Briefing Note

Water-Saving Irrigation

Background

In the 21st century, an increasing number of countries will have to cope with severe water scarcity. It is generally agreed that this water crisis can be attributed to high levels of water use in agriculture, especially in **irrigated agriculture**. Irrigation accounts for 70 per cent of global water withdrawals; in some water-scarce countries more than 90 per cent of all water abstracted is used for irrigation. If actual *consumption* is considered, allowing for unused return flows from the water withdrawn, the global share of irrigation – according to the FAO – is no less than 93 per cent. At the same time, however, irrigation is regarded as an important means of securing the world food supply in forthcoming decades. Thanks to irrigation, 40 per cent of the world's cereal crop is currently produced on just 20 per cent of the land used for growing cereals. The FAO estimates that around 60 per cent of the additional cereal production needed in developing countries by 2025 will have to take place under irrigated conditions. These figures demonstrate both the fundamental importance of irrigation for global agriculture and the difficulties arising from attempts to limit the unsustainable exploitation of water resources for agriculture.

It is explained in the two other GIZ Briefing Notes on water in agriculture that this problem cannot be resolved simply by improving irrigated agriculture itself. Those Briefing Notes also describe actions required outside of irrigation.

Within the field of irrigated agriculture, efforts to achieve substantial water savings have so far focused on increasing the **efficiency of water use**. This efficiency is usually interpreted as being the proportion of water withdrawn from river or groundwater resources that is used to meet the water demand of the irrigated crops. Three principal ways of increasing efficiency of water use are usually put forward. The first approach involves technical modernisation of the design and operation of new irrigation systems or ones that are being rehabilitated. The second calls for improved 'on-farm' water management, often involving the use of **'water-saving' technology**, especially drip irrigation. Thirdly, there are calls for **increases in irrigation water charges** – which are usually very low or non-existant – as an incentive to save water and ensure that infrastructure is maintained.

However, attempts to reduce water consumption in irrigation in developing countries have met with only limited success, confirming the impression that important aspects of the situation have not been fully considered.

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GIZ's position

In the light of these considerations GIZ's position is as follows:

1. Improving the efficiency of water use may contribute to reduced water consumption in irrigation. Consideration of efficiency will, however, need to focus more on increasing **water productivity** – i.e. on increasing agricultural yields or the value added per unit of water used – in order to cope with water scarcity. This can be achieved through technical and technological modernisation, through improvements in operation and maintenance and by optimising the timing and extent of water application. From the perspective of the individual farm such measures automatically result in a saving of water. **From the perspective of the catchment area**, efficiency improvements of this sort are necessary but not sufficient conditions for water savings. Also required are institutional structures and mechanisms that ensure that these savings actually benefit the water resources and are not made available for further use within the individual farm in question. These structures and mechanisms include formal and/or informal regulations on the withdrawal and allocation of water resources and the capacities and funds needed to enforce them. If irrigated agriculture is to play a part in limiting water scarcity, it is essential that the relevant institutional capacities are developed and that water users – most of whom are small-scale farmers – are more closely involved.

   Similar considerations apply to the use of **'water-saving' technology**. When used correctly, such technologies – especially **drip irrigation** – allow significant reductions in the amount of water withdrawn to supply a particular crop. This means that users of modern technology can expand their growing area and/or grow crops that need more water while maintaining water withdrawal at the same level. Users thus have no incentive to reduce their water withdrawal. If water resources are to benefit from the savings made, the amount of water withdrawn must be reduced in line with these savings. The use of modern technology can therefore only result in real water savings across farms in general if the existing water rights or habits of water users can be modified or adapted. If the institutional capacity to achieve this does not exist, reductions in water withdrawal are unlikely to be made. The situation in countries such as Spain and Tunisia and parts of the USA illustrates this clearly: there 'water-saving' technologies are resulting not in water saving but in the overuse of water resources.

   In developing countries with weak institutional structures it is therefore only in exceptional cases that the use of such technologies can contribute to a reduction in the use of water resources across farms in general.

