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Innovative financing for sustainability

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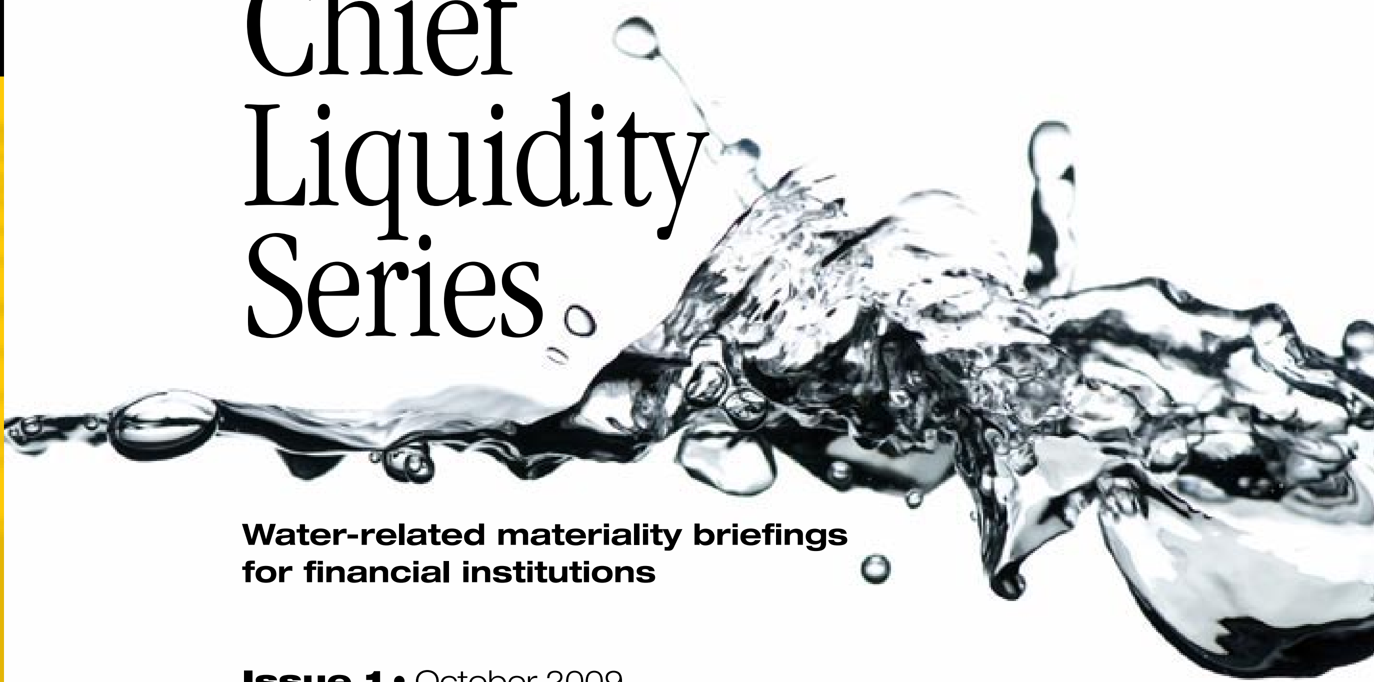
Chief Liquidity Series



Water-related materiality briefings for financial institutions

Issue 1 • October 2009

Agribusiness

Geographies
Australia
Brazil
India
Mediterranean Basin
(Morocco, Italy, Greece)
South Africa

Local guidance on a global issue
A briefing series by the Water & Finance Work Stream of the United Nations Environment Programme Finance Initiative

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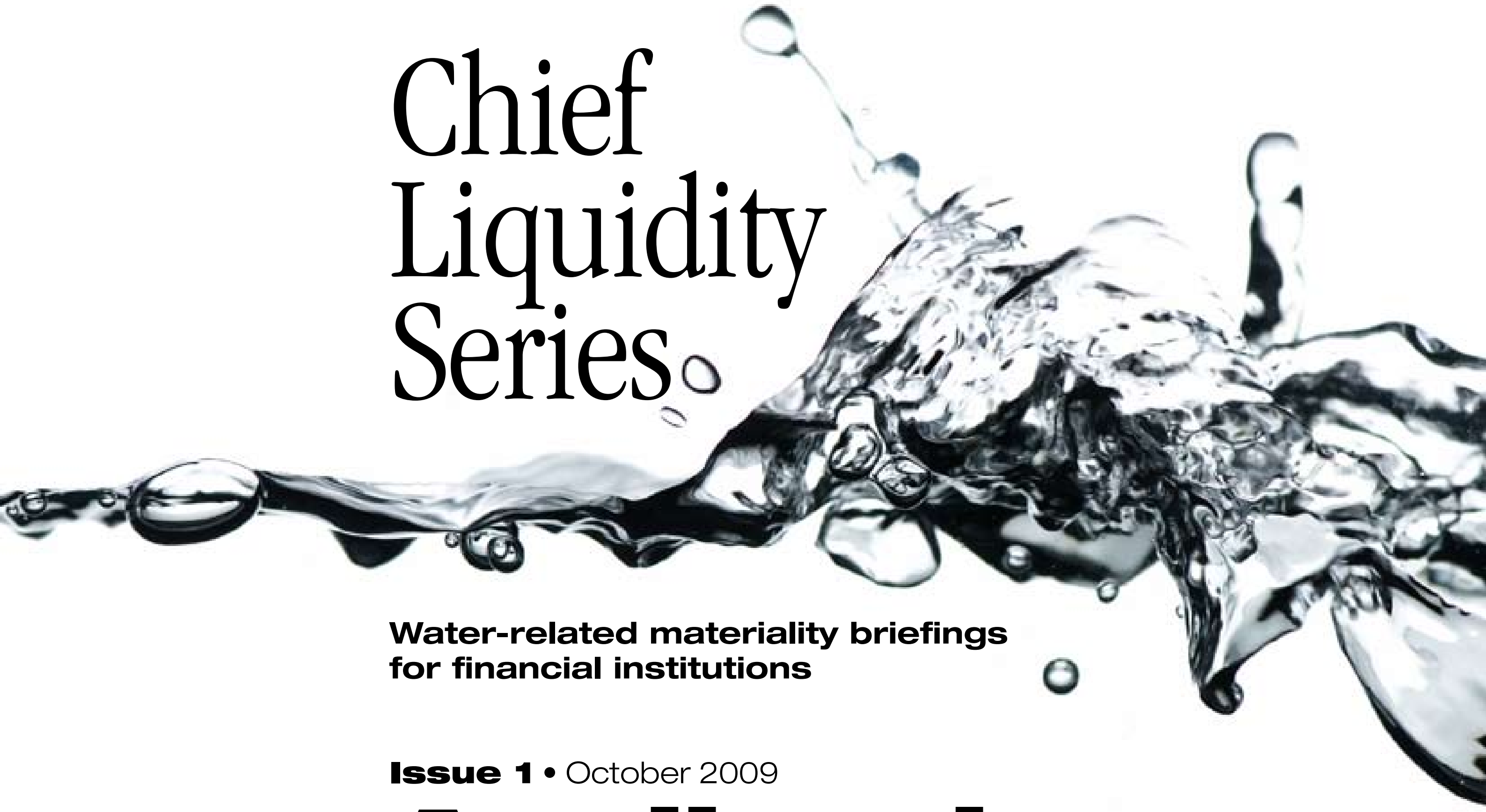

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Prepared for UNEP Finance Initiative by

ARUP

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UNEP Finance Initiative
International Environment House
15, Chemin des Anémones
1219 Châtelaine, Genève
Switzerland
Tel: (41) 22 917 8178 Fax: (41) 22 796 9240
fi@unep.ch
www.unepfi.org

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The UNEP FI Water & Finance Work Stream

Institution	Country
ANZ	Australia
ASN Bank	Netherlands
Banco Santander Brazil	Brazil
BMCE Bank	Morocco
Brazilian Development Bank (BNDES)	Brazil
Calvert	United States
Citigroup	United States
Connexis	Switzerland
Development Bank of Southern Africa (DBSA)	South Africa
IL&FS	India
Insight Investment	United Kingdom
Intesa SanPaolo	Italy
mecu	Australia
Nedbank	South Africa
Nordea	Sweden
Piraeus Bank	Greece
Rabobank International Brazil	Brazil
Rabobank Group	Netherlands
SAM	Switzerland
Standard Chartered Bank	United Kingdom
Stockholm International Water Institute	Sweden
UNEP Regional Seas	Global (based in Kenya)
UN Water	Global (based in Italy)
VicSuper	Australia
Westpac	Australia

The WFWS Project Team

Core Committee
Franz Knecht, **Connexis**
Peter Vos, **Rabobank**

Australia Committee
Dion Smith, **ANZ**
Damien Walsh, **mecu**
Emma Herd, James Sanguinetti, **Westpac**

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South Africa Committee
Elsa Kruger-Cloete, **DBSA**
Vicky Beukes, Brigitte Burnett, **Nedbank**

Foreword from the United Nations Environment Programme (UNEP) Finance Initiative

As the colour green finally starts to earnestly root itself in the consciousness of virtually all layers and trends of society, the colour blue is still struggling to get the consideration it deserves. It is crystal clear, however, that there cannot be a sustainable world economy – as 'low-carbon' and 'eco-friendly' as it might hopefully get – without it being a "water-sustainable" economy as well, able to create jobs and generate well-being while at the same time preserving natural water resources for communities and ecosystems to thrive. We are unfortunately now far removed from this as current human water consumption and its unprecedented ongoing growth continues to leave deep trails: on average, freshwater species populations have fallen by about 50% between 1970 and 2000, representing a sharper decline than that measured in either terrestrial or marine biomes; since 1900, more than 50% of the world's wetlands have disappeared; at the same time 1.1 billion people lack access to water and 2.6 billion lack adequate sanitation services.

What is needed as a first step towards a more water-sustainable future is a replication of the carbon journey: the global water crisis needs to take centre-stage just as climate change has – it needs to become a priority on the agendas of governments and regulators; it needs to be taught at primary schools as much as at business schools. Products and services need to benchmarked, rated, and differentiated according to the amount of water they appropriate in the course of their life-cycles; and it should become an ongoing topic for the media at all levels. Most importantly, water issues need to be considered as what they are: a unique and scarce economic resource with complex links to social and ethical issues.

Water is a fundamental raw input to numerous industry and business sectors – such as agro-industries, chemicals and pharmaceuticals, food processing, iron and steel, oil and gas, power generation, textiles and tourism – and both quality and security of supply are essential for economic activities to thrive. For the broader industry and business community, concerns around water, exacerbated by the global warming impacts on natural water cycles, are growing. How will financial institutions play the deadly serious water game in the decades to come as the water fundamentals shift in the sectors that they finance and invest in? This is the central question addressed by this Series of Briefings to on-the-ground practitioners in financial institutions around the world.

The members of the UNEP FI Water & Finance Work Stream converged from different geographies around the world to conceptualise and develop this very user-friendly Briefing with the aim of offering financial institutions the expertise required to effectively manage water, and ensure that financial institutions understand the global water challenge and act locally to make a global difference.

Water is local: solutions to water issues must be local too.

Paul Clements-Hunt
Head of Secretariat
UNEP Finance Initiative

Foreword from the UNEP FI Water & Finance Work Stream (WFWS)

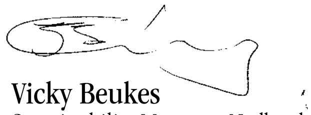
Water has already become one the most disputed resources of the 21st Century. It is clear that, globally, water supplies are limited, requiring careful and constant management by all stakeholders to strike a balance between various needs. There is the need to provide basic water services to all people; there are needs arising from economic development, and there are needs relating to the preservation of ecosystems and the environmental sustainability of water resources. In addition to these competing needs, climate change will alter precipitation patterns and make water availability more erratic in many regions of the world, including those that already today face serious water constraints.

In the centre of the global water scarcity challenge are, among others, the production processes of businesses – or their value creation chains – that provide the basis for the economic well-being of societies. Continued population and economic growth as well as global aspirations to enable better standards of living to all, continue to quickly increase the number and length of such value creation chains – and with them, the size of their water footprints: already today global human water consumption grows at twice the speed of global population growth. Therefore, if the various needs outlined above – those of communities, the environment and businesses – are to be simultaneously satisfied, while sustainable economic growth and the eradication of poverty upheld, the way forward in tackling the global water challenge is clear: our production processes have to become more "water sustainable" – more water efficient and less polluting. As financiers and hence key enablers of production facilities, financial institutions have a significant role to play in the path towards more water sustainability. With this Series of Water Materiality Briefings our aim is to encourage lenders and investors around the world to pro-actively play this role in the future.

The systematic integration of water considerations into core decision making should not be seen as an effort of philanthropy or altruism: in light of exploding water use competition and resource constraints, tightening environmental regulation in both developed countries and key emerging markets such as South Africa, and an ever more conscious and informed customer-base and public, there is little doubt that water pressures will increasingly translate into straight financial risks. In other words: the importance of 'water performance' as a factor in the complex equation that determines the financial performance of companies – and that of loans and investments – will only continue to grow.

The water scarcity challenge is widespread and of a global magnitude, but both water pressures, regulatory frameworks, and suitable solutions vary across regions and sectors; therefore, addressing the challenge requires focused attention locally. Building on the generic Water-related Risk Management Guidelines developed by UNEP Finance Initiative in 2007, these Briefings provide concrete guidance at the local level. As such, they aim to close a gap often found in financial institutions between ambitious environmental policies at the group level but lacking awareness and know-how in daily interactions with clients and investees. We hope that these Briefings will effectively support your institution not only in improving the risk profile of clients, investees and your balance sheet, but also in contributing to the response to one of the most serious challenges the world will face in this century.

Sasja Beslik
Director of ESG Analysis, Nordea
Co-Chair of the UNEP FI WFWS



Vicky Beukes
Sustainability Manager, Nedbank
Co-Chair of the UNEP FI WFWS

1

Water, development and financial institutions

Economic prosperity is an essential ingredient to overall human development and underpinned by the prosperity of many of the producers and providers of goods and services that make up economies around the world. Production activities along the value-creation chains at the heart of the economic system are often described as transformation processes of natural and other resources into goods and services: human labour, energy, fibre, minerals and other resources are inputs in the generation of value and wealth as a basis for human development.

Among all the resource types under consideration, **water** stands out as one of the few resources needed for almost all of such transformation processes, the **production of all goods** and the **delivery of all services**; across countries and throughout sectors, **water is needed by all**. Most importantly, however, and beyond a discussion on the resources needed for products and services, water is the key element needed to **sustain life on Earth**. Strikingly, water is unsubstitutable and its physical availability ultimately capped by nature. Water is unique as it is an irreplaceable condition for human life and the functioning of ecosystems on the one hand, and a core factor in most production processes on the other; coupled with the absolute limits of water availability, this uniqueness makes it a reason of concern and issue of focus, not only by governments but increasingly by private sector companies and their investors.

Population and economic growth, coupled with improving standards of living in many parts of the world are causing global consumption of water to double every 20 years. That is twice as fast as the world's rate of population growth; at the same time, more than one billion people on Earth already lack access to fresh drinking water and it is estimated that by 2025, approximately 2.7 billion people will face severe water shortages if consumption continues at current rates. It does not come as a surprise that water is deemed to become the most contested resource of the 21st century.

Economic prosperity is an essential ingredient to overall human development, but not the only one: equally essential are the functioning of life-supporting ecosystems and the health of human livelihoods, with sustainable access to water in sufficient quality and quantity. In coming decades, it will therefore be one of the key challenges of decision-makers in policy and business to 'de-couple' production processes, economic growth and ultimately standards of living from water consumption and pollution.

Such de-coupling will not only have benefits on the environment and societies, but should be well in line with long-term commercial interests: in light of increasing resource bottlenecks around the world, growing public and consumer awareness on sustainability matters and tightening environmental legislation, businesses and financial institutions that are able to ensure the 'water sustainability' of their operations will be increasingly at a competitive advantage.

The Chief Liquidity Series aims to equip financial institutions with a better understanding of water pressures around the world and their impacts on business performance as well as to guide them on how to start assessing the operations of clients and investee companies in regard to water impacts and exposure to water risks.

2

Why this series of briefings?

This is the first of a series of Water Materiality Briefings with which the Water & Finance Work Stream (WFWS) of the United Nations Environment Programme Finance Initiative (UNEP FI) aims to assist fellow UNEP FI Signatories and the broader financial services community in understanding the financial risks and emerging opportunities associated with water challenges across a range of particularly exposed sectors and diverse geographies.

The notion of providing guidance on a level of sectoral and geographic specificity builds on a set of universal but indicative guidelines for water-related risks and opportunities for financial institutions, published by the UNEP FI WFWS in October 2007.[1] As a logical continuation, these Briefings provide greater detail for easier integration of water-related considerations into financial due diligence and stock picking processes. The reason is that water pressures and their implications on business materialise locally and vary considerably by sector and geography.

The structure and sequence of the Chief Liquidity Series

	Sectors			
Geographies	Agribusiness	Power generation	Extractive industries	…
Australia				
Brazil				
India	ISSUE 1 – 2009	ISSUE – 2009		
Mediterranean Basin				Future issues…
South Africa				
China			Future issues…	
USA				
…				

2.1 First issue on agribusiness

The aims of this briefing on agribusiness are:

- To deliver to financial decision makers – particularly in credit institutions – (but potentially also to asset managers and financial analysts) an overview of water sustainability issues specific to corporate agricultural operations. This is done across a set of geographies around the world where, from the perspective of the finance sector, water-related problems strongly clash with economic growth and financial performance: **Australia, Brazil, India, South Africa and the Mediterranean Basin.** The focus on specific geographies should not exclude businesses and financial institutions in other regions from making use of these Briefings. Rather, they should feel encouraged to use these guidelines as 'proxies' for the management of water issues in all regions that have similar water conditions to either of those addressed here.

- To provide an initial framework of water-related indicators for financial institutions to assess the strategic and operational water performance of agribusinesses. A number of indicative performance indicators (PIs) have therefore been developed and tailored to each of the geographies addressed.
- To raise awareness on the complexities of the topic and the fact that water sustainability is not only a matter of pure water availability and water efficiency; water quality issues as well as the social and environmental implications of corporate water use can be just as important depending on local circumstances and the type of activity observed.

Water footprinting

Water footprinting is an emerging concept to measure the total volume of fresh water that is used directly and indirectly: the total water volume appropriated by products and services. Theoretically, it accounts for the operational water footprint (the direct water use by the business in its own operations) as well as the supply-chain water footprint (indirect water use e.g. for fertilizer production). Water footprinting protocols for agribusiness are still being developed and no consensus has yet been reached on an accepted methodology. While the concept is very promising and it is likely to become a powerful tool in the future, due to methodological gaps, the concept still has to evolve further to become applicable by the financial community. In the meantime, this Briefing is expected to provide guidance to and a first step for financial institutions to address water considerations in commercial (agribusiness) activities until the concept of water footprinting reaches the level of maturity needed.

3
How to use this Briefing?

Each issue of the *Chief Liquidity Series* focuses on the use of water in different sectors, across particularly exposed regions. This first issue looks at activities in the agribusiness sector across Australia, Brazil, India, South Africa and the Mediterranean Basin.

Each chapter of this report addresses a different region and begins with an overview of its overall water-related situation.

The *WaterGAP* (Water – a Global Assessment and Prognosis) model is used throughout to compare amounts of water naturally available with amounts of water required for human use. Outputs of the model are shown for each region. These indicate the level of pressure put on water resources and aquatic ecosystems and provide a quick overview of where water-related 'hotspots' lie.

The implications of water pressures on agribusiness activities and their financial performance are analysed and the impact of agricultural activities on local water parameters discussed. This is done by examining water issues with regards to a set of specific crops: those considered by financial institutions themselves to be the most financially relevant in each of the geographies concerned.

