Drop by drop

Understanding the impacts of the UK's water footprint through a case study of Peruvian asparagus

PROGRESSIO

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About this report

This report is based on collaborative research by Progressio, Water Witness International and CEPES (Centro Peruano de Estudios Sociales / Peruvian Centre for Social Studies), which took place in April and May 2009. The team – Nick Hepworth of Water Witness International, Julio Postigo of CEPES and Bruno Güemes Delgado of Progressio Peru – thank the people, communities, companies and organisations who generously contributed their time, experiences and opinions to the work. Special thanks are extended to Dr Eric Rendón of the Universidad San Ignacio de Loyola and the staff of Progressio and CEPES for their kind support and guidance. Thanks are also due to the expert reviewers who contributed with valuable insights and comments to the final draft. Additional research by Petra Kjell, Progressio.

The opinions expressed in this report are those of the authors and do not necessarily reflect those of Progressio, Water Witness International or CEPES. Together these organisations have researched and analysed the information contained in this report and have made every effort to ensure accuracy and an objective and balanced perspective. The report has also been critically reviewed and checked by a panel of seven international and Peruvian experts in water, environment, trade and development. However, Progressio, Water Witness International and CEPES cannot be held responsible for any errors.

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Executive summary

This report builds on the concepts of virtual water and water footprinting, to show how these ideas can be understood and practically applied to drive sustainable water management and equitable outcomes for the world's poor.

Through a case study in Peru, the report links the production of fresh, year-round asparagus for the international market to the rapid expansion of the agrarian frontier and the 'greening' of the desert to grow the crop. The research shows how this expansion has become unsustainable given the hydrological context and concurrent demands for water in the Ica Valley, the epicentre of Peru's asparagus boom. Huge increases in water demand to support this agricultural expansion are linked to negative economic impacts on small and medium-scale farmers and contribute to water scarcity and inequity for some of the poorest communities in Peru, fuelling social conflict and enhanced vulnerability to climate change across the Ica Valley and beyond.

The complexity of the links between water use, negative impacts and economic and social well-being in Peru means that a considered response is required, and knee-jerk reactions would be unhelpful. Loss of the asparagus trade could have a detrimental impact on livelihoods in Ica where many poor people rely on the jobs it provides. Instead the factors which have conspired to make the industry unsustainable need to be addressed. Based on the analysis in this report, a set of opportunities for progress are presented to help reverse the potentially disastrous outcomes emerging in Peru, which can help prevent similar water crises elsewhere. The report shows that responsibility for the formidable water problems facing Ica, and their solutions, lies in part with the Peruvian government, but that responsibility also lies with other parties driving the asparagus boom from outside Peru, including investors and retailers. The UK represents the third largest market for fresh asparagus from Peru, behind the USA and the Netherlands. The water consumed in growing the asparagus imported to the UK in 2008 has been estimated to be 9 million cubic metres (Mm^3), which equates to about 3,600 Olympic swimming pools of water. Most of this water is used in the Ica Valley of Peru, one of the driest places on earth.

The Ica River rises in the mountain region of Huancavelica, Peru's poorest region, where the catchment has been artificially extended into the Amazon basin to capture water from wetter areas. Here, indigenous communities make a marginal livelihood herding mixed flocks of alpaca, sheep and llama, and already face water problems because of pollution from mining and a highly variable climate. The river flows to the Pacific coast through the region of Ica, which has an average rainfall of less than 1 mm per year. Despite this, the local population have historically managed to survive through a fragile balance of water supply and demand, with a productive agricultural sector using groundwater recharged from the mountains to irrigate crops such as cotton, nuts, fruit and vegetables.

Since the 1990s the cultivation of asparagus in Ica for the fresh export market has exploded from almost nothing to cover nearly 100 square kilometres in 2008. Based on this boom, Peru now dominates the world's asparagus trade, with approximately 95 per cent of the country's fresh asparagus exports originating in Ica. With 40 per cent of Ica's economically active population (EAP) employed in the agro-export industry, the asparagus boom has contributed to near zero unemployment in the area, providing jobs for many poor people.

In the Ica Valley, asparagus is grown intensively in large blocks of land reclaimed from the desert, irrigated by groundwater delivered by drip irrigation through hundreds of kilometres of pipeline. In 2002 this greening of the desert became unsustainable, when the irrigation needs of asparagus began to push the exploitation of the valley's aquifer into the red. With extraction since then significantly exceeding the amount of recharge, the water table in the valley has plummeted, typically by rates of between half a metre and two metres a year, and in places by as much as eight metres each year – almost certainly the fastest rates of aquifer depletion anywhere in the world.

Although the asparagus boom is an opportunity for economic and social development in the valley, unsustainable water resource use has begun to exert a formidable set of negative impacts in the region. These impacts are severe and escalating rapidly, and can be traced directly to the water footprint of developed nations.

The research shows how:

- Overexploitation of the aquifer is already impacting on the asparagus and agro-export industry itself, with spiralling costs incurred in the acquisition of irrigation water. These costs include deepening existing wells, buying up old wells, piping water across great distances, and allegedly trying to beat the ban on new wells through pulling political strings or paying off officials in a race to capture the dwindling resource.

- Pre-existing, 'traditional', small and medium-scale farmers are feeling the brunt of this resource race, forced to go without water because of drying wells and increasing salinity, or pushed into debt and forced to sell land and wells to big agribusinesses because they cannot keep up with escalating costs.

- Water levels in domestic water supply wells are falling rapidly. Already two wells serving 18,500 people in Ica have dried up, and at current rates of exploitation a third of the city's supplies, serving 185,000 people, are likely to dry in the next 25-30 years.

- Poor people in the valley are suffering most. Because of earthquake damage and underinvestment in water supply infrastructure, poor communities sometimes have to survive on as little as 10 litres of water per person per day, compared to the 50 litres specified by the World Health Organisation as the minimum needed for basic health maintenance. As local wells dry up or are bought out by agribusiness, these same communities watch some of the big asparagus farms each use the same amount of water as the entire city of Ica every day. The demands of developed country buyers also mean that water used to irrigate asparagus is often treated to higher quality standards than that provided for public drinking water supply. Furthermore, local people face the problem of groundwater pollution by nitrates from agricultural fertilisers and wastes.

- The increased water demand for asparagus is also driving water scarcity in the mountains above Ica, affecting some of the poorest communities in Peru. Faced with government supported investment to extend a water transfer scheme which already denies them water – diverting drainage from 392 square kilometres of the upper Amazon basin – poor alpaca herders in the hills have resorted to the Latin American Water Tribunal (LAWT) to seek justice. They claim that the water they need to keep their pastures and animals healthy is being diverted to Ica and that this is heightening their vulnerability to climate change. They attest to less snow, less reliable and more intense rainfall, and harsher temperatures. In the face of this changing climate, the water transfer to Ica further limits the livelihood options available to escape the severe levels of poverty experienced by many communities in the mountains.