2. Where volumetric **water prices** can be established and enforced, they can play a major part in cutting water use in irrigation. However, the scope for implementation in developing countries is frequently overestimated. Firstly, there are significant technical and organisational difficulties associated with installing and monitoring volumetric water measurement in irrigation systems used by small-scale farmers. Secondly, considerable institutional capacity and policing power is needed to establish and enforce economically appropriate water prices and organise the collection and use of the fees. In connection with the irrigation of small farms, using local mechanisms for governing common property resources is often a more promising approach.

3. Technical and technological approaches to saving water resources by means of efficiency improvement and withdrawal reductions in irrigated agriculture can only be effective if the improvements are **in the interests of the main stakeholders**. This is frequently not the case. Inadequate transparency with regard to water allocation and use and the associated inefficiencies often pave the way for officials to make money illegally through preferential allocation of water (petty corruption). Increasing transparency and accountability in the management of irrigation can yield significant efficiency gains and water savings.

4. **Plant breeding and crop-growing practices** – especially the choice of a cropping pattern suited to water availability and soil conditions – have an important part to play with regard to water productivity and water savings in irrigated agriculture. The **use of brackish water and wastewater** will also become increasingly important, especially in the environments of large towns and cities.

Action required

The most important fields of action are: efficiency increases combined with adaptation of water withdrawal rights; transfer into practice of progress made in agricultural research; and improvements in water storage and in the use of marginal water resources.

1. **Combining efficiency increases with adaptation of water withdrawal rights**

It is important to reduce water losses in irrigation. If these reductions are to benefit not only the individual farm but also water resources in the catchment area as a whole, adaptation of formal or informal water withdrawal rights is essential. Without such adaptation, improvements of this sort can prevent reusable water being returned for the use of downstream users, thus altering the de facto allocation of water.

In irrigation in developing countries, however, it is unusual for efficiency improvements to be analysed and assessed in terms of their impacts on water resources in the catchment area. Such analysis will in future become increasingly important. As part of this process it is necessary to define the conditions – with regard to institutions and in particular with regard to water law – that must be in place if such improvements are to increase water availability in the catchment area. Analysis of this type must become a component of 'water accounting', a topic that is discussed in more detail in the GIZ Briefing Note 'Water Scarcity and Agriculture'.

The importance and effectiveness of 'water-saving' technologies is highly context specific. Their use in water-scarce countries with weak institutional capacities must be approached with caution.

2. **Transferring progress in plant breeding and crop-growing into practice**

Advisory practice must do more to incorporate **progress in agricultural research** that contributes to water saving. Research may involve, for example, conventional plant breeding, more detailed knowledge of the uses of traditional varieties, improved crop-growing practices or increased salt tolerance. In the context of such innovations it will in future be important to focus more strongly on the different local conditions and needs of small-scale irrigation management, especially in Africa.

In the medium term it is inappropriate to expect water savings from the use of genetically modified high-yielding yet drought-resistant cereal varieties; genetic technology research on drought resistance is still in its early stages.

3. **Water storage and use of marginal water resources**

Special consideration should be given to the many and varied options for retaining the run-off of peak precipitation events and ensuing floods and enabling it to be used by small-scale farmers for irrigation. Greater attention needs to be paid to the use of small private and larger communal storage tanks for rainwater and to all aspects of **rainwater harvesting**. Here, too, it is important not to lose sight of the effect of a large number of such measures on water availability in the catchment area.

The use of 'marginal' water resources – i.e. the reuse of drainage water from irrigated areas and the use of pre-treated wastewater and brackish water – will become increasingly important. Experience in this area under various conditions must be evaluated and made available to other practitioners.

Note: The Briefing Notes on water in agriculture form a set of three. The first deals with the issue of water scarcity in agriculture, providing a general view of agriculture as one of the principal water-using sectors. The second is concerned with effective water management in agriculture and the third explores aspects of water-saving irrigation in more detail.

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