Throughout the report, boxed case studies highlight best local practice and innovation in the sustainable management of water resources in agribusiness activities, with a view to inspiring financial practitioners to promote such practice within their spheres of influence.

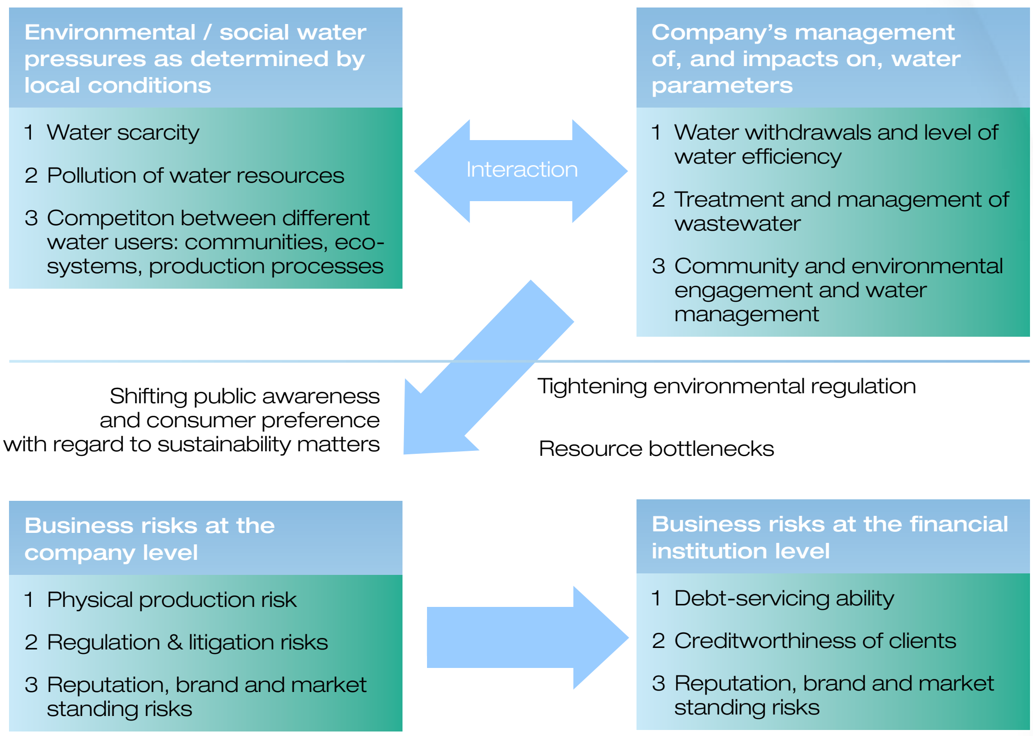
Most importantly, at the end of each geographic chapter (i.e. region), a set of regionally tailored performance indicators (PIs) is presented, and their nature, rationale and financial materiality explained.

4

How water pressures translate into financial risks

Figure 1

Framework of how environmental and social water pressures translate into business and financial risks



Water-related risks can be seen as the result of how a given company deals with external water pressures in a given location: the extent to which it lessens the negative impacts of such pressures on its operations and, vice versa, the extent to which it mitigates negative impacts of its operations on the local water environment. Water-related risks can broadly be categorised as follows:

- **Primary physical (production) risks** – the risk of inadequate quantitative and qualitative water availability needed to sustain minimal levels of production for businesses to be viable, i.e. insufficient or inadequate water supply to ensure profitable yield levels on farms.
- **Reputation and regulatory risks** – the risk of negative impacts on business activities arising from constraints on water quantity and/or deteriorating water quality, other than those directly related to minimal production levels. While these risks stem from water constraints, they do not materialise through insufficient production levels but through reputational and/or regulatory/litigious damage. Such risks can especially arise from the unsustainable behaviour (be it real or perceived) of a given agribusiness operation – either in the form of the over-abstraction and/or the pollution of water resources.

If such risks materialise, they can immediately affect lenders and other types of financial institutions in any of the following areas of concern:

- **Debt-servicing ability** – resource bottlenecks can have immediate effects on company turnover, factor costs, and ultimately profitability and solvency. Financial institutions of all types will be affected by such resource shocks and developments: either through clients' inability to service loans or by insufficient dividend yields from investee companies. Water bottlenecks are expected to become the resource constraint of greatest concern in the 21st century.

- **Creditworthiness of clients** – water-dependent companies and/or companies with a large water impact may become less creditworthy as water constraints intensify over time; this will increase the overall risk exposure of finance providers, which in turn will increase the return expectations of shareholders and equity capital requirements of regulators (where applicable: Basel 2).
- **Reputation, brand and market standing risks** – if reputational or litigious damage occurs at the company level, it can foreseeably affect the financial institutions and investors involved. Impacts can include profitability and solvency problems at the company level as well as direct reputational damage at the level of the financial institution (including, for instance, poor ratings by SRI rating agencies in the marketplace).

Intuitively, corporate water performance in production processes can be addressed by increasing water productivity or water use efficiency. While water productivity – "more crop per drop" – is a significant variable in corporate water performance, it is always affected by local circumstances. Depending on the sector and location of operations, other variables may come to the forefront; the pollution of watercourses may, for instance, represent a greater problem, and hence a greater financial risk, than the pure availability and efficient use of water.

It is the spatial and sectoral complexity of water issues as a source of financial risk that these Briefings aim to provide guidance on; by looking at water challenges where businesses and financial institutions are confronted with them: locally.

5

Global recommendations from local insights

While it is clear that water issues vary from location to location and that, consequently, the management of water-related risks by financial institutions must be tailored to the specific circumstances of the client's operations, a number of issues have been identified that – if systematically considered by financial institutions – can lead to greater water sustainability as well as more profitable and resilient agribusiness operations, everywhere. Regardless of location, financial institutions should make sure that agribusiness operations:

Ensure appropriate levels of water productivity levels relative to regional and national averages or local competitors. *High levels of water productivity may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turn-over. The level of water efficiency of a given operation will depend on a wide set of local factors. National or regional averages can, therefore, only serve as rough 'proxies'.*

Comply with current but also emerging environmental regulation. *Breaching environmental standards and subsequent prosecution can incur financial costs and cause reputation damage and losses from litigation, both for the farm as well as the lender. On the contrary, agribusiness operations that already today comply with environmental regulation that is likely to emerge in the future will be at a clear advantage relative to unprepared peers. Comprehensive environmental regulation with a focus on water impacts is being developed not only in developed countries (EU Water Directive) but in many emerging economies and developing countries as well (National Water Act and the Water for Development and Growth Framework in South Africa).*

Make use of best-available, water-efficient irrigation systems/techniques and provide financing to this end if needed. *The use of innovative irrigation systems can significantly enhance water productivity relative to other conventional techniques. It reduces exposure to water availability risks and input costs making an agribusiness operation more resilient, profitable and solvent. Such improvements can already be achieved by means of proven and economically viable technologies with quick amortisation horizons. Barriers of deployment are usually the lack of awareness and upfront financing.*

Rely on sustainable freshwater sources. *In many parts of the world – examples are Australia, India, the Mediterranean Basin and South Africa – conventional freshwater sources for agriculture, such as natural surface- and ground-water, are unsustainably over-exploited, polluted and at risk of collapse. Relying on alternative, more sustainable sources of freshwater will not only lessen the negative impacts of water withdrawals on natural resources and ecosystems, but also the dependence of agribusiness operations on unreliable water sources and their exposure to increasing water costs – rainwater harvesting, water re-use and recycling as well as sustainable desalination options should be explored.*

Actively look beyond their 'fence' and reach out to local communities and environmental stakeholders. *The sustainability of water resources can only be ensured by an integrated water resource management approach that involves all water users at the basin level. As such, water sustainability goes beyond the mere availability of water for the production process of a given company or farm. It is in the interest of any agribusiness operation to engage with other water users making sure local communities and ecosystems are provided with water in sufficient quality and quantity; if not, its* *acceptance among local stakeholders and, ultimately, its 'licence to operate', will be at stake. Stakeholder engagement and environmental impact assessments are measures that financial institutions can demand on an on-going basis.*

Seek to reduce negative impacts on natural water resources and ecosystems. *Water sustainability goes beyond the mere availability of water for the production process of a given company or farm. In addition to water efficiency measures and the use of water from sustainable sources, further steps can be taken to lessen the environmental impacts of agribusiness activities. Such measures will improve the risk profile of the client in light of tightening environmental regulation and growing public and consumer awareness on sustainability matters. Such measures may include: biological pest management, periodic monitoring of soil through physical-chemical analysis, soil erosion prevention, use of agrochemicals with low contamination and leaching potential, etc.*

6

Water sustainability of agribusiness activities in Australia

The Murray-Darling Basin

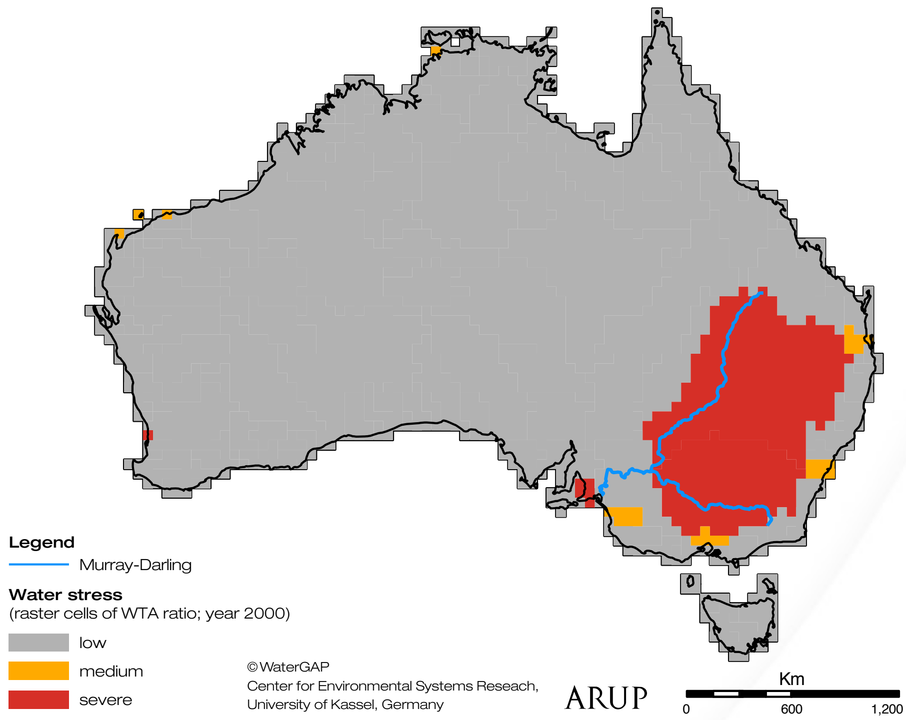
6.1 Local water challenges

The Murray-Darling Basin (MDB) inter-jurisdictional area is managed by the Australian Government, Australian Capital Territory and the States of Queensland, Victoria, South Australia and New South Wales (Figure 2). The Australian Capital Territory and the States all rely on and share its water resources. The MDB contains much of Australia's best farmland.

The River Murray supplies, on average, more than two-thirds of the Basin's water resources for irrigation, industrial, stock, domestic and environmental purposes. Around 75% of the water from the River Murray in the State of South Australia is used for primary production, such as water for stock and irrigating crops. An overview of irrigated land within the MDB is given in Figure 3. Overall, agriculture accounts for about 96% of the water consumption in the MDB which provides 41% of Australia's gross value of agricultural production.[2]

Figure 2

Location of the Murray-Darling Rivers and overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across Australia.



6.1.1 Water availability

Overall, human water consumption and climate change induced reductions in rainfall (see below) have reduced average annual stream-flow at the Murray mouth by 61%. Over the 1895 to 2006 period, the average annual flow to the sea has declined by almost 40%.[3] The MDB must be considered an acutely water stressed basin, as shown in Figure 2.

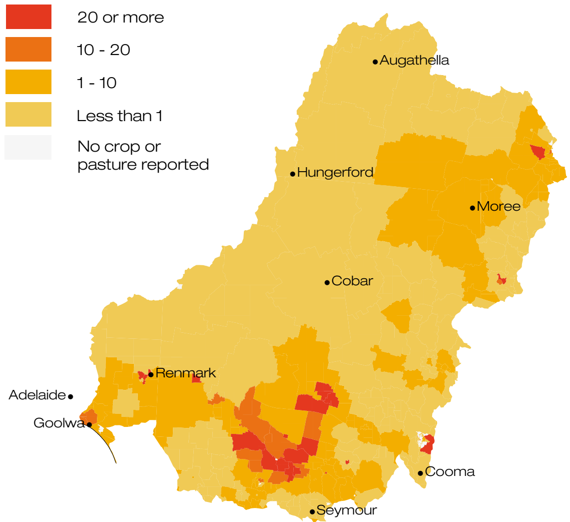
6.1.2 Climate change impacts

Recently, water availability has been severely affected by exceptionally hot and dry years.[4] In 2007, a 117-year low of water inflows to the MDB river system together with historic low storage levels resulted in drought throughout the basin. Delivery volumes of rural water service providers in New South Wales and Victoria decreased by 51% between 2006-07 and 2007-08 and irrigators have received low allocations of water entitlements.[5] These dramatic water bottlenecks are making agribusiness operations in the region less profitable and viable; especially those that are particularly water intensive.

Such resource pressures are only expected to sharpen in the future. Surface water availability across the entire MDB is expected to decline further as a result of climate change. Likely scenarios by 2030 suggest an 11% reduction in average surface water availability across the MDB: 9% in the north and 13% in the south.[6] The reduction would be greatest in the south where the majority of the runoff is generated and where, therefore, the impacts of climate change are expected to be greatest. This is shown in the map of the area given in Figure 4.

Figure 3

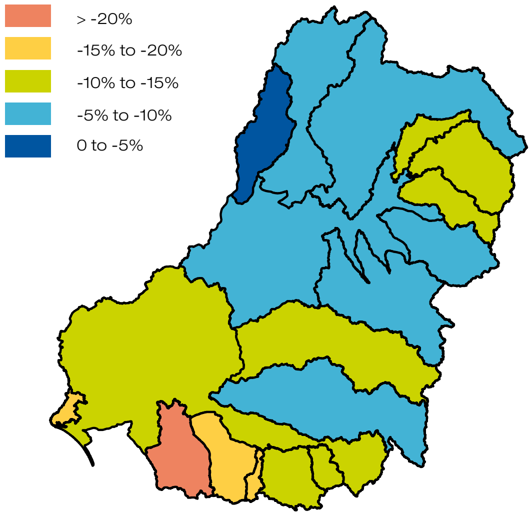
Percentage of crop and pasture land irrigated in the Murray-Darling Basin.



Sources: Geoscience Australia 2004, Australian Bureau of Statistics 2006 (ABS Water Account, 4610.0)

Figure 4

Changes in water availability under the median 2030 climate in the Murray-Darling Basin.



Sources: CSIRO (2008) Water availability in the Murray-Darling Basin, A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project. CSIRO, Australia, p 45.

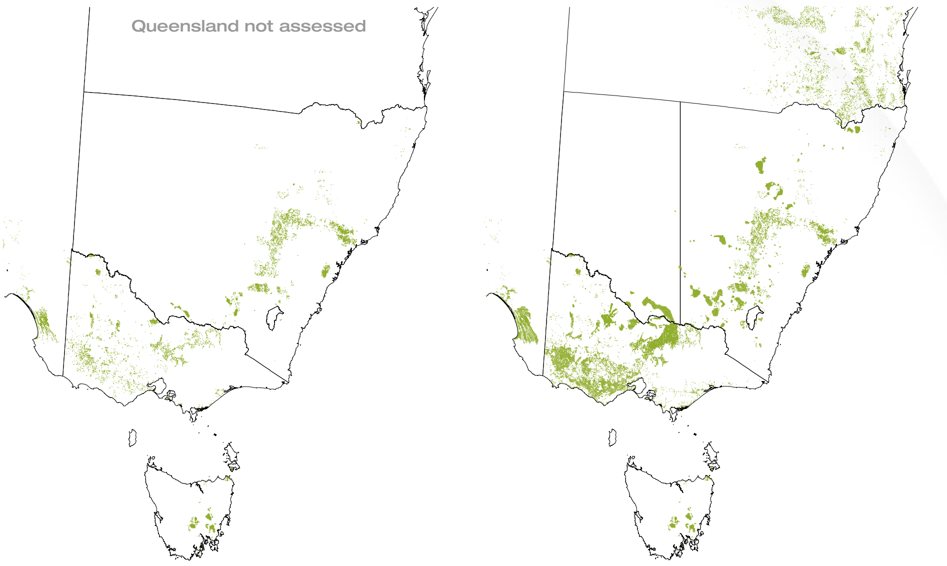
6.1.3 Water quality

See Pls 5a and 5b at the end of this chapter

Changes to the native landscape in the MDB have resulted in the widespread and growing problem of dryland salinity. Farmers are among the first to be affected, through the salinisation of rivers and agricultural land. Areas containing land at risk of dryland salinity in the South-East of Australia are shown in Figure 5. A Basin Salinity Management Strategy has been put in place to control salinity in the MDB and protect key natural resources. **Financial institutions should take into consideration the location of agribusiness activities subject to dryland salinity and encourage clients to monitor/reduce their contribution to irrigation salinity.**

Figure 5

Areas containing land at risk of salinity in the South-East of Australia. The map broadly captures the Murray-Darling Basin.



Ares containing land of high hazard of risk of dryland salinity in 2000

Forecasted areas containing land of high hazard of risk of dryland salinity in 2050

Source: National Land & Water Resources Audit, a programm of the Natural Heritage Trust, © Commonwealth of Australia 2001; reproduced by permission; http://www.anra.gov.au/topics/salinity/risk-hazard/index.html

6.1.4 Institutional/regulatory context

Surface water diversions from the MDB have been capped since 1 July 1997 to prevent further increases in water withdrawals. While this cap is not necessarily sufficient for the sustainable functioning of the basin ecosystem, it is considered an essential first step towards more sustainable water management; the compliance of each of the basin states with the objectives of the cap is monitored annually.[7]

Reacting to the ongoing drought, the Australian Government has initiated policy changes to the management of water resources in the MDB as part of its National Water Initiative, Water for the Future program and is introducing new legislation, such as the Water Act 2007. The latter facilitates the operation of efficient water markets and enables water trading between irrigation districts in the basin.[8] **In light of sharpening environmental regulation in the MDB and beyond, financial institutions have an interest to encourage clients, irrigators and farms to comply with regulation which is likely to emerge but not already in place yet.**

See PIs 8 & 10

Regulatory efforts include the availability of public funding and incentives for water-efficieny investments as set out, for instance, in the recent Intergovernmental Agreement on MDB Reform between the states and the Australian Government.[9] Programs include the Rural Water Use & Infrastructure program which aims to upgrade irrigation infrastructure and improve river management.[10] **From a financial institution perspective, the receipt of funding from such government programs can be a good 'proxy' for: the awareness the client has about the issue; the initiative the client is taking to address the problem; as well as the actual level of water efficiency in the farm or the water irrigation system covering the farm.**

See PI 1

In addition, a Restoring the Balance in the Murray-Darling Basin program has been installed through which the government has committed AUD 3.1 billion to purchase water in the MDB over 10 years in order to restore environmental flows; this includes a recently announced package of 'exit grants' for irrigators.[11]

See PI 8

The Irrigation Hotspots Assessment project identifies the nature, location and amount of water losses in existing channel and piped irrigation delivery systems. **Farms, irrigators and financial institutions should ensure that operations are not located in or affected by a 'Hotspot'. If so, measures should be explored to halt water losses.**

See PI 7

Furthermore, the Australian Government, through its Private Irrigation Infrastructure Operators program, has committed to modernizing irrigation infrastructure and sharing the achieved water savings (from improved water use efficiency) between irrigators and the Commonwealth Environmental Water Holder, which is responsible for holding environmental water entitlements.[12] In May 2009, the Murray-Darling Basin Authority, for instance, started to buy back water on the market from licence holders. This water will help restore environmental flows in drought-affected wetlands in South Australia in order to rehabilitate the provision of environmental services, including to agricultural activities.[13]

See PI 8

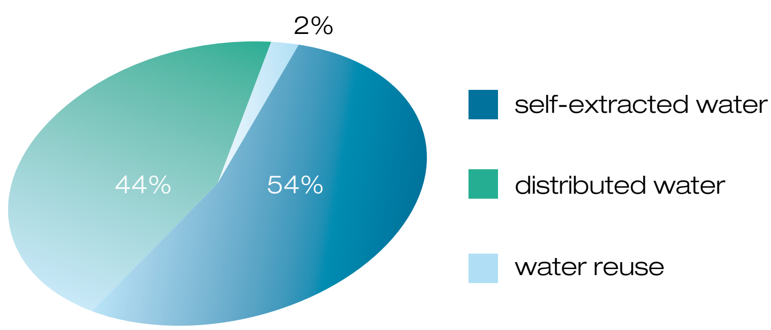
6.2 Water use in irrigated agriculture: grapes, cotton and rice

6.2.1 Sources of water and water trading

Most of the water consumed by the Australian agriculture industry in 2004–05 was self-extracted water (54%), with distributed water (44%) and reuse water (2%) accounting for the remainder. **An increase in the exploitation of alternative and sustainable sources of water (such as water reuse and rainwater harvesting) can have positive impacts on the cost structure and the drought resilience of agribusiness operations.**

See PI 11

Sources of water in the Australian agriculture industry



Water is directly extracted from bores, small farm dams, rivers and their tributaries or supplied by government, private or irrigator-owned water providers. The distribution of types of irrigation infrastructure in the MDB is shown in Table 1. Special attention should be given to the promising concepts of water recycling and re-use systems: these are most widespread in dairy operations and broad acre operations; only 6 % of horticulture farms have water re-use systems in place.