Unless action is taken, the overexploitation of the aquifer will eventually exhaust the water resources which the city of Ica and its population of over a third of a million people depend on for their survival. In a perverse process of self-destruction, all but the most powerful farmers will be forced out as the resource becomes scarcer and more expensive to access.

The causes and impacts of the overexploitation identified by the research are summarised schematically in the 'problem tree', Figure A, at the end of this summary. It traces how regulatory control over water resource use has failed, partly because of inadequate legal and institutional frameworks. Poorly designed and unenforced water laws have permitted a few large agribusinesses to secure preferential access to and use of water at unsustainable rates. Looking more deeply, a lack of rational development planning and control processes, such as Environmental Impact Assessments (EIAs), has facilitated expansion by agribusiness into areas with insufficient water.

These problems seem to have their roots in a lack of regulatory capacity, the apparent subversion by powerful and well connected elites of the little government capacity that does exist, and a lack of political will to control market forces.

Alongside this failure of public policy and public institutions, responsibility is also shared by the private sector, where investors, insurers and purchasers have failed to take due diligence to ensure that the businesses they support exploit natural resources in a way which is sustainable. Of real concern is the failure of existing lending safeguards and market standards to flag, question or deal with the water impacts of a water dependent industry which is overexploiting a rapidly dwindling and limited water resource in one of the driest places on earth. Such standards and safeguards are specifically designed to ensure that economic development is sustainable – good for the environment and the poor. Examples which deserve particular scrutiny include the performance standards of the International Finance Corporation (IFC), the private sector lending arm of the World Bank, which has made substantial investments in the asparagus industry in the Ica Valley; international production standards of good agricultural practice such as GLOBALG.A.P.; and the social and environmental standards of retailers and supermarkets. These standards, which suggest to the market that sustainable production methods have been adhered to, have all been awarded to agro-exporters in Ica. Whilst they have been associated with improvements in employment conditions, our report shows that they reward production which is far from sustainable in its water use.

This case study of asparagus in Ica provides a potent example of how these failures of regulation and responsibility impose significant social and environmental impacts which are felt most painfully by the poor. The findings shed light on what the 'water footprint' imposed by distant consumption means in real terms within developing country watersheds. The lessons learnt are not only relevant for Peru, but have global relevance because:

- The virtual water trade and water footprint serving the developed world is already significant, with a global reach into developing countries, and it continues to grow.
- Weak water resource regulation and challenges in implementing regulatory controls over water resource use are common to most developing countries.
- The failure of corporate responsibility measures, lending safeguards and market standards to adequately consider water resource sustainability is a global phenomenon.

This report does not aspire to provide 'answers' to the water problems of Ica. Ultimately there needs to be a realignment of water supply and water demand in the basin. The hazards of focusing just on new supply side solutions are explored in the report as is the danger that regulatory demand management may prejudice the poor rather than control the powerful. To drive positive change, stronger incentives are required to steer water users and markets towards more sustainable modes of production. Through this research a set of opportunities for progress emerged and these were deliberated, developed and refined in stakeholder meetings in Peru. The report categorises these into the roles which must be played by science, regulation, civil society, investors and retailers. They have been divided into national and international recommendations; however, it should be noted that many recommendations are cross cutting.

National level

The role of science

A lack of readily available data, targeted research and understanding of the water resource, its use and the nature and implications of climate change mean that uninformed management decisions risk perverse outcomes. A key requirement for making progress will be a better understanding of the issues within both the social and natural sciences. The role of high quality research, objectively packaged findings and freely available information is particularly important given the political polarisation and misinformation of the past.

The role of regulation

The new Peruvian water law provides the fundamentals for an effective water resource management regime; however, lessons from past failures need to be learnt, and concerns about water privatisation by stealth, which threaten further polarisation, need to be responded to.

The role of civil society

The oversight roles of NGOs and the media are potentially powerful tools in the democratisation of the management of natural resources, incentivising improved performance and greater accountability within government. Within Peru's new water management arrangements these roles and the capacity to fulfil them need to be nurtured. This will require open and cooperative government and constructive, non-adversarial engagement by the NGO sector which focuses on dealing with the shared risks to society brought by poor water resource management.

