Increasing the efficiency of water use and enhancing agricultural water productivity at all levels of the production chains are becoming priorities in a growing number of countries. In particular, shifting to modern on-farm irrigation practices can contribute to a substantial increase in both water use efficiency and water productivity. The objective of this handbook is to provide a practical guide on the use of pressurized irrigation techniques to farmers, irrigation technicians, and extension workers in the field.
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- **Quick coupling light steel pipes**
- **Quick coupling aluminium pipes**
- **Rigid PVC pipes**
- **Polyethylene (PE) pipes**
- **Selection of PVC and PE pipe’s dimensions**
- **Layflat hose**

#### Pipe connector fittings
- **Malleable iron threaded**
- **Polypropylene (PP) pipe connector fittings**
- **PVC fittings**

#### Flow control devices
- **Shut-off valves or stop valves**
- **Check valves**
- **Regulating valves**
- **Meters**
- **Pressure gauges**
- **Air valves**
- **Safety valves (also called pressure relief valves)**

#### Filters
- **Gravel filters**
- **Hydrocyclone (sand separator) filters**
- **Screen type filters**
- **Disk type filters**
- **Automatic self-cleaning filters**

#### Fertigation equipment
- **Fertilizer (closed) tank**
- **Venturi type**
- **Piston pump**

#### Water emitters
- **Sprinklers**
- **Microsprinklers**
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- Drag hose basin for trees
- Hose basin for field crops
- Hose furrow for vegetables

**Cost**

**Advantages**

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Foreword

Water is essential for all socio-economic development and for maintaining healthy ecosystems. As population increases and development calls for increased allocations of groundwater and surface water for the domestic, agriculture and industrial sectors, the pressure on water resources intensifies, leading to tensions, conflicts among users, and excessive pressure on the environment. The increasing stress on freshwater resources brought about by rising demand and growing pollution worldwide, is of serious concern.

Increasing water productivity holds the key to future water scarcity challenges. Today, agriculture accounts for 70 percent of all water use globally, up to 95 percent in several developing countries. Adding to the pressures on agricultural use is the increased awareness of the instrumental value of water in maintaining environmental services. Increasing the efficiency of water use and enhancing agricultural water productivity at all levels of the production chains are becoming priorities in a growing number of countries.

A comprehensive approach to agricultural water productivity requires actions at all levels, from crops to irrigation schemes, and up to national and international economic systems. In particular, shifting to modern on-farm irrigation practices can contribute to a substantial increase in both water use efficiency and water productivity.

The objective of this handbook is to provide a practical guide on the use of pressurized irrigation techniques to farmers, irrigation technicians, and extension workers in the field. In this second edition, the handbook has been considerably revised, including new chapters on low-cost drip irrigation and pipe distribution systems for smallholders.
Acknowledgements

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The first edition of the handbook was published in 2001 and was prepared by Andreas Phocaides, irrigation technology consultant, with the assistance of Reto Florin, former Chief of the FAO Water Service and David Casanova, irrigation expert.

For its second edition, the handbook was completely revised, with the addition of several new chapters. The author was assisted in its preparation by Ines Beernaerts and Jean-Marc Faurès (FAO), and Virginie Gillet (IPTRID).
# List of acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Acrylonitrile butadiene styrene (thermoplastic material)</td>
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<tr>
<td>AMIT</td>
<td>Affordable micro-irrigation technologies</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ASAE</td>
<td>Society for Engineering in Agriculture, Food, and Biological Systems (former American Society of Agricultural Engineers)</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing Material</td>
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<tr>
<td>BHP</td>
<td>Break horsepower</td>
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<tr>
<td>BOD</td>
<td>Biochemical oxygen demand</td>
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<tr>
<td>BS</td>
<td>British Standards</td>
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<tr>
<td>CAMS</td>
<td>Computer aided management systems</td>
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<tr>
<td>CEN</td>
<td>European Committee for standardization</td>
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<tr>
<td>CIF</td>
<td>Cost insurance and freight</td>
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<tr>
<td>COD</td>
<td>Chemical oxygen demand</td>
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<td>CP</td>
<td>Center pivot</td>
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<tr>
<td>CYS</td>
<td>Cyprus Standards</td>
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<tr>
<td>DIN</td>
<td>Deutsches Institut für Normung (German standards).</td>
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<tr>
<td>DN</td>
<td>Nominal diameter</td>
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<tr>
<td>ECe</td>
<td>Electrical conductivity</td>
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<tr>
<td>ECiw</td>
<td>Electrical conductivity of irrigation water</td>
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<tr>
<td>ECw</td>
<td>Electrical conductivity of water</td>
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<tr>
<td>EN</td>
<td>European Standard</td>
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<tr>
<td>ESP</td>
<td>Exchangeable sodium percentage</td>
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<tr>
<td>ET</td>
<td>Evapotranspiration</td>
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<td>ETc</td>
<td>Crop water requirements</td>
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<tr>
<td>ETo</td>
<td>Reference evapotranspiration</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<tr>
<td>FC</td>
<td>Field capacity</td>
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<tr>
<td>FDS</td>
<td>Family drip system</td>
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<tr>
<td>FOB</td>
<td>Free on board</td>
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<tr>
<td>HDPE</td>
<td>High density polyethylene</td>
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<tr>
<td>IES</td>
<td>Irrigation equipment supply database</td>
</tr>
<tr>
<td>IPTRID</td>
<td>International Programme for Technology and Research in Irrigation and Drainage</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organization</td>
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<tr>
<td>kc</td>
<td>Crop coefficient</td>
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<tr>
<td>LDPE</td>
<td>Low density polyethylene</td>
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<tr>
<td>LEPA</td>
<td>Low energy precision application</td>
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</tbody>
</table>
LR Leaching requirements
NTU Turbidity
PC Pressure compensated
PDS Pipe distribution irrigation system
PE Polyethylene
PIP PVC irrigation pipe
PN Nominal pressure
PP Polypropylene
PR Pressure rating
PVC Polyvinyl chloride
PVC-U Polyvinyl chloride unplasticised (equivalent to uPVC)
O&M Operation and maintenance
RSC Residual sodium carbonate
SDR Standard dimension ratio
SS Suspended solids
Sa Available moisture
SAR Sodium adsorption ratio
SC Saturation capacity
TC Technical Committee
TDR Time domain reflectometry
TDS Total dissolved solids
uPVC Unplasticised polyvinyl chloride
USDA United States Department of Agriculture
WHO World Health Organization
WP Wilting point