Table 1 On-farm irrigation infrastructure in the Murray-Darling Basin in 2006-07[14]

	Dairy	Broad acre	Horticulture
Percentage of farms with			
River pumps	22%	34%	37%
Ground water pumps	36%	28%	18%
On-farm irrigation storage	55%	34%	15%
Tile drains	0%	1%	16%
Other drainage reuse systems	**48%**	**38%**	**6%**

See PI 11

Note: Large potentials for the further development of drainage re-use systems remain untapped across agribusiness classes, but predominantly in horticulture operations. Financial institutions can contribute to the exploitation of such potentials.

See PI 10

Overall, 23% of the farms in the MDB participate in water trading. **Access to and participation in such trading-schemes can enable producers and irrigators to flexibly adapt to changing water availabilities and irrigation needs: shortfalls of water supply can be compensated through the purchase of additional water rights. Achieved water savings can be sold, which may open new revenue streams for farms and additional incentives to increase water efficiency.**

See PI 9

An overview of irrigated areas is shown in Figure 3. In total, the area of irrigated land in the MDB decreased by 8% from 2000/01 to 2004/05. Nationally, the largest decline in irrigated area was for rice, with volumes down more than 81%, followed by cotton (50%) and pasture for grazing (30%). **This signals that farmers are increasingly turning from water-intensive to water-efficient and drought-resistant crops. Agribusiness operations as well as financial backers will have to continue adapting to these new water-stressed circumstances.**

6.2.2 Grapes

Three types of grape (table, dried and wine) are grown and approximately 90% of land used for grapes is irrigated. Grape vines are usually grown under deficit irrigation and are intentionally water stressed to produce desired combinations of size and taste. Irrigation rates and timings are often, but not always, a decision which balances quantity of harvest (i.e. amount of yield) versus quality (i.e. grape content of vitamin C, acids, etc.). Having access to irrigation when desired is therefore critical from a crop management perspective.

See PI 6

Substantial efforts have been made by farmers as well as industry and research in Australia to address water management in viticulture, including research into crop response, irrigation techniques and scheduling. Most vines are already drip-irrigated and use either surface or underground techniques which are considered to be highly efficient but require high levels of expertise to manage effectively.

6.2.3 Cotton

Cotton production remains heavily reliant on rainfall and crops are predominantly grown on laser graded fields using furrow irrigation. The average cotton output is approximately 7.8 bales/hectare.[15]

In a multi farm assessment of water use efficiency in the upper reaches of the MDB, water productivity was found to vary between regions, individual farms and between seasons.[16] On average, during the 3-year period, values of water productivity ranged from 4500 m^3/t to 3500 m^3/t. **Through asking the right questions, financial institutions can play an influential**

See PIs 2, 6 & 9

role in promoting higher water productivity levels and shifts towards more water-efficient crops.

The Cotton Australia Best Practice Manual, which many farmers comply with, identifies measures to improve water productivity and the use of agrochemicals[17] . Further support is available from Cotton Australia, which is the leading body for Australia's cotton growing industry. A Managing the Drought information Kit is also available to farmers.[18]

See PI 9

Case study 1

Renmark Irrigation Modernisation Project

Renmark is a town situated on the Murray River in the Riverland region of South Australia. Irrigated horticulture in the area is dominated by high-value crops such as grapes, citrus and stone fruit. The water supply to farmers is managed and operated by the Renmark Irrigation Trust (RIT), an irrigator-owned water provider. Renmark and RIT hold South Australia's largest single water licence (Licence No. 1) which provides up to 47.9 GL in water entitlements.

With support from the Government's Water for the Future Plan, RIT has undertaken irrigation modernisation planning for the Renmark area and its infrastructure Ü see PI 1. The plan identifies options to modernise RIT's irrigation infrastructure as well as to improve on-farm irrigation practice. Furthermore, it takes into account expected climate change and regulatory developments. Some of the expected results are tabled below:

Table : On farm irrigation practice in 2004-05 and projected changes by 2012

Year	2004-05				2012	
	Drip	Micro-sprinkler/under canopy	Flood/Furrow	Other/None	Drip	Micro-sprinkler/under canopy
Irrigation Method	90%	80%	50%	50-65%	92.5%	85%

A key take-away is that the availability of government support for investments in water infrastructure and efficiency, coupled with careful planning on the basis of climate change expectations and other long-term developments, can be visionary and lead to strategic improvements in the drought-resilience of agribusiness operations.

Source: Renmark Irrigation Trust: Modernisation Plan.

6.2.4 Rice

Rice production in Australia is comparatively efficient and the industry has a strong research program to incentivise further water savings. As an example, paddy rice is often grown as part of a crop rotation system, enabling residual moisture to be maximized by follow-on crops.

Water productivity for yields is in the order of 1000 m^3/t (which is a 50% improvement from 1985). Despite these efficiency improvements, growers are constrained by the on-going sequence of droughts. Without adequate water supply, growers will be increasingly forced to reduce paddy rice area, as well as to turn to other production strategies and/or more water efficient crops.[19,20]

See PIs 2 & 9

6.3 Performance indicators

Based on the current context of water challenges and agribusiness operations in the Murray Darling Basin, 11 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations.

	Description	Rationale and materiality
PI 1 **Has the client received funding for water efficiency improvements from public sources: the Water for the Future program, the Private Irrigators Infrastructure Program in New South Wales or the Australian Irrigation Modernisation Planning Assistance Program?** **Or is the client serviced by an irrigator who has received this type of funding?**	These programs make funding available to rural water projects to improve the efficiency and productivity of water distribution, water use and management. They help irrigation water providers to: I.) develop modernisation plans for their districts, II.) upgrade irrigation infrastructure and III.) assess options to adapt to a future with less water. Clients may, however, have implemented such measures without Government support. In New South Wales, clients may have received funding from the Water Wise on the Farm Program.[21]	• The receipt of funding from such government programs can be a good 'proxy' for: the awareness the client has about the issue; the initiative the client is taking / has taken to address the problem; the actual level of water efficiency of the client or the water irrigation system covering the client. • Clients may have been able to fund such investments without government support. • Mere eligibility to participate in such government programs is a proxy for good practice and client compliance with certain sustainability criteria.
PI 2 **What is the client's crop-specific water productivity performance?**	High levels of water efficiency may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turn-over. The level of water efficiency of a given operation will depend on a wide range of local factors. National or regional averages (or benchmark values) can, therefore, only serve as proxies. **Reference values** Benchmark values of water productivity in Australia are: **Grapes** Wine grapes: 400-303 m^3/ton Sultana grapes: 752-247 m^3/ton (1997 data) **Cotton** 4500-3500 m^3/ton **Rice** approx. 1000 m^3/ton	In addition to environmental benefits, high levels of water efficiency have positive impacts on the cost- structure and drought-resilience of agricultural activities.
PI 3 **What is the expected decline in water availability within the client's area of operation?**	Not all regions in the MDB will be affected by climate change and declining water availability equally: it appears that some regions will be affected more strongly than others. *See Figure 4 on page 18.* **Reference values** See Figure 4 on page 18.	In addition to an assessment of current water availability, the viability of an agribusiness operation will also depend on the forecasted availability of water over the medium to long term.
PI 4 **Has the client conducted an assessment of the security of sustainable water availability in quantitative and qualitative terms?**	Assessments (confirmed by a 3rd party) may allow for a refined understanding of the security of water supply. They may also identify alternative sources of sustainable supply such as rainwater harvesting, re-use of water and water trading. Assessments should also include local demand projections.	A better understanding of the availability and constraints of water supply is key for business success. Together with a regional assessment of water issues, a local assessment at the farm level will provide a basis to identify bottlenecks, adverse developments as well as possible measures and promising solutions.

PI 5 **a.) Is the area of production exposed to dryland salinity risk? If yes, are responsive measures being implemented by the client?** **b.) Are measures in place to minimise the risk of irrigation salinity?**	Salinity results from watertable rises from irrigation systems (irrigation salinity) and from dryland management systems (dryland salinity). Guidance on the latter is availabe for on-farm decisions. Figure 5 on page 19 identifies areas at risk. **Reference values** See Figure 5	A better understanding of the exposure to dryland salinity risk and the implementation of response measures will influence business success in the medium to long term. Dryland and irrigation salinity adversely affect crop yields and quality of output.
PI 6 **Does the client use best available water-efficient irrigation systems/ techniques?**	Drip and micro-sprinkler/under canopy systems are both economically viable and highly water efficient. In contrast, microspray systems, portable irrigators, large mobile machines, solid set under canopy sprinklers, and furrow irrigation are less water efficient.	The use of efficient drip and micro-sprinkler/under canopy systems enhances irrigation efficiency relative to other conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.
PI 7 **How does the location of the client's operations 'perform' under the Irrigation Hotspots Assessment Project? In other words: is the client located in one of the hotspots and, as such, experiencing water losses?**	The Irrigation Hotspots Assessment Project identifies the nature, location and amount of water losses (known as 'hotspots') in existing channel and piped irrigation delivery systems. **Reference values** WELL (operations not in Hotspots) / BADLY (operations in Hotspots)	If the client's operations are located in one of the 'hotspots', this may have adverse cost, regulatory as well as reputation consequences on the irrigation system and the farms it covers.
PI 8 **Have steps been taken to mitigate impacts on ecosystems and the environment?**	Steps may include natural pest management, low water fertilisers and addressing the question of whether the production area is located in or near a site of ecological importance.	Good environmental practice may have positive impacts on financial performance in light of tightening environmental regulation. Agribusiness operations that already today comply with emerging environmental regulation (Restoring the Balance in the MDB Program) will be at a clear advantage relative to peers. The implementation of such considerations may also have reputational benefits for financial institutions in light of consumer preference increasingly shifting towards 'more sustainability'.
PI 9 **Has the client assessed the appropriateness of the crop cultivated relative to local water conditions?**	Water resource conditions include local water availability, precipitation patterns, salinity levels as well as water and air temperature. Crops that are suitable for a specified environment can be identified using the FAO Ecocrop.[22]	Replacement of water-intensive with – efficient and drought-resistant crops is a key opportunity; it can have positive effects on cost structure and business resilience over the medium to long term.
PI 10 **Does the client participate in water trading and/or salinity trading? Or is the client covered by an irrigation scheme that participates in water or salinity trading?**	Water trading between irrigation districts in the basin and between individual irrigators exists on both a temporary and permanent basis.** (Salinity trading schemes exist e.g. at the Hunter River and there is a trial program in Bet Bet in Victoria).***,[23]	Participation in trading-schemes can enable producers and irrigators to flexibly adapt to changing water availabilities and irrigation needs: shortfalls of water supply can be compensated through the purchase of additional water rights. Achieved water savings can be sold, which may open new revenue streams for farms and additional incentives to increase water efficiency. Overall, environmental markets have proven to be flexible, user-friendly and effective means to address environmental problems and resource constraints.

PI 11 **What proportion of the client's total water consumption is from sustainable water sources?**	Sustainable water sources may include harvested rainwater and re-used water. **Reference values** The average proportion of re-used water across the MDB is 2%. As per Table 1 on page 21, the potential to increase water re-use remains largely untapped especially in horticulture operations: there only 6% feature respective drainage systems.	Albeit only limited in scope, such alternative practices, if exploited meaningfully, can provide additional water resources at little (or no) cost and make an enterprise or farm more drought resilient.

Note:

Abbreviations after company name refer to company 'Tickers'. Click on company name to link to Investor Relations web page. Source: www.corporateinformation.com and www.google.com/finance Figures quoted on 15th September 2009

* The successful applicants who have received offers of funding are: Bringan Irrigation Trust, Marthaguy Irrigation Scheme, West Corurgan Private Irrigation District, Western Murray Irrigation Limited, Coliban Water Corporation, South Burdekin Water Board, North Burdekin Water Board, Tatalia Water Supply Inc., Jemalong Irrigation Limited, The Renmark Irrigation Trust, Wimmera-Mallee Water, Tenandra Irrigation Scheme, Trangie-Nevertire Cooperative Ltd, Harvey Water, SunWater, Murrumbidgee Irrigation Limited, Goulburn-Murray Water, Murray Irrigation Ltd and Southern Rural Water.

** Temporary trade – purchase or sale of an annual allocation of water, i.e. the water allocation purchased can be used during the year it was bought; Permanent trade – purchase or sale of the actual entitlement or the permanent right to water.

*** Salinity trading builds on the notion that discharge of salty water should only take place when there are high quantities of low-salt, fresh water in the river. There is a cap on the overall discharge of salty water into the river and allocated rights to do so can be traded.

7

Water sustainability of agribusiness activities in **India**

7.1 Local water challenges

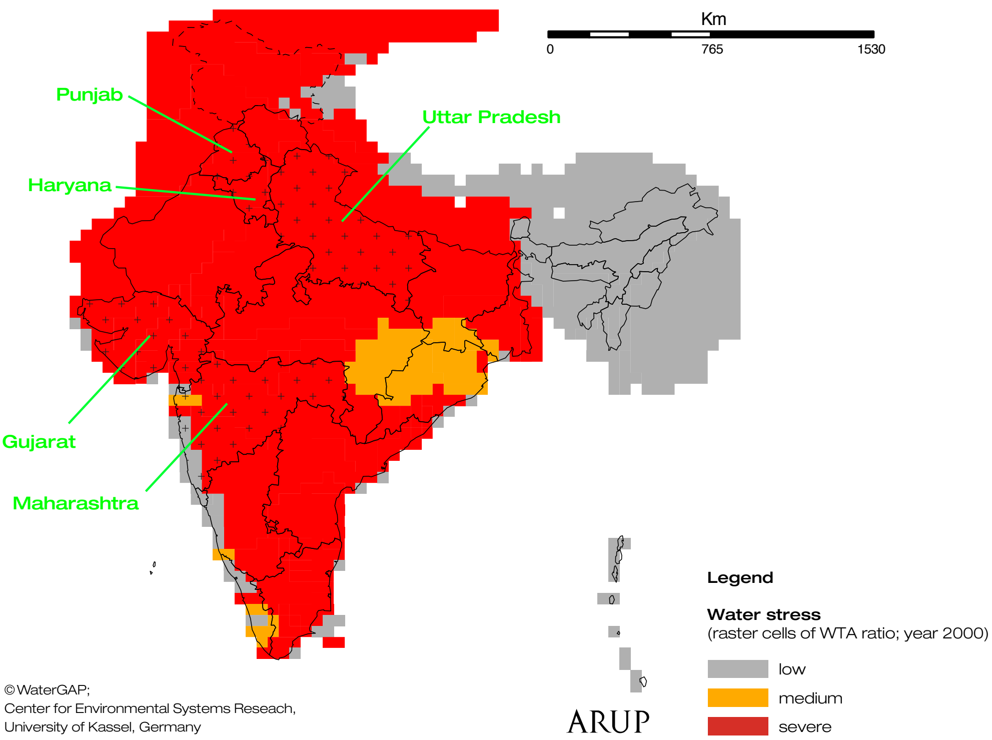
7.1.1 Water availability

Growing water scarcity is evident in India from falling groundwater tables and trends in river discharge. Uneven precipitation patterns, such as the South West Monsoon, compound water management challenges. For example, many areas experience localised, severe water shortages before the summer rains and are then subject to flooding during the monsoon. Water resource availability and exploitation across India are also highly variable due to climate and social factors. Circumstances in the semi-arid west are, for instance, very different to those in the wetter eastern areas.

Figure 6 shows that river basins across India are water stressed with the exception of areas in eastern India and isolated pockets in the South West.

Figure 6

Location of selected states of agricultural importance (labelled in green) and overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across India.

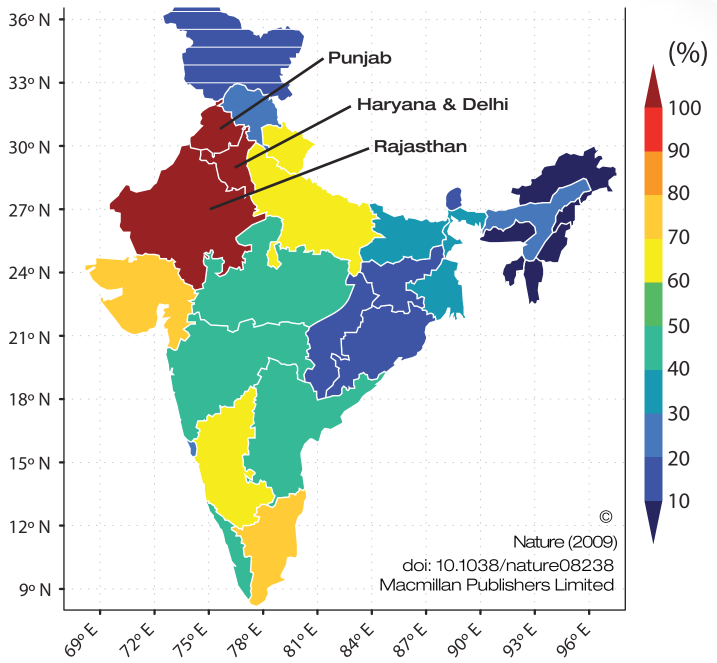


Water use in India is often unsustainable; the most significant cause is the overexploitation of groundwater resources, illustrated in Figure 7. These groundwater resources underpin irrigated agriculture across India, including the agriculturally significant states of Punjab and Haryana. The use of these underground reserves is growing rapidly as farmers turn to pumped wells to provide 'on-demand' irrigation in lieu of declining surface water supplies.[24] **It is and will be increasingly important for farmers and their financial backers to ensure sufficient availability and sustainable use of groundwater resources in the future, many of which are currently at risk of collapse.**

See PIs 3 & 12

Figure 7

Groundwater withdrawals as a percentage of recharge. The map is based on state-level estimates of annual withdrawals and recharge as reported by the Indian Ministry of Water Resources.[25,26]



7.1.2 Climate change impacts

By 2050, freshwater availability, particularly in large river basins, is projected to decrease. Studies indicate that, on average, India will reach a state of water stress before 2025 when overall water availability is projected to fall below 1'000 m^3 per capita.[27] Availability of freshwater will further decrease as a result of the continued shrinking or complete disappearance of Himalayan glaciers and the discontinuation of their critical function: the storage of water and its gradual and uniform release over long and potentially dry periods of time.