International level

The role of investors and retailers

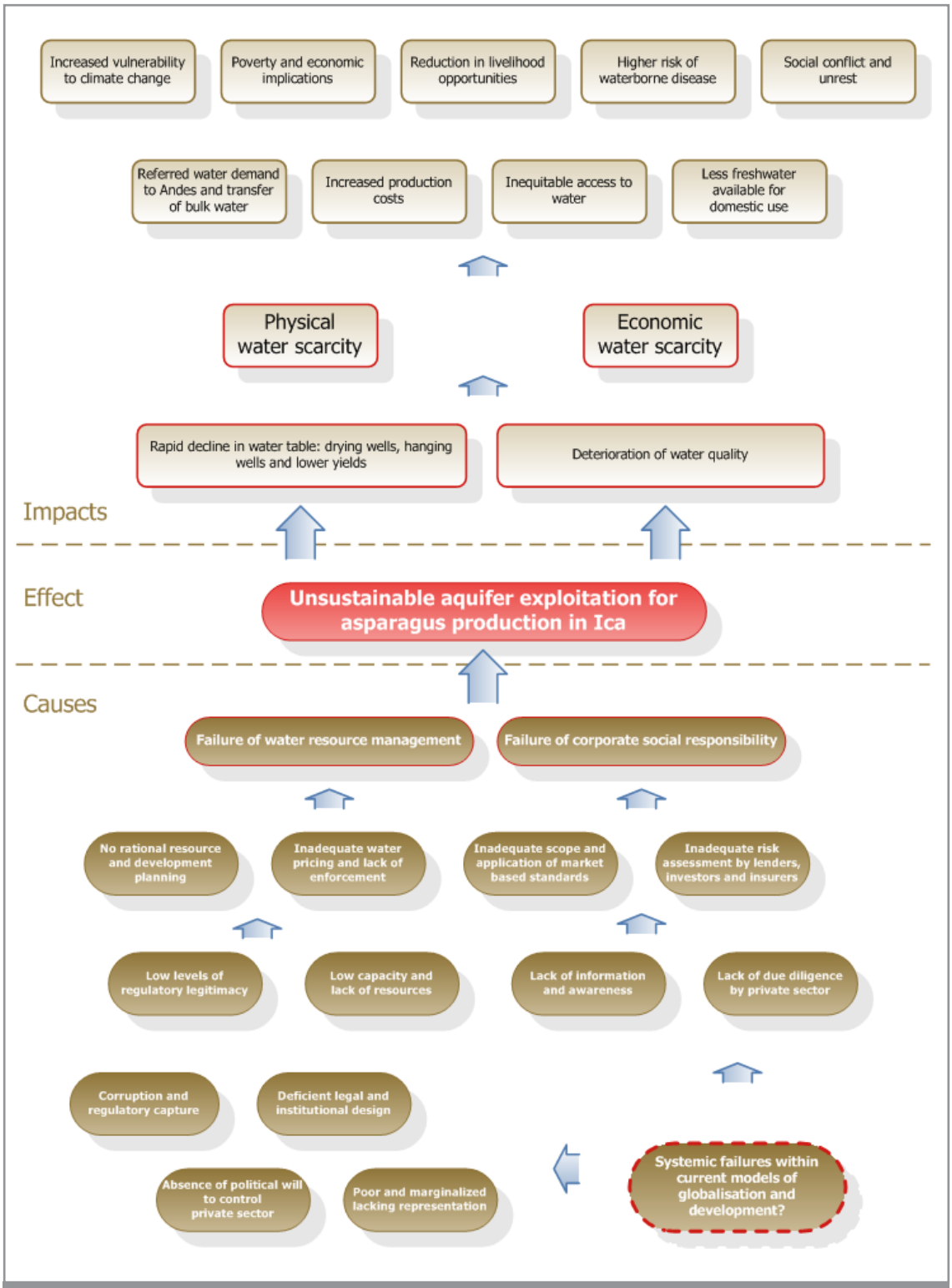
The research provides convincing evidence that the market is a powerful driver of change in Peru's agro-export sector. However, it also shows that existing market standards fail to adequately consider the sustainability of water resource use. Specifically, we found that the failure of standards such as GLOBALG.A.P. and supermarkets' own standards, as well as the IFC's Performance Standards, in relation to water resource use and its impacts, whether through design or lack of compliance, have contributed to the social and environmental problems documented. We strongly recommend that these standards are reviewed and revised to ensure that they only reward production which exploits water resources in a genuinely sustainable way. In addition, production and investments which have been labelled as 'responsible' through compliance with these inadequate standards should be reviewed urgently to check they are not creating hydrological problems comparable to those seen in Ica.

The Alliance for Water Stewardship (AWS) is currently coordinating global efforts to develop new comprehensive standards for sustainable water resource use which better address the complexities of water stewardship. Developed through a participatory approach, these standards will set out what water users must do to ensure that their water use and the catchment they operate in are managed responsibly. The AWS effort will develop a system for independent verification against these standards and will create a recognisable brand in the market place so that responsible water use can be rewarded by consumers, purchasers and investors. We recommend financial and political support for this effort and proactive participation by the full range of water stakeholders.

The role of the donor community

Market based standards, such as those being developed by the AWS, will make an important contribution, particularly where water resource management and regulatory effort by governments falls short. Ultimately, however, sustainable water resource use and allocation must be secured by effective public policy on water. Governments must take responsibility, must act and must be held accountable for ensuring that water resources are managed for the collective 'public good' of their citizens. However, in developing countries external financial and technical support may be necessary, particularly where the powerful forces of commercial agricultural production come into play. Civil society groups, non-governmental organisations, research institutions and the media can play an important role by keeping a watchful eye to ensure that water laws are applied to protect the poor and the environment. Such groups require support for monitoring and communication work, to cap corruption and to ward off resource capture and overexploitation. We therefore call on the UK government to step up its support to civil society and research groups working for social accountability and equity in developing countries, so that the benefits of economic growth are sustained and shared by all.

Further, as we have shown in our analysis, unsustainable water resource use and associated social conflict and inequity, such as that being played out in the mountains of Huancavelica, will be exacerbated by human induced climate change. Developed countries where the majority of greenhouse gas emissions originate clearly have a financial and moral obligation to support countries like Peru and its poorest communities in their efforts to adapt to climate change. The UK should extend its leadership role in supporting climate change adaptation and, given that the impacts of climate change will be felt through changes in the distribution and availability of water resources, we call on the UK government to specifically focus additional support on effective and equitable management of this most precious resource.



↗ Figure A The causes and impacts of unsustainable aquifer exploitation for asparagus production in the Ica Valley

Contents

1 Introduction 11
1.1 Rationale for the study 11
1.2 Research objectives 13
1.3 Methodology 14
2 Understanding the context – Peru and water use in the asparagus industry 16
2.1 Huancavelica 22
2.2 Ica 23
3 The social and environmental impacts of water use by the asparagus industry 29
3.1 Impacts within the lower Ica Valley 32
3.1.1 Impacts within the agro-export industry 34
3.1.2 Impacts on small and medium sized farmers in the Ica Valley 39
3.1.3 Implications for domestic water supply 45
3.2 Impacts in the upstream and adjacent catchments 49
3.2.1 Water transfer from Huancavelica 49
3.2.2 Impacts of the PETACC scheme and its extension 50
4 The implications of climate change 60
5 What are the root causes of these impacts? 64
5.1 Water supply vs demand 65
5.2 A failure of regulation 65
5.2.1 Absence of regional or basin planning 67
5.2.2 Inadequate legal and institutional frameworks and a lack of enforcement 68
5.2.3 Prospects for the new law 73
5.3 A failure of responsibility 74
5.3.1 Agribusiness 75
5.3.2 Investors 75
5.3.3 Retailers 78
6 Opportunities for progress 81
6.1 National level 82
6.1.1 The role of science 82
6.1.2 The role of regulation 82
6.1.3 The role of civil society 83
6.2 International level 84
6.2.1 The role of investors and retailers 84
6.2.2 The role of the donor community 85
References 86
Appendix 1 Calculations for water off take of asparagus exports from Ica – relating asparagus consumption to water demand in Ica 88
Appendix 2 Estimated annual aquifer use 88
Appendix 3 Calculation of asparagus retail value 89
Appendix 4 Total annual water demand at agro-export farm 89
Appendix 5 Seasonal rainfall in Choclococha 89
Appendix 6 Breakdown of relative value to labourer vs shelf price 90
Appendix 7 Increase in irrigation water distributed by Junta de Usuarios del Distrito de Riego de Ica 90

