insufficient attention was given to farmer participation, community action, etc. However, this attention can only be given if the impact of adoption is known – in other words, if the benefits and the costs are clearly articulated.

The inevitable conclusion, then, is that more work needs to be done before we can entreat farmers to adopt these measures. Perhaps it is not adoption that we should aim at but adaptation in a manner that is suitable for the specific set of conditions. The contribution that science should make in this process is to study the necessary conditions for success, which include the analysis of all the consequences of their introduction.