7.1.3 Water quality

Deteriorating water quality, resulting primarily from untreated industrial, domestic effluent, and municipal pollution, limits available water supplies. Naturally occurring water quality issues further exacerbate the problem; high fluorine in Rajasthan and arsenic content in West Bengal are cases in point. Salt-water intrusion into coastal aquifers affects yield and farmers'/agribusiness' operations that solely depend on coastal aquifers may be disadvantaged. Further, farming activities themselves may cause irrigation salinity through water table rise from irrigation systems.

A localised but growing problem in India is water-logging (the saturation of soils with water), which is well documented in large-scale irrigation schemes. It is normally found in areas close to unlined canals where surface water seeps from the canal into adjacent agricultural land. In Punjab, this issue has already caused significant losses in agricultural land.

See PIs 3 & 8

By asking the right questions, financial institutions can play a role in lessening the exposure of clients to polluted water as well as lessening the negative impacts of clients on the quality of natural water resources.

7.1.4 Institutional/regulatory context

Water resources are traditionally managed at the state level; however, the Ministry of Water Resources is responsible for policy guidelines and regulation of water at the federal level. In India, the use, management and ownership of water is often linked to land or irrigation structures, rather than to the resource itself; hence property rights to water are poorly defined.[28] This lack of clarity contributes to the complexity and high cost of legal disputes over water. There is growing recognition that these laws need to be amended and international attention is beginning to focus on this issue.

7.1.4.1 Groundwater exploitation

A critical element in India's growing water scarcity is the proliferation of tube-wells for irrigation. Groundwater development is unregulated and often instigated by the farmers themselves or through institutional finance. **It can be considered as in the highest interest of financial institutions to ensure the sustainable exploitation of ground water resources by farms and other actors.**

See PIs 3 & 11; Figure 7

7.1.5 Transboundary water management

India has a number of transboundary rivers and shares water with Pakistan, Bangladesh and Nepal. The water-sharing agreements between these countries, particularly with Pakistan, can be a source of tension. Inter-state water conflicts are also prevalent due to the federal system in India and are exacerbated by uncertain rights to water at the State level. A notable example is the dispute between Tamil Nadu and Karnataka over the Cauvery River.

7.2 Water use in irrigated agriculture: wheat, cotton, sugarcane and rice

7.2.1 The agricultural sector

India's agricultural sector is dominated by small, marginal holdings with generally low levels of mechanisation. Over 80% of farmers have holdings of less than 2 hectares, which account for 44% of the total holdings, yet these generate over 50% of agricultural output.[29]

Approximately one-third of agriculture is irrigated, with the highest levels of irrigation development located in the states of Punjab and Haryana, which unsurprisingly belong to the group of states with the highest and therefore most unsustainable levels of groundwater withdrawals. **Levels of irrigation efficiency are relatively low and improvements can be achieved by adequately designing, installing, and maintaining irrigation systems.**

See PIs 4, 6 & 11

Inadequate attention has been given to the maintenance of irrigation schemes resulting in the poor performance of these systems. Recent trends towards Participatory Irrigation Management and Water Users' Associations have transferred some of the responsibility for maintenance to farmers themselves, but the results from this policy change have been mixed.[30]

Irrigation and drainage systems are frequently unable to receive and deliver the needed quantity of water. This deterioration, combined with poor management of irrigation supplies – for example, a surplus of water above crop requirements – results in low efficiency levels. **Financial institutions are in a position to enhance the irrigation know-how of clients through the promotion of corresponding training activities; attention should also be paid to the condition of the water infrastructure that clients rely on.**

See PIs 2 & 4

7.2.2 Sources of irrigation water

The greater part of irrigation water in India is sourced from groundwater (wells), with the remainder sourced from canal networks fed by dams or tanks that collect rainwater during the monsoon. A recent analysis[31] of irrigation supplies in India showed that wells provide 61% of the supplied water, canals 29%, tanks 5% and other sources 5%. This dependence on groundwater leaves the agricultural sector vulnerable to falling groundwater tables and the deteriorating quality of these resources. The use of alternative and 'sustainable' sources of water such as water re-use and rainwater harvesting appears to remain well below potential levels, especially in light of particularly uneven rainfall patterns throughout most of India. **From a financial perspective, an increase in the exploitation of alternative resources can have positive impacts on the cost structure and the drought resilience of farms and other agribusiness operations.**

See PI 9

7.2.3 Sugarcane

The sugarcane belts of Uttar Pradesh and Maharashtra are the most significant sugarcane regions, followed by Tamil Nadu and Karnataka. Uttar Pradesh produces more than 40% of sugarcane in India. Here, much of the sugarcane is irrigated by groundwater and, therefore, declining water tables (depths of >20 m) have negative impacts on farm performance.

See Pls 3 & 11

The water productivity of sugarcane in India is about 60-70 m^3/t cane produced under controlled water management, and approximately 90% of the sugarcane production is irrigated. Water supply has a significant impact on cane productivity and profitability. Water is also required for processing. **By asking the right questions, financial institutions can play a role in increasing the crop-specific water productivity of clients.**

See Pl 10

Substantial water productivity gains of 70 to 210% can be especially achieved by shifting from conventional surface to drip irrigation.[32] **Financial institutions can contribute to such shifts towards water-efficient technologies.**

See Pl 6

Highly productive sugarcane areas (exceeding 80 t/ha in Maharashtra, Tamil Nadu and Karnataka for instance) are reliant on agro-chemicals (fertilizers, pesticides, and fungicides) that can seep to surface or groundwater sources if not properly applied.

See Pls 2 & 8

7.2.4 Cereals (wheat)

The states of Punjab and Haryana situated in the North-West of India are regarded as the most important agricultural areas in the country. Irrigation development here is above 80%, and agriculture is characterised by highly intensive inputs of energy, water and fertilisers. The most important crops in the region are wheat and rice. **Falling groundwater tables represent the most significant water risk for agribusiness**: over 75% of the state of Punjab, for instance, is subject to falling water tables.[34]

See Pls 3 & 11; Figure 7

The low level of investments into the maintenance of water infrastructure and efficiency improvements remains a significant concern. Insufficient water supply and the unsuitable timing of irrigation can substantially reduce yields, leading to low profitability at the farm level. Expertise on when to apply water, and on how to manage other inputs such as fertilisers, and pesticides is essential in maximising water productivity levels. **Financial institutions should therefore insist on capacity building and training of farmers on, soil-, water- and agrochemicals management.**

See Pl 2

Current wheat production has low yields in the range of 1-2 t/ha on average across India, but yields in Haryana and Punjab by far exceed the average.[35,36,37] In this context, water productivity and yield levels are closely interlinked. **Improved yield levels can be achieved if water productivity levels are increased.** At an overall yield level of 1-2 t/ha, water requirements range between 3000 and 1700 m^3/t produced. When reaching a yield level of 4 t/ha, water productivity improves to 900 to 800 m^3/t.

See Pl 10

7.2.5 Cotton

Significant areas for the production of cotton are the states of Gujarat, Maharashtra and Punjab. In Gujarat, over 40% of cultivated land is irrigated, particularly in the arid north, by schemes such as the Sardar Sarovar Dam Project. Here, as in many other parts of India, the growth in agriculture has been triggered by an explosive increase in groundwater-withdrawals (see Figure 7) and the introduction of high-yielding varieties, such as transgenic Bt cotton. Cotton output[38] has risen from 3 million bales (of 0.17 t each) in 2002/03 to 11 million bales in 2007/08.

In light of tightening water availability and increasing demand, financial institutions should continually review crop choice and the impacts of agribusiness operations on water resources.

See Pls 3, 5 & 11

7.2.6 Rice

In 2007, rice yields in India were greatest in Punjab, Andhra Pradesh and Haryana (6.0, 5.0 and 5.0 t/ha respectively).[39] Approximately 50% of the total area used for rice production in India is irrigated paddy (rice). However, paddy rice production ultimately relies on rainfall and in periods of low rainfall (e.g. monsoon failure), irrigation inputs are required.

See PI 5

In addition to paddy, other methods with alternate wet-dry rice are increasingly being promoted due to competing water demands. **Financial institutions can ensure the appropriateness of crops relative to local water conditions.**

See PI 10

Although rice yields have increased substantially since 1960, there are still several states that have low yield and water productivity levels. There are significant potentials to improve yields and increase water productivity.

Case study 2

Water savings from drip irrigation in Maharashtra

Irrigated agriculture in Maharashtra uses 70-80% of available water resources in the state. The state government has been very successful in promoting drip irrigation techniques. The reasons are varied and include: the large size of the plots used for cotton and sugarcane framing, the returns that farmers make from these cash crops (allowing greater investment), and the erratic rainfall patterns that make drip irrigation desirable.

The government has actively supported drip irrigation and as a result, a large number of manufacturers of drip systems have based themselves in the region. It is the home, for instance, of Jain Irrigation Systems, India's leading manufacturer, with facilities in the Jain hills that include a training centre for farmers, a demonstration plot and research laboratories. Availability of drip systems and awareness about the benefits of their use are more widespread here than elsewhere in India.

Sweet smell of success

Following the installation of drip irrigation systems in Maharashtra, sugarcane yield has more than doubled while the water and power intensities of production have significantly decreased.

This was also the experience of the 235 farmers of the Sri Vasant Dada Irrigation Society in Sangli who spent Rs 5.4 million to install drip irrigation facilities in 179 ha of their sugarcane plantations.

The upfront financing of approximately Rs 2 million was extended by sugar companies in the form of credit. The farmers were able to repay the loan in just one year, as opposed to the usual payback period of five years. This was possible because of a yield increase due to resource efficiency improvements achieved through the installation of drip systems.

The following table summarises the results:

Power consumed: Before	1.25 hp/acre
Power consumed: After	0.95 hp/acre
Water utilisation efficiency: Before	50 – 60%
Water utilisation efficiency: After	90 – 95%
Seed germination: Before	60 – 65%
Seed germination: After	90 – 95%

Modified from "Down To Earth" supplement (2003) on "More crop per drop" [33]

7.3 Performance indicators

Based on the current context of water challenges and agribusiness operations in India, 11 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations in the region.

	Description	Rationale and materiality
PI 1 **Does the client comply with existing environmental standards and/or is the client in a position to comply with regulation likely to emerge in the future?**	Environmental standards relevant to water sustainability are related to the pollution of water courses and the over-exploitation of water resources.	Breaching environmental standards and subsequent prosecution can incur financial costs and cause reputational damage as well as loss from litigation, both for the farm as well as the lender. On the contrary, agribusiness operations that already comply with environmental regulation which is likely to emerge in the future have a clear advantage relative to 'unprepared' peers.
PI 2 **Has the client participated in training on irrigation, pesticide management or integrated nutrient management?**	Training for farmers is provided in India either through the private sector (such as Jain Irrigation Systems) or through government training schemes such as Command Area Development Programmes.	• Training for farmers has been shown to increase irrigation efficiency and increase yields. • Correct nutrient and pesticide management can further reduce the application of these substances thereby reducing costs. • Efficient use of fertilisers and pesticides can prevent excess run-off of pollutants and contamination of water supplies and therefore prevent reputational damage and loss from litigation.
PI 3 **Has the client conducted an assessment of the security of sustainable water availability in both (a) quantitative as well as (b) qualitative terms?**	An assessment of sustainable water availability should address a number of factors including an assessment of the competing users. **(a) Quantitative security** ***General*** • Availability of water within the river basin; see Figure 6 on page 26. • Levels of storage capacity and load within the basin such as dams and tanks. • Alternative sources of supply (examples: rainwater harvesting, re-use of water, water trading) ***Groundwater*** Levels of ground water depletion as a percentage of annual recharge are shown in Figure 7. Information is also available from state governments at block and district levels. ***Surface water*** Reliability of surface water availability: for example, incidence of unforeseen canal closures; load and capacity levels of reservoirs, etc. **(b) Qualitative security** An assessment of sustainable water quality should include an assessment of salinity and pollution.	(a) Unreliable or uncertain water availability is a significant risk for agriculture. For example, in India, special caution should be taken if tube-well irrigation is proposed in areas where groundwater resources are documented as over-exploited (see Figure 7). (b) High levels of salinity can reduce crop yields. This is a growing area of concern in states such as Punjab where salinity has reduced the availability of water supply. Crops with low salt tolerance are damaged by irrigation with saline water.
PI 4 **Is local water infrastructure, such as canals, well maintained? Do farmers contribute to the maintenance of local irrigation infrastructure?**	Large irrigation infrastructure such as canals in Punjab and Haryana provide surface water to farmers. Maintenance of irrigation infrastructure is essential for the efficient operation of these systems. Canals and irrigation systems require regular maintenance to remove silt, weeds, debris, and also repair leaks. Low levels of cost recovery lead to declining funds for maintenance and exacerbate the poor provision of irrigation services.[40]	In order to operate effectively and efficiently, water infrastructure must be adequately maintained. Over recent years, the performance of canals has declined. Farm reliance on infrastructure, particularly if poorly maintained, can enhance the risk of failure of water supply in sufficient quantity and/or quality.

PI 5 **Has the client assessed whether the crops cultivated are appropriate to local hydrological conditions?**	Water resource conditions include local water availability, precipitation patterns, salinity levels as well as water and air temperature. Crops that are suitable for a specified environment can be identified using the FAO Ecocrop.[41]	Replacement of water-intensive crops with efficient and drought-resistant crops is a key opportunity; it can have positive effects on cost structure and business resilience over the medium to long term.
PI 6 **Does the client use best available water-efficient irrigation systems/ technologies?**	The use of drip and micro-sprinkler systems has been promoted for instance in Maharashtra. State governments often subsidise these schemes and encourage uptake of such technologies by farmers.	The use of efficient drip and micro-sprinkler/under canopy systems enhances irrigation efficiency relative to other conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.
PI 7 **Are both statutory as well as customary rights clearly established for access to water?** **Does the client hold specific water licences and entitlements to use the appropriate amount of water?**	Rights to water include abstraction rights, water rights and licenses under statutory law at the State level. Rights to water are also recognised in customary law, particularly with regard to the allocation of irrigation water, which may overlap with formal State water laws or run in parallel with them.[42]	Clearly established rights to water reduce risks to farmers; for example, established rights reduce the risk of contested water allocations and provide the basis for both formal and informal water trading schemes. [43] In order to minimise the risk of contested water rights with local communities, customary rights should be respected, in addition to statutory rights.
PI 8 **Which of the following practices to reduce environmental and water resource impacts have been adopted?**	Eco-friendly management techniques can prevent the early depletion of soil fertility and pollution of groundwater resources. Practices include: cost-reducing biological pest management high water efficiency in sugarcane processing: application of dry washing techniques (water use should be lower than 2 m^3/t of sugarcane) treatment of wastewater from crop processing application of slurry or sewage sludge in line with environmental standards triple rinse followed by appropriate deposition and disposal of agrochemicals containers no-tillage system (NTS) high degree of diversification of crop species or crop rotation periodic monitoring of soil through physical-chemical analysis prevention of soil erosion application of herbicides and pesticides with low water contamination and leaching potential	Eco-friendly agricultural practices can increase profitability through cost reductions, soil fertility recovery, and erosion mitigation, and attract new customers with increasingly sustainability-oriented consumption preferences.
PI 9 **Does the client access innovative sources of water supply: re-use of water, managed aquifer recharge and/or rainwater harvesting?**	India's overall water situation is characterized by overexploitation of groundwater resources and declining water tables. In addition to improvements in water productivity, more sustainable water sources should be explored and further exploited.	Farms and agribusiness operations over-dependent on water resources will be at a competitive disadvantage relative to those that diversify irrigation water sources to more sustainable alternatives. Increasing levels of water re-use as well as collecting and storing rainwater during the Monsoon period appear promising ways forward. The use of such sustainable sources can reduce the pressure on groundwater tables across the country.

PI 10 **What is the client's crop-specific water productivity performance?**	High levels of water productivity/efficiency may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turn-over. The level of water efficiency of a given operation will depend on a wide set of local parameters. National or regional averages can, therefore, only serve as rough proxies. Reference values Benchmark values of water productivity in India are: **Sugarcane** 70-60 m^3/ton **Wheat** For yield levels of 1-2 t/ha: 3000-1700 m^3/ton For yield levels of 4 t/ha: 900-800 m^3/ton **Cotton (for Haryana; year 1996)** Approx. 2100 m^3/ton **Rice (for Haryana; year 2003)** 2777-1500 m^3/ton	In addition to environmental benefits, high levels of water productivity/efficiency have positive impacts on the cost-structure and drought-resilience of agricultural activities.
PI 11 **Is the groundwater used by the client exploited in a sustainable manner? Does the client contribute to the conservation/sustainable use of groundwater resources?**	Figure 7 shows that groundwater withdrawals are unsustainable in many parts of India, often because groundwater development is unregulated and instigated by farmers themselves.	Clients depending on groundwater resources should ensure that own as well as collective withdrawals of groundwater resources are sustainable in the long term. If aquifers cease to supply sufficient quantities of water due to over-exploitation, agricultural activities will become unviable.

Notes :
* Water quality data is available from State Groundwater Boards; however there are complexities with regard to the application of this data, for example seasonal variations in water quality and the effects of averaging data.

8
Water sustainability of agribusiness activities in **Brazil**

8.1 Water challenges

Brazil is a prime example of a region where water pressures and resulting financial risks are not necessarily a consequence of chronic water shortage or prolonged droughts, but a result of agricultural / industrial pollution of water resources.

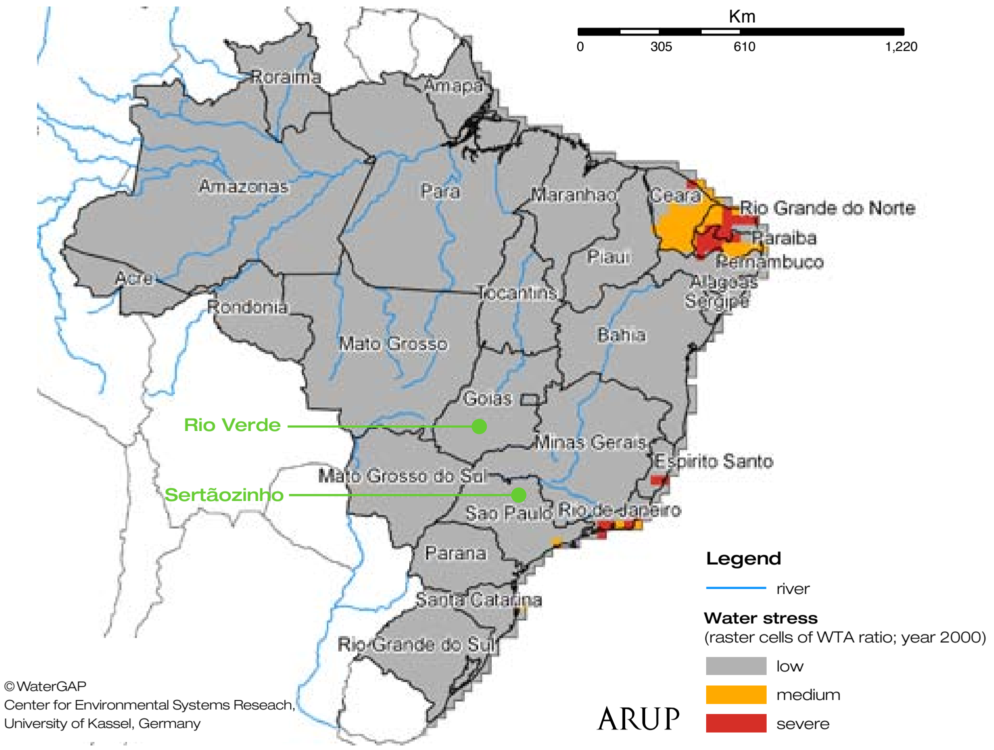
8.1.1 Water availability

Brazil has abundant water resources with approximately 12% of the world's available freshwater. Important sources of water include the Amazon river basin and large aquifers such as the Guarani aquifer (a transboundary system shared by Argentina, Paraguay and Uruguay).