List of maps, figures, tables, and case studies

Map 1	Peru and the study location of Ica	13
Map 2	The Ica-High Pampas River Basin of Peru showing mean monthly rainfall totals in the Lower and Upper Basins	21
Map 3	The area of Huancavelica from where drainage is diverted from the High Pampas (Amazon) basin to the Ica basin and the proposed Incahuasi extension	51
Figure 1	Interdisciplinary mixed methodology of triangulation and validation used by this research	15
Figure 2	Annual value and volume of fresh and preserved asparagus exported from Peru 1990-2008	18
Figure 3	Where does the virtual water embedded in Peru's asparagus end up?	20
Figure 4	Satellite image of the lower Ica Valley	27
Figure 5	The effect of doubling groundwater exploitation from 2002 to 2007 on the water balance of the Ica-Villacuri aquifer	30
Figure 6	Relative trends in asparagus production and groundwater levels in the Ica Valley 1990-2008	31
Figure 7	A three-dimensional representation of the Ica-Villacuri aquifer	31
Figure 8	Groundwater levels at representative wells across the Ica Valley and Villacuri 1997-2007	33
Figure 9	Projected future groundwater levels based on current rates of decline	47
Figure 10	Nitrate levels at selected water sources in Ica Valley, May 2009	49
Figure 11	Extract from a recent study by SENAMHI showing past rainfall averages for sections of the Andes	61
Figure 12	Available annual rainfall records for locations within the Ica Valley	62
Figure 13	Voice of Ica, front page, April 2009; the illegal drilling rigs in question, still quarantined; and a copy of the regional government resolution prohibiting new wells in the valley	69
Table 1	Selected social and environmental indicators for Ica, Huancavelica and Peru	22
Table 2	Comparison of the characteristics of agro-export and small to medium sized farms in the Ica Valley	25
Case study 1	The experience of an agro-exporter	35
Case study 2	The perspective of a small-scale farmer	40
Case study 3	The experience of a medium sized farmer	41
Case study 4	Pressure to sell water sources	42
Case study 5	Salty water, fear and suspicion	43
Case study 6	The opinion of an Ica water supply engineer	46
Case study 7	The view of Ica's poor	48
Case study 8	The experience of people in the hills of Huancavelica	54
Case study 9	The Carhuancho water conflict	56

Acronyms

AAA	**Autoridades Administrativas del Agua/River Basin Authorities**
Agua-C	**Civil Association for Water Management**
ANA	**Autoridad Nacional del Agua/National Water Authority**
ALA	**Autoridades Locales de Agua/Local Water Authorities**
ATDR	**Technical Administrator of the Irrigation Districts**
ATPA	**Andean Trade Preference Act (ATPA)**
AWS	**Alliance for Water Stewardship**
BASC	**Business Anti-Smuggling Coalition**
BRC	**British Retail Consortium**
CAO	**Compliance Advisor Ombudsman, International Finance Corporation and Multilateral Investment Guarantee Agency**
CEPES	**Centro Peruano de Estudios Sociales/Peruvian Centre for Social Studies**
CONAM	**Consejo Nacional del Medio Ambiente en Perú/National Environmental Regulator**
CRASVI	**Commission of Groundwater Users of Ica Valley**
DESCO	**Centro de Estudios y Promoción del Desarrollo/Centre for the Study and Promotion of Development**
EAP	**Economically Active Population**
EIA	**Environmental Impact Assessment**
HACCP	**Hazard Analysis and Critical Control Point**
IADB	**Inter-American Development Bank**
IDEA-PUCP	**Instituto de Estudios Ambientales, Pontifica Universidad Católica del Peru/ Environmental Studies Institute, Pontifical Catholic University of Peru**
IFC	**International Finance Corporation**
INADE	**Instituto Nacional de Desarrollo/Peruvian National Institute for Development**
IPROGA	**Instituto de Promoción para la Gestión del Agua/Institute for the Promotion of Water Management**
IWRM	**Integrated Water Resource Management**
LAWT	**Latin American Water Tribunal**
MINAG	**Ministry of Agriculture**
MINEM	**Ministerio de Energia y Minas/Ministry of Energy and Mines**
PETACC	**Proyecto Especial Tambo Ccaracocha**
PTPA	**US-Peru Trade Promotion Agreement**
SENAMHI	**Servicio Nacional de Meteorología e Hidrología del Perú/Peru's National Meteorology and Hydrology Institute**
Soles	**Peruvian currency**
USAID	**United States Agency for International Development**
WWF	**World Wildlife Fund**
WWI	**Water Witness International**

1 Introduction

1.1 Rationale for the study

It is widely acknowledged that the sustainable use of rivers, lakes and groundwater is a fundamental but increasingly challenging requirement for meeting global poverty reduction and equitable development aspirations. A changing and increasingly variable climate adds to the challenge of delivering water for society's escalating health maintenance, food production and economic development needs, whilst at the same time maintaining the planet's biodiversity. Where we fail, it is the poorest communities in the world's developing countries who most acutely feel the brunt of water problems, through inaccessible or degraded water resources, and associated impacts on agriculture and water related natural resources which they depend on for their livelihoods.

It is also acknowledged that the emergent global water crisis is not caused by a lack of water itself but by a lack of effective water management.[1] Although the natural environment provides an important backdrop, it is how we administer, allocate, control and regulate water uses which are often the crux of water scarcity. Again, it is the poor, without political, financial or other capital, whose well-being is most vulnerable to inadequate or just plain unfair water resource management. The challenges for equitable management are likely to be exacerbated by climate change, which will be felt largely through changes in the distribution of water resources.[2]

Integrated Water Resource Management (IWRM) has emerged as the dominant idea for how the global community can manage water more effectively.[3] IWRM in practice sees water resource use – abstractions of water from the environment or discharges of wastewater to it – controlled by the state with varying degrees of participation in decision making. The idea is that governments will coordinate and regulate water resource use at a basin scale for the public good, so that quality and quantity are protected to meet the needs of concurrent and future users and functions. IWRM reforms are ongoing throughout the world with implementation and capacity building programmes receiving significant support from development partners, in particular the World Bank. Despite this backing, the entrenched interests that benefit from privileged access to water resources are powerful protectors of the status quo – in many countries IWRM will take decades to deliver the results needed by the poor today.