Despite the large volumes of available water, the North-eastern region has an arid climate containing only 3% of the country's water resources, but supporting almost 30% of the population. In this area, river basins are classified as water-stressed (see Figure 8). Water stressed regions also exist in the south which supports most of Brazil's urban population. Competing uses in the area, combined with poorly maintained water supply systems, have led to water conflicts.

Figure 8

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across Brazil.



8.1.2 Climate change impacts

A detailed assessment of different climate change scenarios and respective impacts on water resources and agriculture is beyond the scope of this Briefing. Two aspects of climate change are, however, considered relevant: temparature increases and changing rainfall patterns such as decreases in overall precipitation and/or more uneven and erratic rainfall. For the already semi-arid north-eastern region, model simulations suggest with high confidence that, by the middle of the 21st century, annual average river runoff and water availability will decrease. Shifting rainfall patterns and changing water regimes will have direct consequences on the rain-fed production of sugarcane and soy bean. Increases in temperature and associated decreases in groundwater levels are projected to cause gradual replacement of the tropical forest with savannah in eastern Amazonia by mid-century.[44]

8.1.3 Agricultural activity and water use

Although water does not seem to be a limiting factor today, irrigated agriculture in Brazil is rather marginal. In some regions, especially the Cerrado, or savannahs, total rainfall in the rainy season is enough for the development of agriculture.

The southern state of Paraná has the highest total water withdrawal in Brazil, as well as substantial agricultural production. It is predicted that irrigation and agricultural activities will further expand towards the centre of the country (e.g. Central-west region) where abundant supply of water exists. In this region, irrigation has already grown substantially, following recent advances in soil management and irrigation techniques.

On a larger scale, a connection exists between the conversions from permanent vegetation to cattle ranching (e.g. deforestation of the Amazon forest) and available moisture for rainfall in the centre and south of the country. Water is exported by low altitude winds from Amazon into these regions causing precipitation.[45,46] Therefore, in addition to climate change induced alterations in precipitation patterns nationally, continued deforestation in the Amazon forest is likely to decrease water availability in the highly productive regions of central and southern Brazil in future decades.

8.1.4 Water quality

Pollution of water sources by agricultural chemicals (e.g. caused by triazine used for corn production[47]) and untreated animal waste, has increased the cost of water supply for human consumption in the past. Furthermore, rapid urbanisation and a growing industry have had and will continue to have negative effects on water quality.[48] Further information is provided below.

8.1.5 Institutional/regulatory context

Guidance on water sustainability is found in the National Water Resources Policy (Law 9.433/97), which introduced the following fundamental premises for water management in Brazil: (I) water is a public good; (II) water is a limited resource, with economic value; (III) priorities for human consumption and watering livestock; (IV) use of water by several sectors (challenge of preventing conflicts on water use); (V) river basins as the planning and management unit; and (VI) participative management.

The regulation of water use in Brazil is based on a recently established legal framework that promotes the "user pays" and "polluter pays" principles. Also, rainwater harvesting, water storage, and flood control projects are promoted in the states of Goias, Mato Grosso, Mato Grosso do Sul, Pernambuco, Bahia, Santa Catarina, and Rio de Janeiro.[49] In May 2009 Brazil's Ministry of National Integration authorized the release of R$ 7.8 million to support such measures. **The receipt of such funding can be a first sign of client awareness regarding water issues and willingness to take action; in light of sharpening federal regulation on water, financial institutions should encourage clients to comply with emerging regulation before it becomes mandatory.**

See PIs 1 & 2

Watershed and basin committees that introduce voluntary water fees have been recently established. At present, two states actually charge irrigation fees called 'cobrança'. It is expected, however, that the introduction of water fees both for irrigators and end-users will become increasingly widespread in many parts of the country. This applies also to schemes of Payments for Ecosystem Services (PES) at the larger watershed level which have also started to emerge.[50] PES can be instrumental in protecting and restoring important ecosystems that ensure the steady provision of clean water to water users downstream. There is also evidence of localised water trading in the north-eastern region of the country.[51]

see PI 8

8.2 Water sustainability issues in the production and processing of sugarcane

Agriculture in Brazil is highly important for economic development and welfare. Sugarcane production is predominantly rain-fed and most of the sugarcane region in São Paulo does not rely on irrigation.[52] Therefore, sugarcane production is rather affected by meteorological variability than by technical irrigation problems or deficiencies. Sugarcane is mainly produced in the state of São Paulo and its neighbouring states. Agricultural techniques for sugarcane production are well optimised which results in high productivity levels.

8.2.1 Water quality aspects

The production of sugarcane results in decreases of water infiltration into the soil due to so-called soil compaction.[53] Intensive sugarcane production is often associated with water quality degradation due to the use of agrochemicals. The aspects are explored in more detail in the following paragraphs.

Agrochemicals

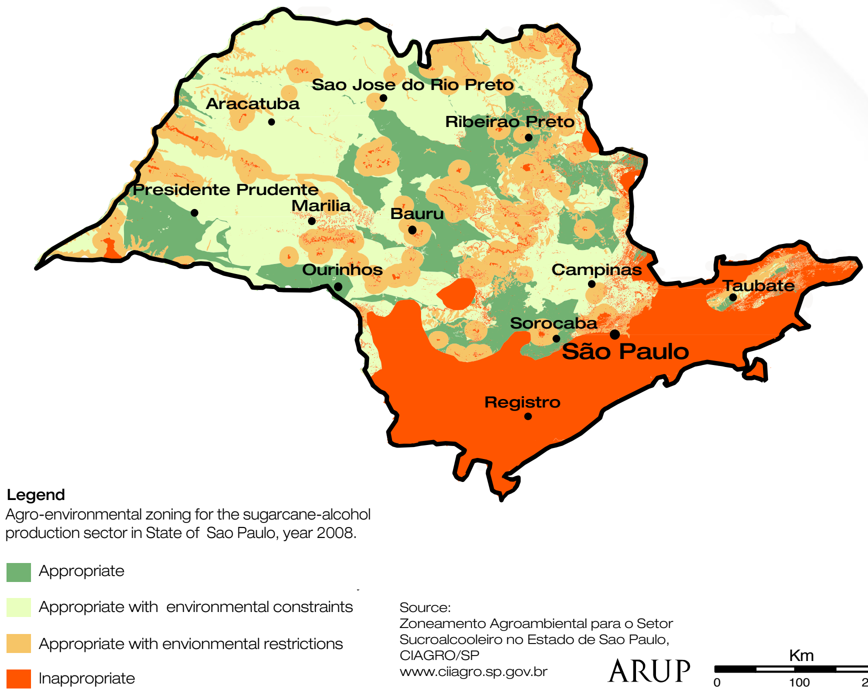
Water run-off from sugarcane plantations is thought to have negative impacts on both groundwater (such as the Guarani aquifer in southern Brazil) and surface water resources given its pesticide and herbicide content. However, research by Embrapa, the Brazilian Agricultural Research Corporation, has found little evidence[54] of groundwater pollution from sugarcane in the Guarani aquifer. Following herbicide tests in the region of Ribeirao Preto City, no pollutants were detected in groundwater samples.[55] A modelling study in the region indicated the leaching potential of chemicals into the groundwater, but no evidence was found in samples taken. It is assumed that this is due to the rapid degradation of agrochemicals in the soil and their low mobility into groundwater reservoirs.[56]

Nevertheless, the perceived danger of the potential contamination of the Guarani Aquifer with agrochemicals has led to a 'zoning' of environmentally vulnerable areas. Within the state of São Paulo, as well as in other areas of the country, systems of 'agro-environmental zoning' have been introduced: they identify land appropriateness levels for sugarcane production (see Figure 9). **The concept of environmental zoning makes it easier for financial institutions to assess the environmental sustainability of clients' operations on the basis of their location.**

See PI 4

Figure 9

Agro-environmental zoning for the sugarcane production in the State of São Paulo.



The amount of herbicide used in sugarcane production is being gradually reduced, especially as a result of the steady and substantial reduction in the practice of ´straw burning` (as the remaining straw in the field immobilises many herbicide molecules).[57] In addition, new legislation in the state of Sao Paulo will entirely ban straw burning from 2014 (which means that sugarcane harvests will have to be entirely mechanized). **In light of new environmental regulation and the resulting costs of compliance, early compliers will be at a competitive advantage relative to late compliers.**

See Pl 1

Despite Brazilian legislation being less strict than international standards (e.g. Atrazine is still in use[58]), many large scale sugarcane systems build on biological pest control (farms often have their own 'respective laboratories' as evidence shows that biological control can be cheaper than the application of agrochemicals) and pest resistant varieties. **Financial institutions can be influential in promoting best available techniques and innovative management, especially when cost and environmental benefits can be achieved simultaneously. For instance, training for farm staff on pesticide management and biological pest control can be requested.**

See Pls 1, 3 & 6

Nitrate

In some areas the production of sugarcane demands the frequent use of nitrogen as a fertiliser. This can be a strong pollutant if leached into surface and/or groundwater. The primary source of this pollution is urea. However, the increasing cost of nitrate has led to reductions in the use of nitrogen in sugarcane production. Today, sugarcane production in Brazil emits less nitrate, for instance, than residential and industrial sewage.[59]

Organic components

Vinasse is now typically used as a fertiliser in sugarcane fields. Commonly, the layer of organic matter from vinasse remains in the first 50 cm of soil.[60] However, precautions must be taken and the standards determined by Companhia de Tecnologia de Saneamento Ambiental (Cetesb) require regular monitoring through soil analysis.

See Pls 1 & 7

Case study 3

Water sustainability and profitability at once – large scale production of organic sugarcane in Brazil

The Sao Francisco sugar mill today features best practice in sugarcane production by balancing productivity and profitability with enhanced environmental performance. Having applied conventional methods with high environmental impacts in the past, the management of the sugar mill decided to differentiate itself from competitors in order to become more competitive and attract new customers. As a result, the Green Cane Project was designed and implemented.

As part of the project, the company modified its production methods and introduced new procedures that comply with requirements for organic certification: the practice of straw burning was halted and leaves and refuse left in the fields to protect the soil against erosion and solar radiation. As a consequence, particulate emissions were significantly reduced and soil biodiversity (earthworms, insects) increased; the use of pesticides was replaced with a sophisticated system of biological plague control which diminished pollution pressures on adjacent water courses and groundwater resources. Furthermore, fallow areas were reforested with native Brazilian species introduced to protect water resources and a sugarcane bagasse-fired power plant.

The Sao Francisco sugar mill was rewarded the organic producer certificate in October 1997 and is still considered a successful pioneer in the production, at industrial scale, of organic sugar in Brazil. Supplying 25% of the global demand for organic sugar and exporting to more than 60 countries, at present, it is the world's greatest private enterprise in organic agriculture.[61,62]

Mechanised harvesting procedures replace straw burning in sugarcane plantations in Sao Paulo state. In addition to cost benefits the left straw protects the soil against excessive evaporation and enriches soil biodiversity.

Picture provided by Native Produtos Orgânicos / Usina São Francisco Gerente de Produtos.[63]

8.2.2 Processing

See PI 6

Sugarcane processing traditionally requires large quantities of water. However, in recent years, water efficiency has increased from 5.6 m^3/t to 1.83 m^3/t of sugarcane. Levels of water re-use in the sector are relatively high,[64] and a new technique of dry cane washing is expected to replace the standard wet cane washing process.

In Brazil sugarcane is partly processed into ethanol. In 2006, approximately 17-18 million m^3 of ethanol were processed out of approximately 450 million m^3 of sugarcane.[65,66] During this process, vinasse is released as a by-product .The disposal of vinasse can have negative impacts on the water environment due to its high oxygen demand and acidic nature. These problems have been overcome in recent years through regulation, improvements in the vinasse/litre of ethanol rate (currently, the average is of 10-12 litres of vinasse/litre of ethanol, but levels of 6 litres are possible[67]) and its monitored use as a fertiliser.

8.3 Performance indicators

Based on the current context of water challenges and agribusiness operations in Brazil, 11 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations in the region.

	Description	Rationale and materiality
PI 1 **Does the client comply with existing environmental standards and/or is the client in a position to comply with regulation likely to emerge in the future?**	Environmental standards are related to the contamination of water resources due to mismanagement of vinasse and/or pollution. An assessment of environmental liability is desirable especially as tougher legislation for the individual farmer is likely to emerge, requiring compliance with international standards.	Breaching environmental standards and subsequent prosecution can incur financial costs and cause reputational/litigious damage, both for the farm as well as the lender. In contrast, agribusiness operations that already comply with environmental regulation that is likely to emerge in the future have a clear advantage relative to 'unprepared' peers.
PI 2 **Has the client received funding from Brazil's Ministry of National Integration to build rainwater harvesting capacity?**	The Ministry recently authorized the release of R$ 7.8 million to support rainwater harvesting and other water-related measures. Governmental funding can support farmers (especially small producers in the North East) to collect rainwater and ensure water supply during dry seasons.	Catching, storing and using rainwater is a promising avenue to enhancing water availability and business resilience during dry periods.
PI 3 **Has the client participated in training on irrigation, pesticide management or integrated nutrient management?**	Training programs are an effective instrument in the promotion of good agricultural practice with regard to soil and water conservation.	• Training for farmers has been shown to increase irrigation efficiency and increase yield. • Correct nutrient and pesticide management can reduce the application of these substances, thereby enabling the realisation of cost benefits. • Efficient use of fertilisers and pesticides can prevent excess run-off of pollutants and the contamination of water resources, and therefore prevent reputational/litigious damage.
PI 4 **Are agriculture operations compatible with the restrictions imposed by the 'agro-environmental zoning' of the respective area?**	'Agro-environmental zoning' is a planning approach that has only recently been introduced in Sao Paulo and further states in Brazil. Zoning categorises the suitability of the land for sugarcane production and crop expansion. Particular consideration is given to the vulnerability of water-related ecosystem services and adjacent aquifer systems (such as the Guarani aquifer). The approach of agro-environmental zoning is likely to further expand into other regions of Brazil and beyond. **Reference values** see Figure 9	Compliance with zoning maps prepared from geo-spatial data can be a reliable proxy when assessing the sustainability of agricultural operations.
PI 5 **Has the client conducted a water availability assessment?**	Areas under water stress are shown in Figure 8. An assessment of the current and future availability of sustainable water supply is important in guaranteeing continuity and profitability of production processes.	Agribusiness operations that build on a long-term analysis of water availability are exposed to less risk and uncertainty than those that do not.

PI 6 **Which of the following practices to reduce environmental and water resource impacts have been adopted?**	Eco-friendly management techniques and procedures can prevent the early depletion of soil fertility as well as the pollution of ground- and surface water resources. These can include: cost-reducing biological pest management high water efficiency in sugarcane processing: application of dry washing techniques (water use should be lower than 2 m³/t of sugarcane) treatment of wastewater from crop processing application of slurry or sewage sludge (e.g. vinasse as fertilizer for sugarcane production) in line with environmental standards triple rinse followed by appropriate deposition and disposal of agrochemicals containers no-tillage system (NTS) in contrast to conventional-till systems high degree of diversification of crop species or crop rotation periodic monitoring of soil through physical-chemical analysis soil erosion prevention application of herbicides and pesticides with low water contamination and leaching potential	Eco-friendly agricultural practices can increase profitability through cost reductions, soil fertility recovery, erosion mitigation and the attraction of new customers with sustainability-oriented consumption preferences.
PI 7 **Are processes in place to monitor the impact of the facility on the water environment over time and to potentially review operations?**	Environmental monitoring is necessary to assess the impact of farming activities on the environment; it identifies actions required to prevent damage to aquatic ecosystems and public health. Consideration should be given to pesticide management plans, pest management strategies, as well as ecotoxicological bioassays from soil, water and sediment samples.	Understanding and monitoring the environmental impact of operations will enhance the reactivity to prevent environmental degradation, litigation costs as well as reputational damage.
PI 8 **Does the client participate in a scheme of Payments for Ecosystems Services or does the client contribute to the cost-recovery of water provision through the payment of water fees ('cobranza')?**	Payments for ecosystem services and water provision can be used to maintain water delivery infrastructure as well as to protect and/or restore watershed ecosystems.	Functioning watershed ecosystems can ensure the steady provision of clean water, often at less cost than manmade water infrastructure.
PI 9 **Has the client assessed whether the proposed or existing activity is appropriate to local hydrological conditions?**	Water resource conditions include local water availability, precipitation patterns, salinity levels, as well as water and air temperature. Crops that are suitable for a specific environment can be identified using the FAO Ecocrop.[68]	Replacement of water-intensive crops with efficient and drought-resistant crops is a key opportunity; it can have a positive effect on cost structure and business resilience over the medium to long term. In Brazil, however, the appropriateness of crops may rather be determined by their plague resistance and the redundancy of agrochemicals.
PI 10 **(a) Has the client assessed its water impacts on adjacent communities?** **(b) Has an ongoing process been established for community relations management on water issues?**	(a) With its dynamic and diversified economy, high rates of urbanisation and high water demands for power generation, Brazil's available water resources are subject to competing pressures. Special attention must be given to the needs of poor and vulnerable groups. (b) Community relations management can involve a designated contact person in the local community as well as a community relations department within the agribusiness company.	The licence of agribusiness operations to operate often depends on the extent to which they are accepted by local communities. The appropriate consideration of local needs and interests will have positive effects on the reputation/regulatory risk profile of the operation and its socio-economic viability.

PI 11 **In the case of new projects, were stakeholders consulted on the design or location of the project?**	The National Policy of Water Resources highlights the principle of "decentralized and participative management". It is necessary to ensure that stakeholders (such as small producers and local NGOs) are informed about the nature and implications of the planned project.	The licence of agribusiness to operate often depends on the extent to which it is accepted by local communities. The appropriate consideration of local needs and interests will have positive effects on the reputation/regulatory risk profile of the operation and its socio-economic viability.

9
Water sustainability of agribusiness activities in South Africa

9.1 Water challenges

9.1.1 Water availability

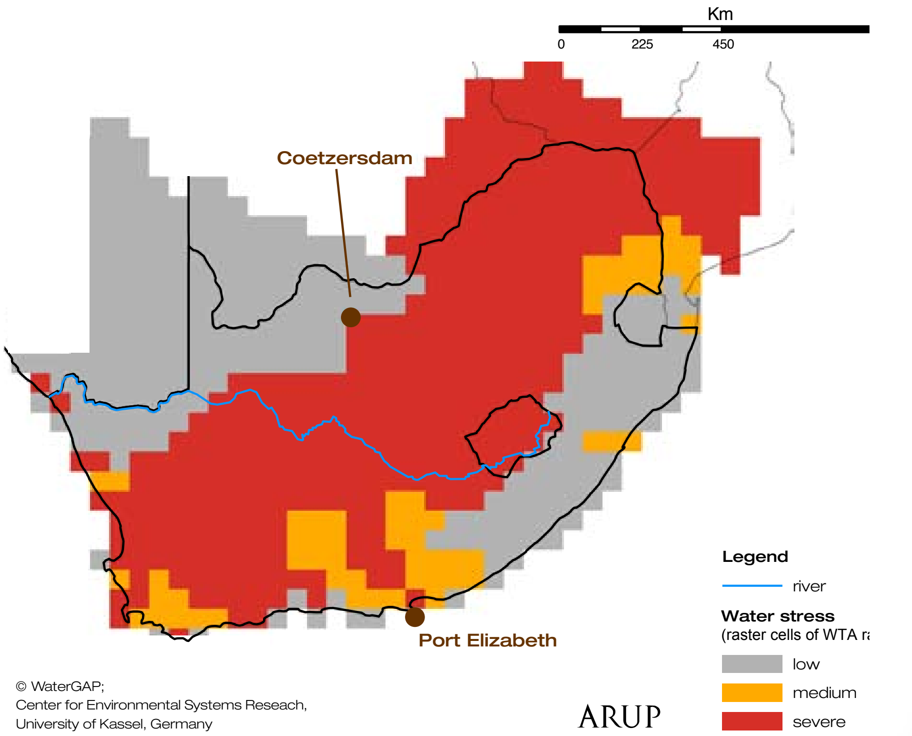
South Africa is a water scarce country where the demand for water is in excess of natural water availability in several river basins. The effects of variable rainfall patterns and different climatic regimes are compounded by high evaporation rates across the country. For example, the Cape Town region experiences a 'Mediterranean'-type climate with rainfall throughout the year and most precipitation during the winter. In contrast, the inland climate of Johannesburg has a rainy season in the summer months (October – April) but is dry throughout the rest of the year.

As groundwater availability is limited by predominantly hard rock geology in South Africa, surface water is the more significant resource. In areas where groundwater is available, it is frequently over-exploited as, for instance, in Dendron, Springbok Flats and Coetzersdam.[69] Social and demographic factors also contribute to water scarcity; one of these factors is, for instance, the distribution of significant settlements and industry adjacent to mineral deposits rather than water resources.

Water availability in South Africa has been assessed using WaterGAP and Figure 10 shows that many areas of South Africa experience severe water stress.

Figure 10

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP. This shows low, medium and severe water stress in river basins across South Africa.



9.1.2 Climate change impacts

Climate change will affect two key parameters: firstly, temperatures will increase and, secondly, rainfall will decrease and be distributed more erratically. A recent estimate[70] of the climate change effects on water resources suggests that South Africa may experience a reduction of 10% in average rainfall reducing surface water runoff up to 50-75% by 2025.

9.1.3 Water quality

Water pollution is a growing problem and can be attributed to municipal pollution, industrial effluent, acid mine drainage and salinisation caused by irrigation. Municipal pollution due to informal settlements built close to watercourses has been linked to contamination of irrigation supplies and as a result, retailers (particularly in export markets) have threatened to cancel fruit imports from regions where pollution is in excess of their local standards for food production.[71]

See PIs 7 & 10

An example of the growing salinisation problem is the area irrigated by the Orange River system. In the Eastern Cape, the water quality of the Orange River falls in quality as it mixes with the Eastern Cape's more saline river system. This leads to a progressive deterioration in water quality from the north to the south. **Financial institutions should ensure, firstly, that clients are not affected by polluted water supplies and, secondly, that water resources are not being polluted by the clients.**

9.1.4 Institutional/regulatory context

South Africa's water policy is underpinned by the National Water Act of 1998. This legislation has a strong emphasis on social equity, environmental sustainability – it features the concept of the Ecological Reserve by which 27% of instream flows[72] have to be allocated to the environment – and on South Africa's responsibility to neighbouring states through the sharing of transboundary river basins.

The Department of Water and Environmental Affairs (DWEA) is responsible for water management decisions in conjunction with river basin authorities, catchment organisations and water user associations. Irrigation policy in particular has evolved under the direction of DWEA and the Department for Agriculture. The National Water Resource Strategy reports that 98% of the available water resources are allocated of which 65% are allocated to agricultural activities. The recently announced Water Growth and Development Framework is outlined in the box below.

The Water for Development and Growth Framework (March 2009)

The Department of Water Affairs (DWEA) is very concerned about the magnitude of water use inefficiencies in irrigated agriculture and aims to improve water use behaviour.

To date farmers have been exempted from certain water charges and fees. It is the Department's view that the sector needs to make a contribution to the operations and maintenance of state-owned irrigation infrastructure.

The Department is also considering other interventions including a water allocation reform, the creation of a water market and the promotion of innovative techniques to enhance water efficiency. Volumetric charging may soon become mandatory.

The Framework provides four recommendations for irrigated agriculture:
1.) Enforce irrigation scheduling.
2.) Incentivise the use of technology for enhanced water use efficiency.
3.) Introduce cascading water tariffs, and 4.) Stop all illegal water use.

Currently, irrigated farms pay a water resource management charge and hence contribute to the sustainability of water resources and to ensuring that all water users receive their allocated share of water. These funds also contribute to specific activities such as the removal of invasive plant species. **The development of water regulation in recent years shows that the issue is being addressed and will increasingly be addressed by public authorities. Farms and agribusiness operations that already today comply with emerging regulation and regulation likely to emerge in the future will have a competitive advantage relative to unprepared peers.**

See PIs 2, 5 & 10

Water trading is one of a number of tools under the National Water Act aimed at enabling improved water management. **Water markets provide additional incentives for water efficiency improvements enabling farmers to 'sell' and immediately monetise achieved water savings.**

See PI 5

9.1.5 Transboundary water management

South Africa has entered into a number of bi-lateral and tri-lateral transboundary water agreements with neighbouring states on watercourses such as the Orange and Limpopo River systems.

Nationally, a system of inter-basin water infrastructure enables the large-scale transfer of water in-between provinces. As a result of this strategy and despite water availability challenges, South African Governments have so far succeeded in providing water for agriculture and industry at the needed scale:[73] large volumes of water are transferred from the relatively water-rich eastern areas of the country to the water scarce areas in the west by means of man-made infrastructure. While this makes agricultural operations possible in many dry areas of the country, the reliance of farms on water transferred over long distances is risky: political priorities in South Africa could potentially shift leading to a reconsideration of water-transfer policies. For instance, the Water for Development and Growth Framework (2009) makes the recommendation that inland water resources should be retained for use inland rather than being transferred to coastal locations.[74]

See PI 8

9.2 Water sustainability in irrigated agriculture: citrus fruits and vines

The South African agricultural sector consists of two sub-sectors: the less developed subsistence sector and a well-developed commercial sector.[75] Approximately 1.3 million hectares of land are irrigated of which 50'000 ha are smallholdings.[76] The focus in this report will be primarily on the commercial sector given its relevance for the local and international financial services sector – which relies on large irrigation schemes.

Most commercial sector operations are found in the Orange River Basin[77], the Crocodile River (a tributary of the Limpopo in the north of South Africa)[78], the Lower Vaal River (central)[79], the Sundays/Fish basins (situated north of Port Elizabeth[80] where citrus fruits are grown) and finally in the Western Cape region. Deciduous fruits, including apples, are grown in the Western Cape and the Eastern Cape. Fruits, including grapes (grown in the lower Orange region) for wine, earn as much as 40% of agricultural export earnings in some years.

Irrigation across South Africa uses over 50% of the surface water resources and virtually all large irrigation schemes are supplied from storage dams. As a result of high conveyance losses, a significant proportion of this water does not reach farmers. In the Mokolo Basin, for instance, these are in the range of 35-40%.[81] **Financial institutions should, therefore, pay attention to the condition of the water infrastructure relied on by clients.**

See PI 12

9.2.1 Citrus fruits

South Africa is the second largest exporter of citrus fruits in the world (after Spain). Approximately 20 million trees are found on 58'000 hectares of orchards, some of which are over 300 years old. Oranges for export markets make up almost 70% of the yield. The majority of irrigated citrus fruit plantations are located in Mpumalanga, Western Cape, Eastern Cape and Limpopo.

The investments and business risks associated with citrus orchards are different from those of so-called annual crops. Substantial yields are not recoverable until 5-7 years after planting, and orchards have life cycle production spans of 20-30 years depending on citrus type and variety.

Water management is essential for high quality and quantity yields. Water quality, particularly salinity, affects both yield quality and quantity. **Financial institutions should ensure that water management skills are developed and that reliable assessments on the long-term availability of water of sufficient quality have been made.**

See PIs 3 & 7

In the Cape region most rainfalls during the winter months (May to August). Water deficits therefore occur when the fruits require most water, the flowering and early fruit setting stages (October to March).[82] Therefore, supplemental (deficit) irrigation is required to manage citrus crops in a productive, high-yielding manner. **The potentials of rainwater harvesting during wet seasons to enhance of irrigation security in dry seasons should be explored.**

See PI 4

See PIs 13 & 14

Case study 4

Water conservation and wastewater disposal in Robertson town

The town of Robertson in the Western Cape is situated in the "valley of wine and roses". The three wineries and a grape juice concentration plant located in Robertson all have the common problem that the quality of their effluent does not meet legislative requirements; moreover, the wastewater treatment plant of the municipality is already operating at full capacity. At present, therefore, the wineries discharge the effluent through an irrigation system, but the salt and organic content of the effluent is high, resulting in environmental and water resource pollution.

Action taken

A national project addressing water problems has been set up through a South Africa – Netherlands cooperation program on water management involving the participation of the Department of Water and Environmental Affairs (DWEA) and a strategic alliance of companies, public authorities and institutes (Frysian Water Alliance). The prime objective of the project consists in encouraging all key stakeholders to implement appropriate water conservation/ water demand management measures.

See PI 11

To this end, the largest wine and fruit processor in South Africa KWV, the Breede River Winelands Municipality in Western Cape, several wineries in Robertson and DWEA have agreed on a pilot project to treat the industrial and municipal effluent in Robertson for reuse in both agriculture and households ("grey water"). This pilot project on water-reuse has demonstrated the possibility for sustainable growth in agricultural output and local social improvement in light of harsh water conditions. As part of it, the technical, commercial and environmental viability of water recycling and reuse has been assessed and the results will be used to develop policy that provides incentives for water reuse in various regions in South Africa.

Sources: Nuon Energy & Water Investments[85], Global Water partnership Toolbox[86]

9.2.2 Vines

Approximately 103'000 hectares of agricultural land are used for vine orchards in South Africa. These orchards are concentrated in the Western and Northern Cape regions.[83] Vines for table grape are also a long-term investment. Financial gains depend on climate factors and sufficient water availability at important crop stages. The highest water demand coincides with the dry season from October to January.

See PIs 13 & 14

South African table grapes and vines require between 520-830 mm of water per year, which means that water productivity compares well to international standards.[84]

9.3 Performance indicators

Based on the current context of water challenges and agribusiness operations in South Africa, 14 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations in the region.

	Description	Rationale and materiality
PI 1 Does the client hold specific water licences and entitlements to use the needed amount of water?	Clear property rights to irrigation water reduce the risk of water conflicts between competing users and provide a framework for water trading or compensation if the rights to water are removed.	A lack of water entitlements relative to forecast water needs can lead to insurmountable water constraints and insufficient levels of production.
PI 2 Does the client comply with existing environmental standards and/or is the client in a position to comply with regulation likely to emerge in the future?	Environmental standards relevant to water sustainability include the contamination of water supplies and the over-abstraction of water. For example, water withdrawals resulting in river flows falling below the ecological reserve – which according to the South African Water Act 1998 ought to be maintained at 27% – can trigger adverse regulatory responses.	Breaching environmental standards and subsequent prosecution can incur financial costs and cause reputational damage and losses from litigation, both for the farm as well as the lender. In contrast, agribusiness operations that already comply with environmental regulation likely to emerge in the future will be at a clear advantage relative to unprepared peers.
PI 3 Has the client participated in training on irrigation, pesticide management or integrated nutrient management?	Training programs are effective instrument in the promotion of good agricultural practice with regard to soil and water conservation. In South Africa, training for farmers is available through AgriSETA courses; training can be provided on how to adhere to irrigation standards and guidelines, such as those provided by the South African Irrigation Institute (SABI).	• Training for farmers has been shown to increase irrigation efficiency and increase yields. • Correct nutrient and pesticide management can furthermore reduce the application of these substances thereby reducing costs. • Efficient use of fertilisers and pesticides can prevent excess run-off of pollutants and contamination of water supplies and therefore prevent reputational damage and losses from litigation.
PI 4 Does the client use best available water-efficient irrigation systems/ technologies?	In South Africa, irrigation consists of 33% surface water systems, 55% sprinkler and 12% Micro-Drip Irrigation.[87] In light of sharpening water pressures, farmers should strive to adopt the most water efficient system available for their irrigation requirements. This is in line with recommendations in the *Water for Development and Growth Framework (2009) – Promoting Water Conservation and Water Demand Management.* [88] These recommendations should be taken seriously as they are likely to be picked up in future regulation requiring farmers to do so.	The use of innovative irrigation systems such as drip irrigation or well managed centre or linear pivot sprinkler systems[89] enhances irrigation efficiency relative to conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.
PI 5 Does the client have access to (participate in) a water trading scheme?	Water trading is one of a number of tools under the National Water Act that facilitate better water management. It is an important mechanism for promoting efficient and productive water use.	Participation in trading-schemes can enable producers and irrigators to flexibly adapt to changing water availabilities and irrigation needs: shortfalls of water supply can be compensated by purchasing additional water rights. Achieved water savings can be sold, which may open new revenue streams for farms and additional incentives to increase water efficiency. Overall, environmental markets have proven to be flexible, user-friendly and effective means to address environmental problems and resource constraints.

PI 6 **Has the client conducted an assessment of the security of sustainable water availability in quantitative terms?**	Water stressed river basins are identified in Figure 10. An assessment of sustainable water supply should report on levels of physical availability (surface supply and groundwater levels), storage capacity within the river basin, levels of unallocated water within the catchment and socio-economic factors such as the nature and number of competing water users.	A better understanding of the availability and constraints of water supply is key for business success. Together with a regional assessment of water issues, a local assessment on the farm level will provide the foundation to identify bottlenecks, adverse developments as well as possible responsive measures and promising solutions.
PI 7 **Has the client conducted an assessment of security of sustainable water supply in qualitative terms?**	An assessment of sustainable water quality should include an assessment of salinity, micro-pollutants and eutrophication.[90] High levels of salinity can reduce crop yields. This is a growing area of concern, for instance, in the Orange River Basin and can reduce the utility of available supplies. Attention should also be given to how the activities of the client may exacerbate existing water quality issues. This includes, for instance, the level and intensity of saline returns from irrigation.	Not only water availability in quantitative terms, but also the availability of water in high enough quality has become a key determinant of agribusiness viability.
PI 8 **Is the client dependent on water transfers from other regions?**	In South Africa, large volumes of water are transferred from the relatively water-rich eastern areas to the water scarce areas in the west. While this enables agricultural operations in many dry areas of country, the reliance of farms on water transferred over long distances can be risky if political priorities shift in leading to a reconsideration of water-transfer policies. Due to conveyance losses, such transfers can be very inefficient.	Dependency on distant water sources can be a source of political/regulatory and physical water risks. Farmers able to sustainably source required water input locally have a competitive advantage.
PI 9 **Has the client assessed the appropriateness of the crop cultivated relative to local water conditions?**	Water resource conditions include local water availability, precipitation patterns, salinity levels as well as water and air temperature. Crops that are suitable for a specified environment can be identified using the FAO Ecocrop.[91]	Drought resistant crops and those with higher salt tolerance levels present a key opportunity; their introduction can have positive effects on cost structure and business resilience over the medium to long term.
PI 10 **Have steps been taken to mitigate adverse water impacts on ecosystems and the environment?**	Has the client improved the water environment beyond what is required by law? This may include proactive water quality management procedures, rainwater harvesting, wastewater reuse systems or improving weed control to minimise water consumption from non-agricultural species.	Sustainable water management, including investment in alternative supply options reduces individual risk of failing water supply.
PI 11 **(a) Has the client assessed its water impacts on adjacent communities?** **(b) Has an ongoing process been established to manage community relations in regards to water issues?**	Consideration should include upstream and downstream users, local communities, poor and vulnerable groups and ecosystem requirements such as the ecological reserve. Community relations management can involve a designated contact person in the local community as well as a community relations department within the agribusiness company.	Water sustainability and equity considerations are interlinked and an assessment of the impact on competing users may reduce the risk of negative off-farm impacts.
PI 12 **Is local water infrastructure, such as canals well maintained?** **Does the client contribute to the maintenance of local irrigation infrastructure?**	Maintenance of irrigation infrastructure is essential for the efficient operation of these systems. Canals and localised systems require regular maintenance to remove silt, weeds, debris and repair leaks. Low levels of cost recovery lead to declining funds for maintenance and exacerbate the poor provision of irrigation services. In South Africa, farmer contributions such as the *Water Resources Management Charge* are used to fund the operation and maintenance of infrastructure. This is particularly relevant if the farmer is dependent on water sourced from dams or transfers.	In order to operate effectively and efficiently, water infrastructure must be adequately maintained. The bad shape of irrigation and water transfer infrastructure in South Africa leads to high conveyance losses. Farm reliance on infrastructure, particularly if poorly maintained, increases the risk of water shortfalls.

PI 13 **Does the client access innovative sources of water: managed aquifer recharge, re-use of water and/or rainwater harvesting?**	South Africa´s natural water resources are increasingly stressed. Furthermore, the problem is exacerbated as for many agricultural activities most water is needed when least water is available. Intensive rainwater harvesting during the wet season for use during the dry season should be further expanded. This applies to the re-use of grey water from agricultural and other activities.	Farms and agribusiness operations reliant on conventional/unsustainable water resources will be at a competitive disadvantage relative to those that manage to diversify water sources to more sustainable alternatives. Increasing levels of water re-use as well as collecting and storing rainwater during the wet season (even at the scale of aquifer recharging) appear promising ways forward.
PI 14 **What is the client's crop-specific water productivity performance?**	High levels of water productivity/efficiency may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turnover. The level of water efficiency of a given operation will depend on a wide set of local parameters. National or regional averages can, therefore, only serve as very rough proxies. Reference values Benchmark values of water productivity in South Africa are: **Table and wine grapes (Western Cape Province)** 263-213 m^3/ton	In addition to environmental benefits, high levels of water efficiency have positive impacts on the cost- structure and drought-resilience of agricultural activities.

10
Water sustainability of agribusiness activities in the Mediterranean Basin
Italy, Greece and Morocco

10.1 Introduction

The European Environment Agency (EEA) contends that water use in agriculture is unsustainable in many parts of southern Europe. A contributing factor is that current regulatory and pricing mechanisms 'have failed to manage [and reduce] demand'.[92] In a recent report, the EEA highlights appropriate water pricing as 'the core mechanism' for making agricultural water use more efficient. Farmers have been shown to reduce water consumption and adopt water efficient practices when illegal extraction is effectively policed and water paid for by volume. It should be noted, however, that contradictory findings have been reported in other studies.[93]

Several global studies have concluded that the Mediterranean will be significantly affected by climate change through decreases in precipitation and increases in temperature. These factors lead to confident projections that the area will suffer from increasing water shortages in the future.[94]

10.2 Local water challenges in Greece

10.2.1 Water availability

Water availability in Greece is limited due to its Mediterranean climate. Precipitation is spatially skewed with 1500 mm/year in the west to less than 400 mm/year in the East. Water shortages are common, particularly in south-eastern areas where water use is highest while precipitation lowest.

Few rivers exist in peninsular Greece all of which are small, and many dry up during the summer. By contrast, rivers in the Balkan Peninsula, which flow through northern Greece – e.g., the Vardar and Struma – have significant summer discharge.[95] The relatively small and seasonal nature of many rivers leads to limited capacity for irrigation. Agriculture at present uses 84% of available resources while domestic supply and industry account for 13% and 1.7% respectively.