Alongside these national IWRM reforms, additional contributions are being made through the development of new concepts like virtual water and water footprinting. These seek to better understand and highlight the implications of international trade and the links between consumption and water use on a local, regional and global scale. The idea of 'virtual water' was introduced by Professor Tony Allan, winner of the prestigious Stockholm World Water Prize, to describe the sum of all water used at the point of production (sometimes called hidden or embedded water) for goods which may then be exported and consumed in distant parts of the world.[4] For example a can of cola consumed in the UK contains only 0.35 litres of water, yet to grow and process the sugar needed to make the cola in each can requires an average of 200 litres of water in places like Brazil or India.[5]

1 Chenoweth, J (2008) 'Looming water crisis simply a management problem' in New Scientist, 28 Aug 2008, pp 28-32.

2 See for example Bates, B C et al (eds) (2008) Climate change and water, Technical paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva.

3 IWRM is defined as 'a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems'. Global Water Partnership Technical Advisory Committee (TAC) (2000) 'Integrated water resources management', TAC Background papers 4, Global Water Partnership www.gwptoolbox.org/images/stories/gwplibrary/background/tac_4_english.pdf accessed 15 July 2010.

4 Allan, J A (2003) 'Virtual water - the water, food and trade nexus' in Water International, 28, pp 4-11. According to Allan, virtual water is the volume of freshwater used to produce a product, measured at the place where the product was actually produced - it refers to the sum of the water used in the various steps of the production chain.

5 Hoekstra, A Y and Chapagain, A K (2008) Globalization of water: Sharing the planet's freshwater resources, Blackwell Publishing, Oxford.

Building on this work, Hoekstra developed the 'water footprint' concept in 2002.[6] The water footprint is an indicator of freshwater use that looks at both direct and indirect water use of a consumer or producer.[7] The water footprint of an individual, community or business is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community or produced by the business. Water use is measured in terms of water volumes consumed (evaporated) and/or polluted per unit of time. A water footprint can be calculated for a particular product, for any well-defined group of consumers (eg an individual, family, village, city, province, state or nation) or producers (eg a public organisation, private enterprise or economic sector).

In 2008 the World Wildlife Fund (WWF) published research which applied water footprinting methodology at a national scale to characterise the water footprint of the United Kingdom.[8] This research shows that the virtual water used to support high levels of consumption in the UK has enormous implications. As the sixth largest importer of virtual water globally, the UK has the potential to impact on water users and sustainable development all over the world. When all the water needed to grow the food and produce the goods consumed in the UK is considered, only 38 per cent of the water used is actually from the UK, where even with relatively high rainfall there are regular droughts. 62 per cent, or 63.6 billion cubic metres of the UK's annual water use is sourced through its overseas water footprint. That equates to over 30 times the flow of the River Thames or over 25 million full Olympic size swimming pools of other people's water each year.[9] So whilst the average UK citizen directly uses about 150 litres of water per person per day (nearly two bath tubs), through taps and toilet flushing, their indirect consumption of embedded water through imported products averages at a staggering 4,645 litres, or 50 full bath tubs of the world's water every day.

Given that many of the countries where this water is sourced are both very poor and face water scarcity and water management issues, this raises some pressing questions. As the WWF work points out, one problem with the water footprint methodology is that it is value free. Although it reveals the geographical extent of virtual water consumption, it doesn't answer the 'so what' questions about the impacts on the environment and local water users. To be playful with the terminology, it doesn't consider who the footprint treads on.[10] If the obligations of global citizenship are to be met, individuals, organisations and governments in responsible nations need to understand what their water footprints actually mean at a local level. Ultimately, by understanding and acting on the impacts of our water footprints we have an opportunity to drive improved water resource management and more sustainable patterns of consumption, and to contribute to the equitable future we all need.

This report builds on the ideas of virtual water and aims to take water footprinting to the next stage. It explores the social and environmental impacts of the UK's water footprint and considers its implications for sustainability and equity in developing countries through a case study of Peruvian asparagus. 73 per cent of the UK's overseas water footprint is in agricultural water use and 71 per cent of this is embodied in crop production – in the food crops we import.[11] The rapid growth of the agricultural export industry along the arid coast of Peru therefore provides a useful lens through which to see the nature and origins of the problems caused by our thirst for virtual water. This case study is particularly potent because of a recent boom in high value, high water demanding crops such as asparagus, grown on an industrial scale to supply the UK and other developed country markets, and the rapidity and traceability of impacts of this growth in virtual water exports. As will be seen, these circumstances allow for a robust exploration of potential policy responses, advocacy messages and opportunities for progress towards more sustainable and equitable water resource use at a local, national, regional and international level.

6 Hoekstra, A Y (ed) (2003) Virtual water trade: Proceedings of the International Expert Meeting on virtual water trade, Delft, The Netherlands, 12-13 December 2002, Value of water research report series No 12, UNESCO-IHE, Delft, The Netherlands, www.waterfootprint.org/Reports/Report12.pdf accessed 9 July 2010.

7 Hoekstra, A Y et al (2009) Water footprint manual: State of the art 2009, Water Footprint Network, Enschede, the Netherlands, www.waterfootprint.org/downloads/WaterFootprintManual2009.pdf accessed 9 July 2010.

8 Chapagain A, and Orr, S (2008) UK water footprint: the impact of the UK's food and fibre consumption on global water, Volumes 1 and 2, WWF-UK, Godalming, UK.

9 Volume of an Olympic size pool calculated as 25m x 50m x 2m = 2,500 m^3.

10 In recognition of this weakness the Water Footprint Network are attempting to 'bolt on' sustainability assessment to the accounting tool of water footprinting.

11 Chapagain A, and Orr, S, as note 8.

1.2 Research objectives

Progressio and its partners in this research study, Water Witness International[12] and CEPES,[13] are particularly interested in the interrelationships between international virtual water flows, water availability at a local level, poverty and vulnerability to climate change. As well as investigating the problems, we also seek to develop a progressive response to the issues that water footprinting raises and to explore what can be done in the UK, Peru and elsewhere to drive positive change. In particular we want to develop responses which have real benefits for poor communities and biodiversity conservation and which support economic growth which is genuinely socially and environmentally sustainable. The interest and momentum developed through water footprinting is a valuable opportunity to develop 'next generation' water management and policy tools which link water footprints to social and environmental impacts in developing countries.

↗ **Map 1 Peru and the study location of Ica**

The study focuses on the basin of the River Ica which flows from Huancavelica, the poorest region of Peru,[14] in the high Andes to the Pacific Ocean around 300 km south of Lima, through the Ica Valley where expansion of the agro-export industry has been particularly intensive (see Map 1). Within this basin the research posed the following questions:

- What are the social and environmental implications of water use in the agro-export industry?
- What are the interactions between these impacts and climate change vulnerability, in particular for the poorest communities?
- What are the root causes of any negative impacts observed?
- What future strategies are available to secure more equitable and sustainable water resource management, who has responsibility for implementing these, and what action should they take?