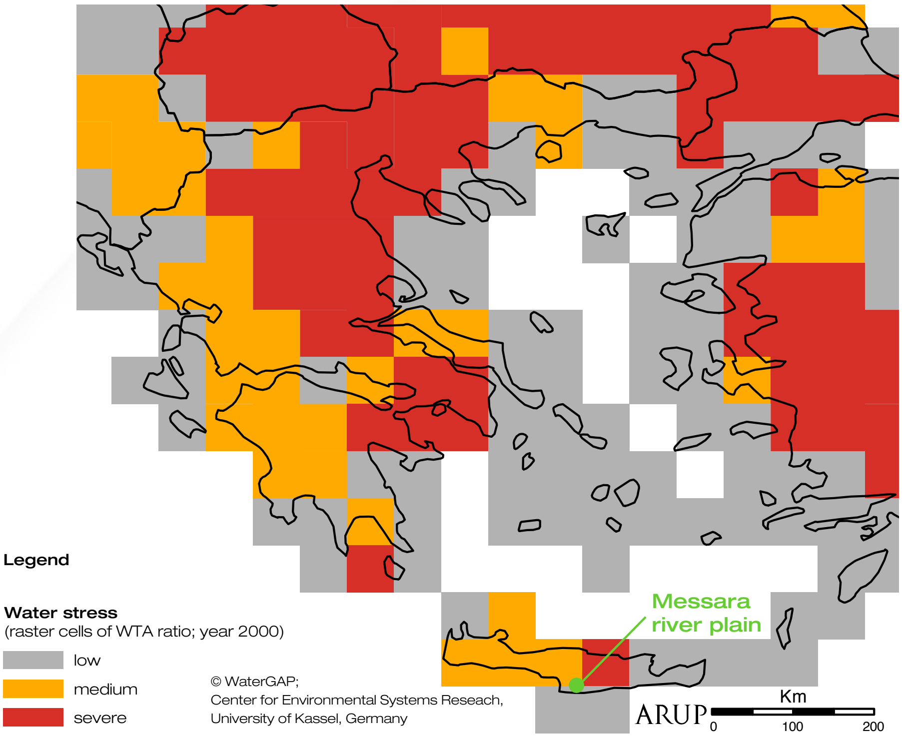
See PI 2

Over-exploitation of groundwater resources has resulted in low groundwater tables and there is limited effective control on the amount of water extracted.[96] **In Greece as in most Mediterranean Basin countries, financial institutions should pay close attention to the sustainability of water availability and water use, with a special focus on the sustainability of groundwater exploitation by clients and other users in the vicinity of clients.**

In the addition to agricultural activities, the large Greek tourism industry also continues to have significant impacts on water availability. The high tourist season takes place in the period May to September when water availability is at a minimum and water stress peaks. Levels of water stress in river basins across Greece are presented in Figure 11.

Figure 11

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP that indicates low, medium and severe water stress in river basins in Greece.



10.2.2 Water quality

Groundwater salinity is a growing problem which is caused by both seawater intrusion into aquifers and 'returns' from irrigation water. Seawater intrusion is exacerbated by the long coastline of Greece, the karstic characteristics of the aquifer systems and the potential for sea-level rises in the future. Critical areas of aquifer salinisation are shown in Figure 12. Deteriorating water quality directly depletes overall resource availability as irrigation water with a high level of salt content can damage crops.

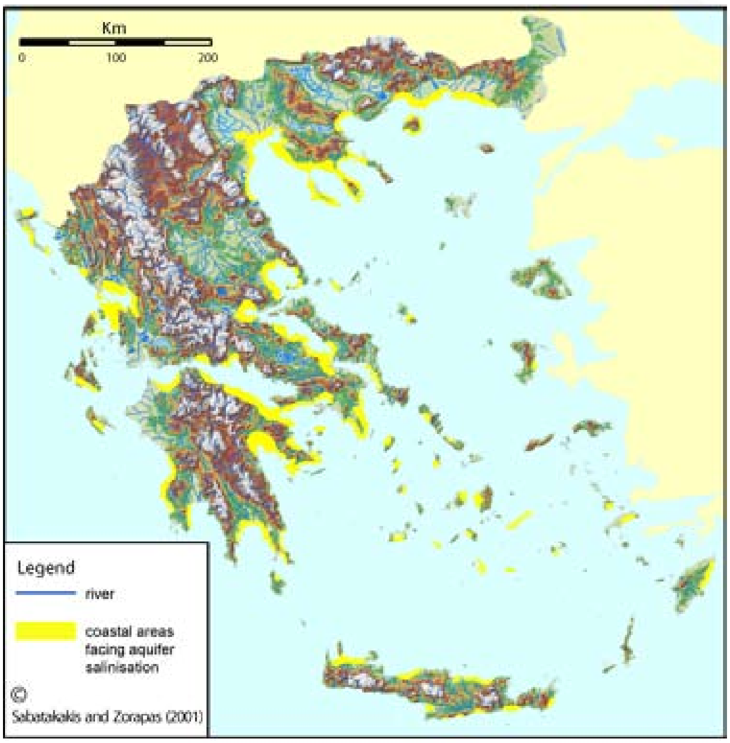
Arsenic contamination in groundwater in the north of the country (Thessaloniki, Chalkidiki prefecture and others[97]) is found in some agricultural 'hotspots' where groundwater is used for irrigation. Risks to food safety and yield are likely to increase with the build-up of arsenic in the soil.[98] The pollution of surface and groundwater from excessive use of agrochemicals further challenges farmers in Kopaida and Arta, Argolida.[99]

See Pls 3 & 7

In addition to the over-exploitation of surface and groundwater resources in terms of volume, the exposure of borrower clients as well as their direct contribution to water pollution should be carefully assessed by financial backers.

Figure 12

Areas facing problems of aquifer salinisation across Greece.



10.2.3 Institutional context

The transposition of the European Water Framework Directive (WFD) into Greek legislation has resulted in a new institutional arrangement.[101] The protection and management of river basins and the implementation of the WFD are the responsibility of the 13 Regional Water Directorates. In the case of shared river basins, the National Water Committee determines which regional authority is responsible.[102] To comply with the WFD, increasing attention has been given to minimum ecological flows, which is the component of river flow necessary to maintain ecosystems. **Financial institutions will have an increasing interest in ensuring the compliance of borrower clients with existing and/or emerging environmental regulation such as the European Water Framework Directive.**

See PIs 1 & 7

10.2.4 Agricultural activity and water use

Water for agricultural use has become a controversial issue in recent years. For instance, the cultivation of water intensive crops in arid areas such as Thessaly is a source of concern where inefficient irrigation scheduling, illegal wells and low irrigation efficiency have depleted water availability.[103] Lake Karla, a lake within the plain of Thessaly, has been drained and the government is proposing to recharge it with water from a nearby reservoir. **Such adverse developments can, in principle, be avoided through a number of measures including: the early assessment of the appropriateness of crops in light of local hydrological conditions as well as the introduction of water-efficient irrigation technology.**

See PI 4

Until 2005, irrigators connected to public networks still paid according to the irrigated area rather than the quantities of water used. After the implementation of the WFD, agricultural water users will have to start paying for water at levels that reflect the real costs of its supply. **Financial institutions should therefore start assessing the viability of clients' operations on the basis of higher overall costs.**

See PI 5

10.2.5 Transboundary water management

Approximately 25% of the available water from rivers comes from trans-boundary rivers, with Greece situated at the downstream end.[104] Increases in water use in upstream countries and subsequent reductions in river flow will further reduce the water availability for agriculture.

10.3 Local water challenges in Italy

10.3.1 Water availability

Water availability in Italy varies substantially across the country. Parts of southern Italy, with its extremely uneven rainfall pattern, are considered semi-arid and water here is a limiting factor. Severe droughts have occurred in the past, for example during the period 1988–90.[105]

The common practice of withdrawing groundwater (principally for irrigated agriculture) throughout Italy, and particularly in the south, has led to the overexploitation of potentially renewable resources. This has put serious pressure on many of the underground water systems.[106] As a result, public water supply increasingly relies on desalinated water as an additional resource. **In Italy as in most Mediterranean Basin countries, financial institutions should pay close attention to the sustainability of water availability and water use, with a special focus on the sustainability of groundwater exploitation by clients and other users in the vicinity of clients.**

See PI 2

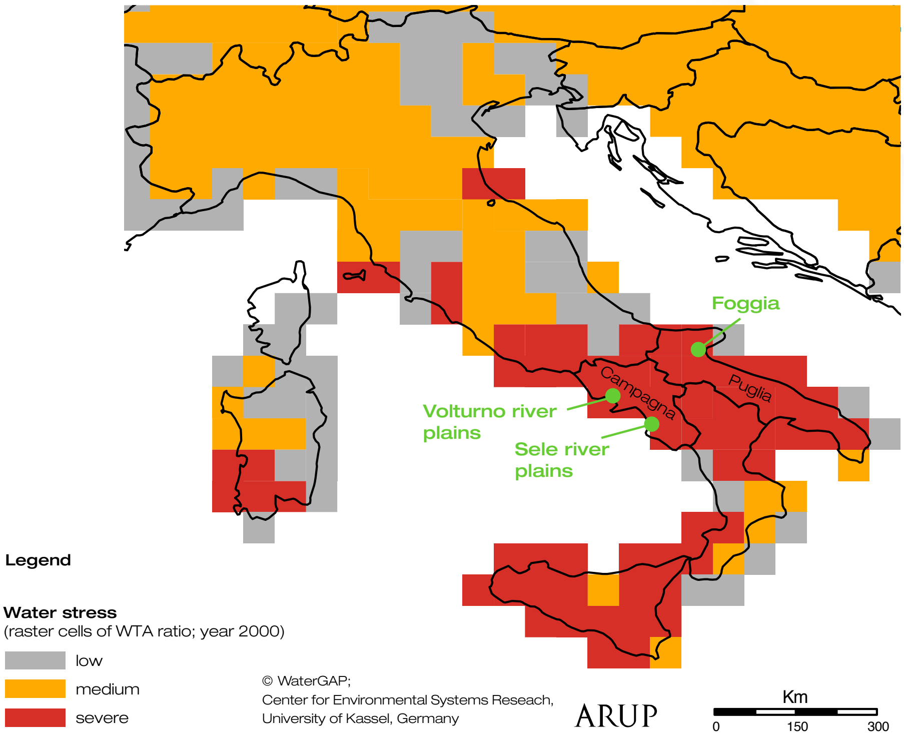
Increasing standards of living and a growing tourism sector have placed additional pressures on water availability. The tourism industry in particular exacerbates water supply problems as the high season, which takes place from May to September, coincides with peak water stress. Consequently, water resource conflicts between different users (tourism, industry and agriculture) are becoming increasingly likely. An overview of the water stress in river basins across Italy is shown in Figure 12.

Treated urban wastewater provides a reliable source of water supply relatively unaffected by periods of drought or low rainfall. In Italy this water source is used primarily in agriculture. However, use in golf courses, municipal land and, increasingly, industry has been observed.[107] **Given the sustainability as well as the risk and cost benefits linked to the concept of water re-use, financial institutions should promote such approaches to their borrowers as well as local authorities.**

See PI 6

Figure 13

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP that indicates low, medium andsevere water stress in river basins across Italy.



10.3.2 Water quality

See Pls 2 & 3

In some coastal plains, groundwater abstraction results in saltwater intrusion and a deterioration in groundwater quality. The Volturno and Sele Plains in southern Italy are areas where this problem has been observed.

Where there are high levels of agricultural activity, for example in the Po River Basin, groundwater resources often contain high concentrations of nitrates due to fertiliser use. The waste produced by agricultural and animal production and the high level of regional development has negatively impacted water resources and led to additional degradation of surface and groundwater quality. **In addition to the over-exploitation of surface and groundwater resources in terms of volume, the exposure of borrower clients as well as their direct contribution to water pollution should be carefully assessed by financial backers.**

See Pls 3 & 7

10.3.3 Institutional context

Italy has a long history of water legislation with core principles mentioned in the Consolidated Law of 1933, Law 319 of 1976, regarding water quality and water use and followed by Law 183/89, which takes the catchment basin as the principal focus for water use and conservation measures.[108] The European Union Water Framework Directive commits Italy to achieve a sufficiently good state of all water bodies by 2015 both in quantitative as well as in qualitative terms. On a regional level, the established District Basin Authorities are responsible for water resource management and allocation to different uses.[109]

In many parts of the country irrigation water withdrawn from surface water bodies continues to be paid for on the basis of the area irrigated. The transposition of the European Water Framework Directive (WFD) into Italian legislation has led to a new water fee system that aims to charge on a volumetric basis. While this transformation has not yet been adopted in every part of the country, it is fully implemented, for instance, in the Foggia province. Currently, the water fee is of approximately Euro 0.12 per m^3 of surface water withdrawn. It should be noted that groundwater, which is used intensively in the Foggia province, is not as of yet subject to the water fee.

See PI 5

After the full implementation of the European WFD, agricultural water users will be required to pay for water in a way that more accurately reflects the real costs of water supply. Financial institutions should start assessing the viability of clients' operations on the basis of higher water costs.

10.3.4 Agricultural activity and water use

Italy has the greatest absolute area equipped for irrigation within the southern member states of the European Union (3.97 million ha). Agriculture accounts for approximately 50% of Italy´s total water use.[110]

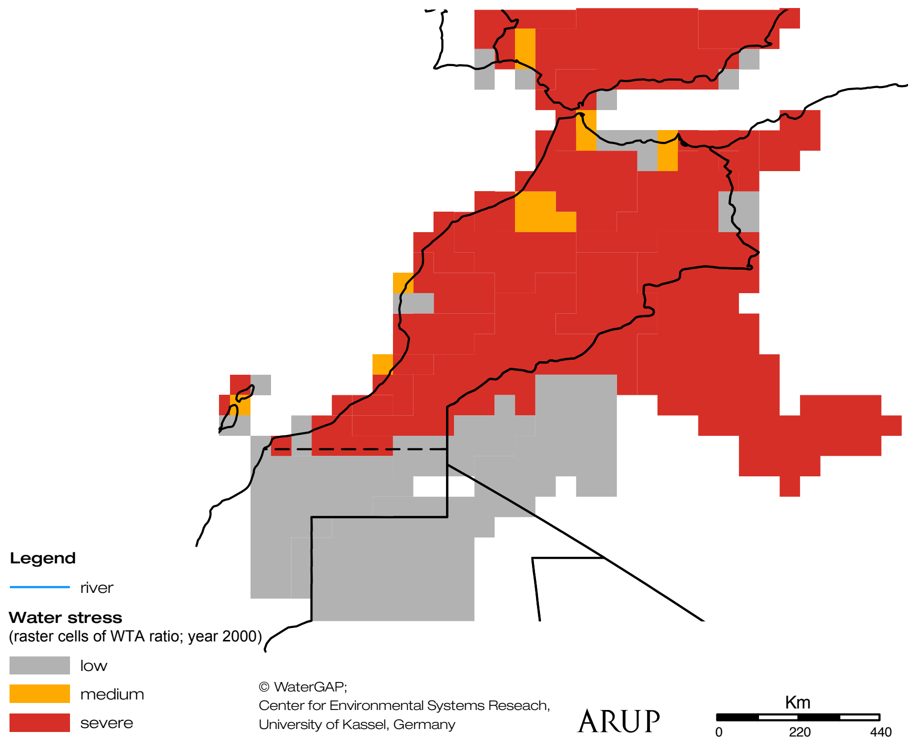
10.4 Local water challenges in Morocco

10.4.1 Water availability

Three river basins (Loukkos, Sebou and the Umm Ribia) provide over 70% of Morocco´s water resources. Until 2000, only 3 of the 8 major river basins in Morocco were considered to be water stressed. Since then, a growing population, increased urbanisation, extended irrigated agriculture, the production of water-intensive crops and the growth of the industrial and tourism sectors, have placed additional pressures on water resources. Today's water stressed basins include the Souss Massa, Bou Regreg, Tensift, Loukkos of Sebou and Umm Ribia (see Figure 14). It is predicted that the Moulouya river basin will be added to the list in the near future.[111]

Figure 14

Overview of the water withdrawal-to-availability ratio calculated by WaterGAP that indicates severe water stress in river basins across Morocco.



10.4.2 Climate change impacts

Likely climate change prospects were briefly outlined in the introduction. In addition, a preliminary trend analysis of available rainfall data suggests that climate change will decrease precipitation in parts of the Atlas Mountains, which is the main source of water supply in western Morocco.[112] Notwithstanding the effects of climate change, Morocco's water deficit is exacerbated by variable and irregular climatic conditions, which include cycles of repeated drought. In the past, drought cycles have roughly spanned over 4 years.

10.4.3 Water quality

Water quality problems in Morocco have been reduced by the improvement of the sanitary conditions of urban areas through the collection, treatment and reuse of wastewater.

10.4.4 Institutional context

Morocco has made considerable progress in the management of irrigation systems by passing management responsibility to groups of users known as Water User Associations (WUA).[113] In 1984, an irrigation water pricing review introduced the current formula-based tariff system, whereby volumetric tariffs are directly linked to the real costs of water supply. Today, irrigation charges are moving towards complete cost recovery for operations and maintenance.[114] Authorities have, furthermore, partially revoked earlier plans to expand irrigated schemes, have introduced water-quotas and scheduled the building of additional dams.[115] However, the work of the WUAs is reported to be very inefficient in some regions. This is due to poorly qualified farmers and the often old irrigation infrastructure.

The Government of Morocco has recently introduced Le Plan Maroc Vert which aims to develop a modern, high-performance and internationally competitive agricultural sector within the period 2009-2013. Among other objectives, the plan aims to support small farms in rural areas to achieve better productivity through the cultivation of cereals that are more drought resistant. **This signals the importance that should be given to the appropriateness of crops with regards to local water conditions.**

See PI 4

Public-private-partnerships in irrigation management have been implemented in Morocco. These are the El Guerdane project and the ORMVA reform project. Small-scale farmers' inability to progress towards higher-value-added agriculture and adjust to potentially higher water prices may, however, pose risks to these partnerships.[116,117]

See PI 5

10.4.5 Agricultural activity and water use

Water challenges in Morocco are interlinked with the economy's dependence on agricultural exports. Morocco uses 80-90% of its freshwater resources for irrigated agriculture.

Of the total agricultural area equipped with irrigation systems, approximately 30% is irrigated from groundwater, often unsustainably. For example, in the Souss region in southern Morocco the main aquifer is largely depleted and water is being withdrawn at 179% of the renewable resource.[118] Since 1969, the water table has decreased at an average of 1.5 m per year. Some private tube wells now pump water from depths of over 200 m. Despite this, the Souss valley produces 60% of the country's citrus fruits, contributing to half of Morocco's exports of these products. **In Morocco as in most countries in the Mediterranean Basin, financial institutions should pay close attention to the sustainability of water availability and water use, with a special focus on the sustainability of groundwater exploitation by clients and other users in the vicinity of clients.**

See PI 2

Experiences in managing large-scale irrigation systems in Morocco such as the Bitit Irrigation System, have shown that:[119]

- Clear water allocation rules are the basis for good water management practice. Transparency in assigning water rights to farmers appears is key to reducing water conflicts.
- Increasing water productivity is a key component in the development of sustainable irrigation systems. **Financial institutions can play a role in increasing water productivity.**
- Conflicts between agricultural, domestic, industrial and tourism users, will become more frequent, as will conflicts between small-scale and large-scale farms.

See PI 9

10.5 Water sustainability in irrigated agriculture: citrus fruit, tomatoes and olives

10.5.1 Situation in Greece

Greece has the highest population dependent on agriculture in Europe. Between 33-40% of total agricultural area is under irrigation, mostly for crops (approximately 70%), vines (4%) and trees (25%).[120] Water is often supplied through public networks. Within these networks, efficient irrigation technologies have not been widely adopted. While surface water irrigation accounts for 35-40% and irrigation with sprinklers amounts to 50-55%, drip irrigation remains at 10% only. There is significant scope, therefore, to improve water productivity at the farm level by switching to more water efficient techniques or by improving current systems. **Financial institutions can play a role in equipping the agribusiness sector with more water efficient irrigation systems; in most Mediterranean countries corresponding government subsidies are in place.**

See PI 8

Data suggests that water recycling and reuse is limited in Greece.[121] The use of treated effluent to irrigate crops is limited as there is still low public confidence in this concept. **It should, however, be in the highest interest of financial institutions and their agricultural clients to further explore such opportunities.**

See PI 6

Citrus fruits in Greece

Citrus fruits are grown predominantly in the Northeast Peloponnese, Crete, Thesprotia and Arta. These areas are predominantly classified as water stressed regions in Figure 11. The water requirements of citrus fruits vary between 900-1200 mm/yr. Yields of these citrus crops are considered good if they fall between the ranges of: orange 25-40 t/ha/yr; grapefruit 40-60 t/ha/yr; lemons 30-45 t/ha/yr and mandarin 20-30 t/ha/yr.[122] Water productivity for various citrus is between 500 – 600 m^3/t yield suggesting marginal opportunities for further improvement.[123] **Financial institutions can play a role in increasing water productivity.**

See PI 9

Olives in Greece

Olives are remarkably tolerant to water stress. Three different types of olive orchards can be found: non-irrigated, low-output orchards often on marginal soils; intermediate orchards; and high-intensity, high-output orchards.[124] While, in overall terms, only a few olive orchards are irrigated, efficient water irrigation systems such as drip and scheduled irrigation are typical features of high input systems.

In many cases, the rise of productivity in olive groves has been achieved at the expense of dramatic reductions in groundwater levels. In parts of the Messara plain, a 20 m drop in the groundwater level has been recorded since 1985.[125,126]

Water productivity data is limited, but research suggests it to be in the order of 450 – 1100 m^3/tonne yield for Spain.[127] It appears that the best water productivity values can normally be obtained in high yielding and intensively managed orchards. **Financial institutions can**

See PIs 2 & 9

play a role in increasing water productivity and the sustainability of groundwater exploitation.

10.5.2 Situation in Italy (the Foggia Province and Campania Region)

Tomatoes in Italy

Tomatoes in southern Italy are cultivated mainly in the alluvial plains of the Campania Region (8,000 ha) and in the Foggia Province (27,000 ha; largest concentration of tomato production in Southern Italy). The average production is 60 t/ha. Tomatoes are produced for industry (e.g. canned peeled tomatoes) and for direct consumption (e.g. salad tomatoes).

Industry-tomato is traditionally grown in the Campania region (the so-called 'red gold' area) where most of the processing plants are based. Increasing demand for canned tomatoes during the 1980's has furthermore increased production levels in the province of Foggia. Industry-tomato is predominantly grown in open fields. Water resources are derived mainly from the rivers in the region. In the Foggia province, the entire irrigation system is dependent on large artificial reservoirs; in Campania, small diversion dams are used. Irrigation is managed by *Irrigation and Land Reclamation Consortia*, which are responsible for collection, adduction and distribution of water.

Fresh-produce tomatoes for direct consumption are grown in greenhouses, which are concentrated in the Sele plain (province of Salerno, Figure 13). Producers have widely installed groundwater wells to assure year-round availability of water for their production. The withdrawal of water from these coastal aquifers has been pushed to the edge of sustainability and saline intrusion in the coastal plains is a problem. Problems may, therefore, arise in the future if the over-exploitation of water resources, and the increasing salinity levels that accompany over-exploitation, continue.

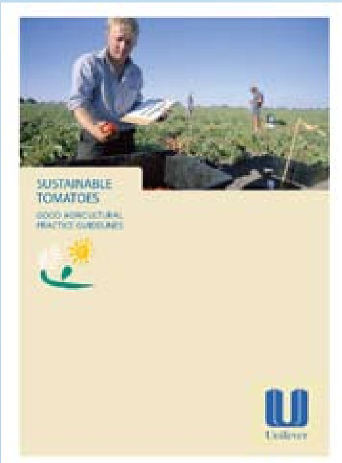
See PIs 2, 3 & 7

Through asking the right questions, financial institutions can play a role in making sure that groundwater resources are neither over-exploited nor polluted.

See PI 8

Water productivity may be improved by soil moisture monitoring, optimised irrigation as well as root drying and regulated deficit irrigation management.[128, 129] Guidelines on sustainable tomato production are available (see case study below).

Case study 5 Sustainable tomatoes and the Good Agricultural Practice Guidelines by Unilever[130]



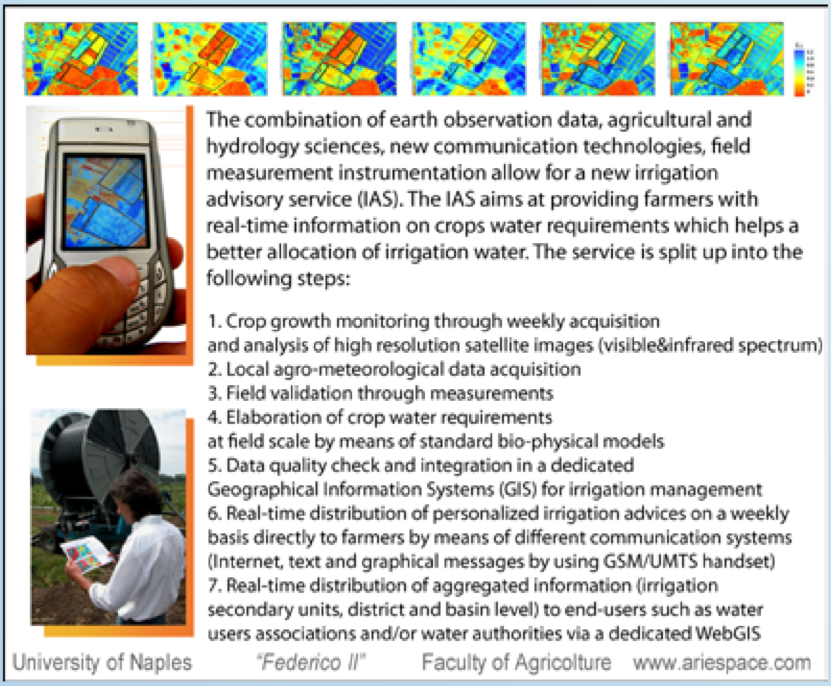
Unilever provides good agricultural practice guidelines which address sustainability of tomato production under the focus of soil health, soil loss, nutrients, pest management, biodiversity, product value, energy, social and human capital, and water.

To further increase water productivity the potential areas for improvements are outlined as follows:
- Promote wider use of irrigation scheduling techniques
- Support enhanced water management systems based on drip irrigation
- Evaluate drip irrigation distribution uniformities

Case study 6 **Re-use of water in the Belice Basin, Western Sicily, Italy**

Within the Garcia-Arancio districts a number of projects have been undertaken aimed at using the effluent of treatment plants to supply irrigation water. Secondary treatment plants of the municipalities of Castelvetrano, Menfi and Sambuca di Sicilia, were connected to the internal irrigation networks of the respective agricultural districts in order to directly supply water during the summer, when high peaks of water demand arise.[131]

Case study 7 **The "Piano Regionale di Consulenza all'Irrigazione" in Campania**



See PI 6

Given the sustainability as well as the risk and cost benefits linked to the concept of water re-use, financial institutions should promote such approaches to their borrowers as well as local authorities.

10.5.3 Situation in Morocco

Morocco is a key producer of citrus fruits with exports to EU, Russia, US and Canada. Approximately 90% of water in Morocco is used for agriculture. More than 30% of the citrus orchard area is under drip irrigation, with the remainder being irrigated by furrow systems.

Cost recovery of irrigation water is achieved in large irrigation schemes managed by the regional agricultural development agencies, on the basis of a system of pricing principles outlined in the Agricultural Investment Code, enacted in 1969. National policies have recently led to the introduction of incentives to install advanced technology drip irrigation in all new and/or replanted orchards. All farmers eligible for a credit can receive subsidies of 60% when installing drip irrigation, provided they have legal titles for their land. **Financial institutions can play a role in equipping the agribusiness sector with more water efficient irrigation systems (and subsequent training); in most Mediterranean countries, corresponding government subsidies are in place.**

See PI 8

Case study 8

Water resources sustainability and reuse of water in agriculture

In the rapidly expanding town of Drarga (6000 inhabitants), near Agadir in southern Morocco, a new wastewater treatment and reuse plant sells treated wastewater to farmers for irrigation. The Municipality collects sewage fees to recover all of the operation and maintenance costs and some of the plant's capital costs. Further cost recovery elements include the sales of reclaimed water to farmers, reeds harvested from the polishing ponds, and sludge and methane gas from the anaerobic basins to, respectively, produce compost and drive pumps at the plant. Since October 2000, the treated wastewater has met WHO guidelines for reuse in agriculture without restriction. The project, furthermore, includes the introduction of drip irrigation demonstration plots.

Source:[132,133]

See PI 6

Given the sustainability as well as the risk and cost benefits linked to the concept of water re-use, financial institutions should promote such approaches to their borrowers as well as local authorities.

Citrus fruits in Morocco

See PI 9

Citrus fruit is produced by both large-scale orchards (mainly for export) and small scale traditional enterprises (primarily for domestic markets). Average annual yields for the year 2004 are estimated at 15-18 t/ha, which is lower than other large Mediterranean producers such as Italy, Greece, Spain, Turkey and Egypt. Yields levels are expected to increase to 24 t/ha in 2010. Water productivity of citrus fruit production is in the broad range of 500 – 1000 m^3/t yield indicating that there is potential to further improve water productivity per hectare through improved irrigation practice (such as better timed irrigation; improved pest and disease management which would further improve water productivity as yield losses would be reduced).**Financial institutions can play a role in increasing the water productivity of agribusiness clients.**

Citrus production is affected by water stress and sub-optimal yields are commonplace:

See PI 9

- The largest production area, the arid Souss valley, is often subject to inadequate supplies of water. This affects overall yields and the quality of yields.

See PI 2

- The water table in many parts of Morocco is below 150 m. Pumping from this depth adds significant costs for producers.
- Quality of water is important: high salt content seriously affects both the quality and quantity of citrus yields. Additional irrigation may also be needed to dilute and move salts into deeper soil.

Case study 9

Drip irrigation and small-scale farmers in the Tadla irrigation scheme in Morocco

To relieve water scarcity, public authorities in Morocco have set-up various subsidy programs giving farmers access to efficient irrigation technologies, such as drip irrigation. 42'000 ha have been equipped with drip irrigation technology so far, and the Ministry of Agriculture aims to equip another 550'000 ha by 2020.[134] The importance of training offerings to farmers alongside equipment subsidies has been one of the key lessons learnt.

10.6 Performance indicators

Based on the current context of water challenges and agribusiness operations in the Mediterranean Basin, 9 tailored PIs are presented. These aim to support financial institutions in starting to assess the water-performance of farms and agribusiness operations in the region.

	Description	Rationale and materiality
PI 1 **Does the client comply with existing environmental standards and/or is the client in a position to comply with regulation likely to emerge in the future?**	Environmental standards relevant to water sustainability are related to the pollution of water courses and the over-exploitation of water resources. Under the EU Water Framework Directive, member states should aim to achieve good status of all bodies of surface water and groundwater by 2015. This is supported by the Directive on Plant Protection Products (i.e. pesticides and control of pollution), a directive that regulates pest-control and a directive that limits nitrogen pollution from fertilisers and manure.	Breaching environmental standards and subsequent prosecution can result in financial costs and cause reputational damage and losses from litigation, both for the farm as well as the lender. In contrast, agribusiness operations that already comply with environmental regulation likely to emerge in the future will be at a clear advantage relative to unprepared peers.
PI 2 **Has the client conducted an assessment of the security of sustainable water availability in terms of quality (including the sustainability of relevant groundwater resources)?**	An indication of water-stress levels in river basins is shown in Figures 11, 13 and 14. ***General*** • Current and future availability of water within the river basin • Levels of accessible storage capacity and load such as dams and tanks • Climate change impacts ***Surface water*** Reliability of surface water availability, e.g. the incidence of unforeseen canal closures; load and capacity levels of reservoirs, etc. ***Groundwater*** Levels of ground water use as a percentage of annual recharge; observed trends and forecasts regarding groundwater levels (water table developments), groundwater exploitation and groundwater recharge. Many agricultural regions in the Mediterranean Basin rely heavily on groundwater abstractions leading to the unsustainable over-exploitation of such resources and their potential failure in the near future. ***Water demand factors*** • Levels of unallocated water within the catchment • Socio-economic factors such as the number and nature of competing users and corresponding demand forecasts	A better understanding of the availability and constraints of sustainable water supply is key for business success. Together with a basin-wide assessment, a local assessment at the farm level will provide the foundation to identify bottlenecks, adverse developments as well as possible measures and promising solutions.
PI 3 **Has the client conducted an assessment of the security of sustainable water availability in qualitative terms?**	An assessment of water quality should include an assessment of salinity. Maps of salt affected soils are available for Italy and Greece. [135] Groundwater salinity from arsenic contamination (Thessaloniki area) are visble in Google Earth Pro.[136] The assessment should further include: • aquifer salinisation (e.g. Figure 12 and local maps of Morocco and Italy), • micro-pollutants, • eutrophication (e.g. River Po in Italy), and • industry discharge. Under the EU Water Framework Directive the quality of water is likely to improve in future years.	High levels of salinity or pollutants in irrigation water can significantly reduce crop yields. Lemons and oranges in particular have very low tolerance levels. Attention should also be given to how the activities of the client may exacerbate existing water quality issues. This includes, for example, saline returns from irrigation and the non-appropriate use of agrochemicals.

PI 4 **Does the client use best available water-efficient irrigation systems/ technologies?**	In South Africa, irrigation consists of 33% surface water systems, 55% sprinkler and 12% Micro-Drip Irrigation.[87] In light of sharpening water pressures, farmers should strive to adopt the most water efficient system available for their irrigation requirements. This is in line with recommendations in the Water for Development and Growth Framework (2009) – Promoting Water Conservation and Water Demand Management. [88] These recommendations should be taken seriously as they are likely to be picked up in future regulation requiring farmers to do so.	The use of innovative irrigation systems such as drip irrigation or well managed centre or linear pivot sprinkler systems[89] enhances irrigation efficiency relative to conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.
PI 5 **Will the client´s operations still be commercially viable once meaningful and volume-based tariffs have been introduced?**	Both under the European Water Directive as well as in Morocco, new water tariff structures are being established based on water volumes consumed rather than the area irrigated. Tariffs are likely to increase in order to more fully reflect the true costs for water provision and provide strong incentives for water efficiency.	Meaningful and volume-based water tariffs are strong incentives for water efficiency improvements. However, they put increased cost pressure on agricultural activities potentially making previously bankable operations unprofitable.
PI 6 **Does the client access innovative sources of water supply: re-use of water and/or rainwater harvesting?**	The water situation of much of the Mediterranean Basin is and will increasingly be characterized by (1) climate change induced reductions in precipitations and surface water availability; (2) overexploitation of groundwater resources and declining water tables. In addition to water productivity improvements, more sustainable water sources must be explored and exploited. Many pilot projects in different countries have already successfully implemented water re-use concepts in agricultural activities.	Farms and agribusiness operations reliant on conventional/unsustainable water resources will be at a competitive disadvantage relative to those that manage to diversify water sources to more sustainable alternatives. Increasing levels of water re-use and potentially rainwater-harvesting appear to be promising ways forward.
PI 7 **(a) Have steps been taken to mitigate impacts on ecosystems and the environment?** **(b) Are processes in place to monitor the impact of the facility on the water environment over time and to review and implement strategy on the basis of the monitoring data?**	(a) Steps may include natural pest management, low water fertilisers and addressing the question of whether the production area is located in or near a site of ecological importance. (b) Environmental monitoring is necessary to asses the impacts of farms on the environment and allows to identify actions to be undertaken in order to prevent damage to aquatic ecosystems, surrounding vegetation and public health. (c) In countries of the European Union these aspects have become material to the private sector in general since the inception of the Environmental Liability Directive, which makes businesses liable for any environmental damage they cause.	Good environmental practice may have positive impacts on financial performance in light of tightening environmental regulation. Agribusiness operations that already today comply with emerging environmental regulation (under the European Water Directive as well as the Environmental Liability Directive) will be at a clear advantage relative to peers. The implementation of such considerations may also have reputation benefits for financial institutions in light of consumer preference increasingly shifting towards 'more sustainability'.
PI 8 **Does the client use best available water-efficient irrigation systems/ technologies?** **Have government subsidies been secured for the installation of such systems?**	Commonly, drip and micro-sprinkler/under canopy systems are both economically practicable and highly water efficient. In many European countries and beyond, special Government programs and subsidies are in place to support farmers purchase and install new and water-efficient systems.	The use of drip and micro-sprinkler/under canopy systems enhances irrigation efficiency relative to other conventional techniques. It reduces exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.

PI 9 **What is the client's crop-specific water productivity performance?**	High levels of water productivity/efficiency may not be a sufficient condition for sustainable water management, but a necessary one. Water productivity is usually measured as m^3 per ton of harvest or unit of turn-over. The level of water efficiency of a given operation will depend on a wide set of local parameters. National or regional averages can, therefore, only serve as rough proxies. **Reference values** Benchmark values of water productivity in the Mediterranean Basin are: **Tomatoes** 125 m^3/ton, however, large differences exist subject to growing conditions and varieties.	In addition to environmental benefits, high levels of water productivity/efficiency have positive impacts on the cost-structure and drought-resilience of agricultural activities

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About the UNEP Finance Initiative (UNEP FI)

The United Nations Environment Programme Finance Initiative (UNEP FI) is a global partnership between the United Nations Environment Programme and the private financial sector. UNEP FI works closely with the 180 financial institutions that are Signatories to the UNEP FI Statements, and a range of partner organisations, to develop and promote linkages between the environment, sustainability and financial performance. Through regional activities, a comprehensive work programme, training activities and research, UNEP FI carries out its mission to identify, promote, and realise the adoption of best environmental and sustainability practice at all levels of financial institution operations.

About the UNEP FI Water & Finance Work Stream

The UNEP FI Water & Finance Work Stream aims to create awareness and capacity among financial institutions in order to promote their proactive approach towards water issues, both in the area of water-supply and sanitation as well as with regards to water as a production factor in businesses downstream.

This is done by identifying and addressing the common grounds between the commercial objectives of financial institutions and the water sustainability goals of society at large.

Project teams

Project team at the United Nations Environment Programme Finance Initiative (UNEP FI)

Head of Unit	Paul Clements-Hunt
Project Lead	Remco Fischer
Project Team	Susan Steinhagen, Leonie Goodwin, Sarah-Kristin Klein

Project team at Arup

Project Director	Justin Abbott
Project Manager	Matthias Retter
Project Team	Virginia Hooper, Rory Padfield, Elaine Trimble, Jean Rogers, Matheus Martins
Extended team	Jennie Barron, Stockholm Environment Institute Tim aus der Beek, University of Kassel

UNEP Finance Initiative
International Environment House
15 Chemin des Anémones
CH-1219 Chatelaine, Geneva
Tel: (41) 22 917 8178
Fax: (41) 22 796 9240
fi@unep.ch
www.unepfi.org

www.unep.org
United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel.: ++254-(0)20-62 1234
Fax: ++254-(0)20-62 3927
E-mail: cpiinfo@unep.org

UNEP

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UNEP FI is a strategic public-private partnership between UNEP and the global financial sector. UNEP works with over 180 banks, insurers and investment firms, and a range of partner organisations, to understand the impacts of environmental, social and governance issues on financial performance and sustainable development.

Through a comprehensive work programme encompassing research, training, events and regional activities, UNEP FI carries out its mission to identify, promote and realise the adoption of best environmental and sustainability practice at all levels of financial institution operations.

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