12 Water Witness International is an independent not-for-profit research and advocacy organisation based in Scotland working to promote sustainability and social equity through improved performance and accountability in the management of water resources.

13 CEPES – Centro Peruano De Estudios Sociales/Peruvian Centre for Social Studies, an independent research body working to empower poor communities and reduce poverty in Peru.

14 Salazar, M (2008) 'PERU: Upbeat poverty stats questioned', IPS (Inter Press Service) website, 29 May 2008, http://ipsnews.net/news.asp?idnews=42586 (accessed 9 July 2010).

In this report we:

- introduce the social and environmental contexts of the study basin
- describe the methodology adopted by the research
- appraise the impacts of water use by the agro-export industry both locally in the Ica Valley aquifer and further afield in the high catchment and adjacent areas
- consider the implications of these impacts on resilience and vulnerability to climate change
- attribute the impacts seen to a set of interrelated causative factors
- present opportunities for progress towards more sustainable and equitable water use, identifying relevant actions and responsibilities.

In order to bring the study to life, the report quotes the testimony of people interviewed and uses case studies to illustrate key points. It aims to do so in an objective way by balancing and presenting perspectives of different stakeholders. However the identities of contributors have been withheld or altered to avoid any unforeseen consequences.

1.3 Methodology

An iterative approach based on triangulation between secondary data sources such as research reports and published data, key informant testimony and field observations was adopted to make the best use of time spent in the field.[15] This type of interdisciplinary methodology is ideally suited to a study of this nature, validating existing studies and secondary data sources through comparison with the perspectives of multiple stakeholders and contemporary observations within the study area.

The experience and insights of local partners are crucial to properly situate and interpret local cultural, linguistic and behavioural norms and contexts and to secure rapid access to key informants and available data sources. We paid specific attention to the political economy of water resource management – on understanding networks of power and influence; and on addressing local priorities and adapting the research design to meet local needs. To provide additional validation and to support interpretation, initial results and insights were deliberated at a meeting of key stakeholders in Lima at the end of the field research. A schematic representation showing the four elements of the methodology is presented in Figure 1.

The research team spent four weeks in Peru in April and May 2009. After collating secondary data sources and baseline data, and meeting with key informants in Lima, they travelled to Huancavelica where informants from government, NGOs, water infrastructure engineers and local communities were interviewed, where possible during joint visits to the field to stimulate discussions. Unless otherwise indicated, the statements quoted in this report were made between April 22nd and May 10th 2009.

Continuing to the lower part of the Ica basin, the research team was provided with generous access, visiting several large agro-export estates, medium and small farms and communities, and discussing the issues with a wide range of informants. These included farm managers and irrigation engineers; representatives of Water User Associations (Junta de Usuarios); community members; local researchers and academics; government officers and engineers from the water infrastructure and supply operators.

15 The methodology has been used effectively by the lead author and colleagues within both academic and consultancy assignments including for clients such as DFID, WWF and WaterAid.

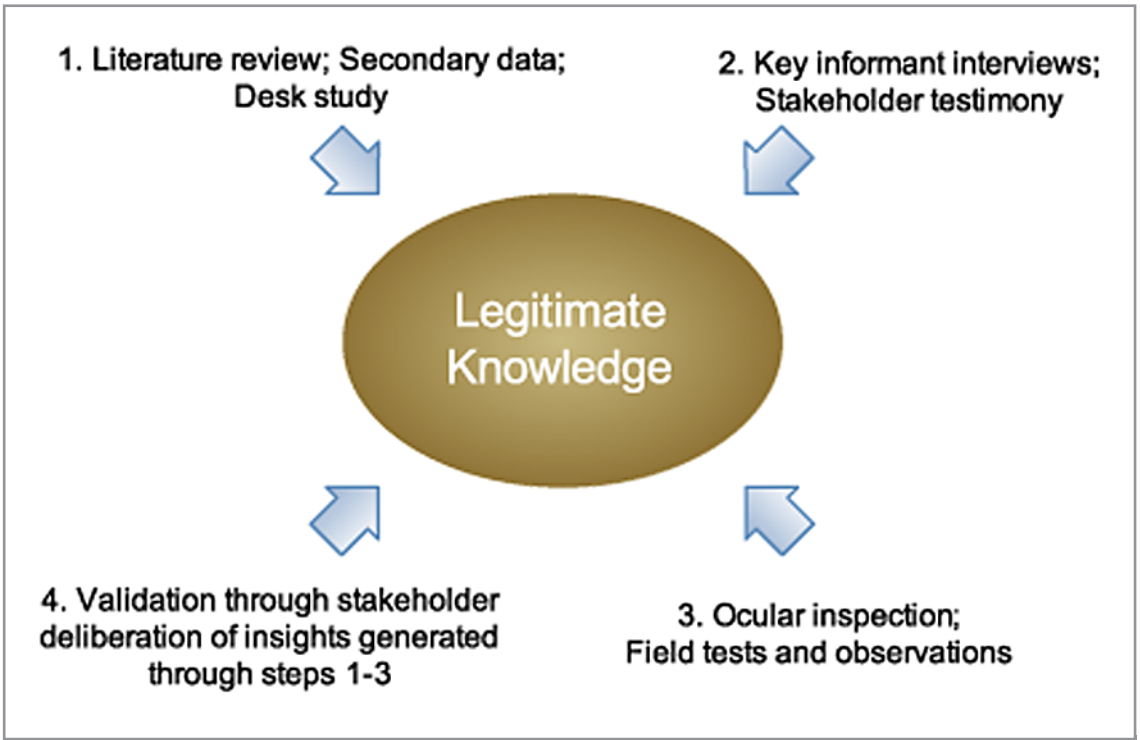


Figure 1 Interdisciplinary mixed methodology of triangulation and validation used by this research

Throughout the fieldwork, observations and samples were taken to cross-validate data from other sources. In total 52 key informant interviews were conducted which focused on experiences and perceptions of water use, environmental and social change, the nature of impacts, root causes of identified problems and the role of climate variability, and these were recorded through contemporaneous notes which were then read back and checked by the informant. In Ica and Huancavelica, communities facing water problems were actively sought out and an iterative and flexible research design helped to continually refocus on the most relevant issues and sources of data. Care was taken to cross-reference data sources in order to avoid prejudicing or favouring certain viewpoints and at the end of the research the results were presented at a stakeholder meeting in Lima to further check and confirm the validity of the findings. Such an approach has provided rich and grounded insights within limited time and resource constraints.

To support objectivity and technical accuracy and to avoid misrepresentation, this report has been further validated thorough external review, both within Peru and by international experts in water, corporate responsibility and sustainable development.

2 Understanding the context – Peru and water use in the asparagus industry

The economy of Peru has shown steady growth since the 1990s: GDP grew by 9.2 per cent in 2008, the 11th highest rate globally, and foreign exchange reserves are at record levels. This has been attributed to trade liberalisation policies, privatisation and market reforms started in the 1990s and continued by the current regime of President Alan García. These include the contested US-Peru Trade Promotion Agreement (PTPA) which further promotes free markets and foreign investment. Economic expansion has been fuelled in particular by foreign and domestic investment in manufacturing (15.6 per cent of GDP), agriculture (9.2 per cent of GDP), and the high mineral prices that have benefited the mining sector (5.8 per cent of GDP).[16]

However, this healthy macro-economic picture hides the startling level of wealth disparity and inequality which characterises Peru. 53 per cent of Peruvians live below the national poverty line and 25 per cent live in extreme poverty.[17] 24 per cent of under-fives are malnourished and this figure hasn't improved in 10 years. The UN gives Peru a score of 0.773 on their Human Development Index,[18] ranking the country 87th of 117 countries. Peru fares much worse in assessments of equality, coming 109th out of 126 countries based on the Gini Coefficient.[19] Although exports have provided substantial revenue and self-sustained growth, a more egalitarian distribution of income has proven elusive – with countries as disparate as Nigeria, India and Indonesia recording much more equal wealth distribution.

The socio-economic divides within Peru are drawn along fairly distinct cultural and geographical lines, between the coast's mestizo-Hispanic culture and the more diverse, traditional Andean cultures of the mountains and highlands. Most Peruvians are either Spanish-speaking mestizos – a term that usually refers to a mixture of indigenous and European/Caucasian – or Amerindians, largely Quechua-speaking indigenous people. Peruvians of European descent make up about 15 per cent of the population and have traditionally maintained a strong hold on economic and political power. With economic development, access to education, intermarriage, and large-scale migration from rural to urban areas, a more homogeneous national culture is developing, mainly along the relatively more prosperous coast.

Peru's natural environment is both a boon and a bane to its people. As one of the most biodiverse countries in the world, and with an abundance of natural resources such as gas, oil, metals and minerals, there are real opportunities for sustainable exploitation to benefit everyone. Historically however, the benefits of exploitation, for example of mining in the high Andes, whilst supporting national economic performance, have delivered few long term benefits for local populations. In addition, natural resource exploitation has exerted significant economic, environmental and social externalities because of ineffective regulation, short-term planning and resultant pollution of soils and water. Recurrent natural disasters bring national emergencies, widespread infrastructure damage, strife and death. Floods, hail and frost linked to El Nino events take their toll on a regular basis and as recently as 2007 an earthquake measuring 7.9 on the Richter scale levelled much of Ica and Huancavelica.

16 International Monetary Fund, Report on GDP of Peru, http://www.imf.org/external/pubs/ft/weo/2009/01/weodata/weorept.aspx?sy=2006&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=293&s=NGDPD%2CNGDPDPC%2CPPPGDP%2CPPPPC%2CLP&grp=0&a=&pr.x=59&pr.y=9 Peru accessed 9 July 2010.

17 World Food Programme Website, http://www.wfp.org/countries/peru accessed 9 July 2010.

18 The HDI (2008) combines normalised measures of life expectancy, literacy, educational attainment, and GDP per capita. It is claimed as a standard means of measuring human development - a concept that, according to the United Nations Development Program (UNDP), refers to the process of widening the options of persons, giving them greater opportunities for education, health care, income, employment, etc. The basic use of HDI is to measure a country's or an area's development.

19 The Gini coefficient is a measure of statistical dispersion most prominently used as a measure of inequality of income distribution or inequality of wealth distribution. It is defined as a ratio with values between 0 and 1: a low Gini coefficient indicates more equal income or wealth distribution, while a high Gini coefficient indicates more unequal distribution. 0 corresponds to perfect equality (everyone having exactly the same income) and 1 corresponds to perfect inequality (where one person has all the income, while everyone else has zero income). Worldwide, Gini coefficients range from approximately 0.232 in Denmark to 0.707 in Namibia.

70 per cent of Peru's population of 28.7 million people live along the dry Pacific coastal strip, west of the Andes watershed. This area receives only 1.8 per cent of the country's rainfall, the vast majority of which falls to the east of the Andes and flows to the Atlantic Ocean through the Amazon basin. In the past, management and regulation of Peru's water resources has been the responsibility of the Ministry of Agriculture who devolved much of this responsibility to farmers themselves through a system of water user boards known as Junta de Usuarios, who oversee and administer water allocation for irrigation. Under these institutional arrangements the water user boards tended not to consider the limits of availability or the needs of other sectoral users. As a result agricultural interests have been heavily favoured, the resource over-allocated and legitimacy eroded with de facto open access and free water for those who can afford the pumps and fuel to obtain it. These problems and the urgency of current reforms are brought into stark focus by this research and are covered in detail in Sections 3 and 5 of this report.

Historical developments in land use policy also provide an important contextual backdrop. Under the military government of the 1960s, a programme of agrarian reform was started based around land redistribution to campesinos or peasant farmers. Political changes since then, however, have tended to promote large agribusiness to meet the needs of urban food consumers and export markets. This model has re-concentrated land ownership along the coast into a few economic groups, fostered their link to international markets, and promoted food importation and trade to meet Peru's needs. Smaller scale agrarian production, particularly in the Andes, has been displaced by imported, subsidised food, and at the same time has lost technical assistance and credit support from the government.

These changes and the policies driving them are counteracting the agrarian reform of 45 years ago and increasing the gap between modern agriculture in the coastal valleys and the farming systems in the Andes. Partially in response to this, but also linked to political unrest in the mountains in the 1980s and 1990s, there has been a huge influx of people from the Andes to the coastal strip, and indigenous migrants now provide the labour needed by the booming agricultural export industry.

Fresh asparagus has been at the forefront of the investment boom in high value export crop production along the dry coastal belt of Peru. These crops – asparagus, artichoke, chillies, paprika, avocado, legumes, and fruit such as grapes, tangerines and pomegranates – have displaced cotton as the primary crop along the coast. Peru's asparagus industry has boomed in the past ten years and now dominates world trade in fresh asparagus.[20] The sector is dominated by medium to large operators who both produce and export. Most of the producers see asparagus as a way to diversify their investment portfolio rather than as a livelihood strategy.[21] The rapid expansion of the agrarian frontier in Ica to grow asparagus has been fuelled by a set of coincidental factors. Agricultural manual labour costs in Peru are some of the cheapest in South America, half of that in Brazil, Columbia, Mexico and Chile. Farm labour in Ica costs about US$7 per day, whilst in the USA it costs US$7 per hour.[22] Consistent sunlight, suitable sandy soils and availability of manure to condition it, and until recently, cheap water provide conducive growing conditions. It is estimated that users have been paying US$0.01 per m^3 of water in Ica compared to US$0.2 in Colombia and US$0.78 in parts of the USA.[23] Investment in cold storage and convenient access to air freight facilities in Lima, favourable legislation relaxing labour conditions and providing significant tax breaks for agricultural investments,[24] and favourable international trade agreements have also attracted huge levels of investment in the sector by those eager to see the rapid and high returns from asparagus.

20 Shimizu, T (2006) Expansion of asparagus production and exports in Peru, Institute of Developing Economies, Japan.

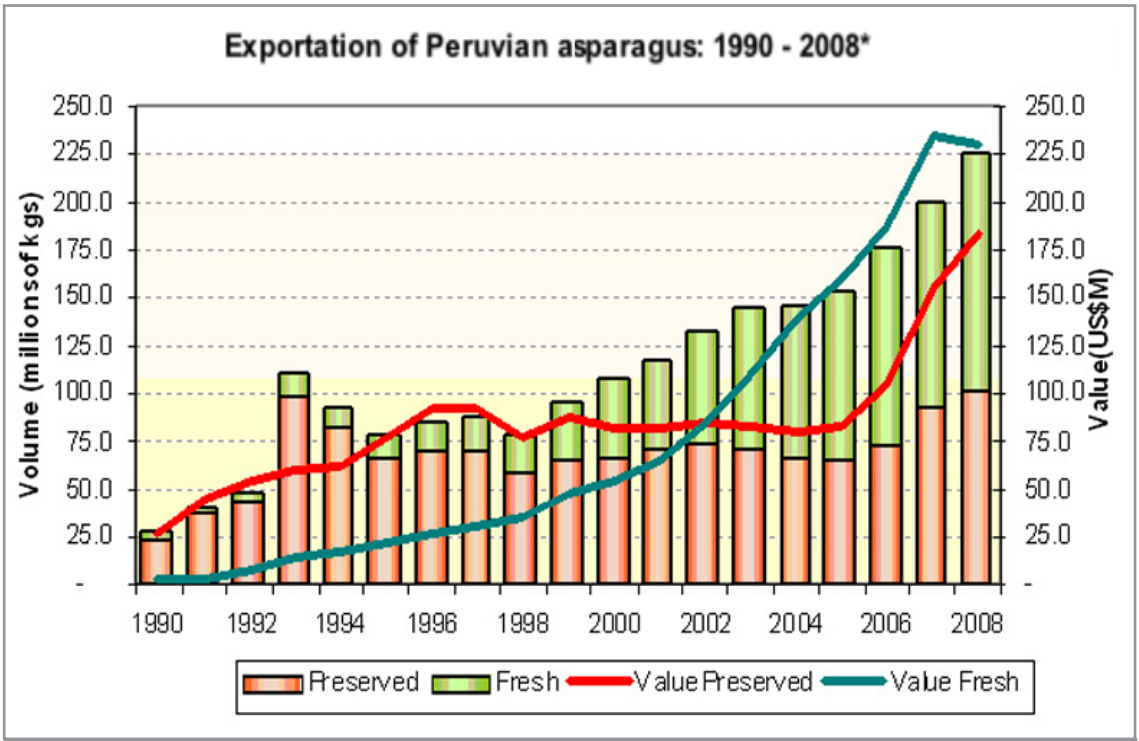
21 OECD (2007) Market access and private standards: case study of the Peruvian fruit and vegetable markets, Directorate for Food, Agriculture and Fisheries, Committee for Agriculture, Working Party on Agricultural Policies and Markets, AGR/CA/APM(2006)23/FINAL, http://www.oecd.org/officialdocuments/displaydocumentpdf/ accessed 9 July 2010.

22 MINAG, cited in Rendón, E (2009) The water footprint of the Ica Valley, PhD doctoral thesis, Universidad San Ignacio de Loyola, Peru.

23 Rendón, E, as above.

24 The 1990 Law for Agricultural Promotion was initially to be in force until only 2010, but has been extended until 2021 and grants labour and tax advantages to agro-exporters. For example agro-export activities outside Lima pay 50 per cent less income tax.

Figure 2 illustrates the phenomenal increase in fresh asparagus production which has grown from negligible levels in 1990 to make a major contribution to the national and regional economy.[25] Asparagus is the second most important agricultural export from Peru after coffee and Peru is now the largest exporter of fresh asparagus and the second largest exporter of preserved asparagus in the world.[26] The fresh asparagus trade now generates over US$230 million per year in export revenue for Peru, and, together with preserved asparagus, generates over US$450 million per year.[27] Almost all of this expansion of Peru's fresh asparagus crop has been seen in the Ica Valley some 300 km south of Lima, which now grows 95 per cent of all Peruvian asparagus. The area under fresh asparagus in Ica has grown from four hectares in 1986 to 9,610 hectares (almost 100 square kilometres) in 2009.[28]



↗ Figure 2 Annual value and volume of fresh and preserved asparagus exported from Peru 1990-2008 (Source: MINAG-DGIA)

The growth of the fresh asparagus trade has contributed to Ica's track record of virtually zero unemployment.[29] Figures collected in 2005 suggested that 40 per cent of the EAP of Ica work for the agro-export business with 10,000 new jobs created by the agricultural export boom in Ica between 1998 and 2005.[30] Opinions diverge about the value of this employment for the well-being of poor families. Some informants spoke of the huge benefits brought by an effective increase in average daily salary from US$1 to US$10 dollars a day in just 15 years.[31] Other sources maintain that the majority of agricultural workers still live below the poverty threshold and that the employment on offer fails to meet the criteria which the International Labour Organisation

25 In 2008 however, as suggested by the dip in fresh asparagus value in figure 2, there was a slight decline in demand for asparagus, thought to be linked to the global economic crisis. Some farmers are looking for alternative crops.

26 Shimizu T (2009) Structural changes in asparagus production and exports from Peru', Institute of Developing Economies discussion paper 201, May 2009, Institute of Developing Economies, Japan.

27 Figures from Aduanas (Customs), Agro-CEPES 2008.

28 Rendón, E, as note 22.

29 INEI 2007 cited in Rendón, E, as note 22.

30 Chacaltana J (2007) Desafiando el desierto: realidad y perspectivas del empleo en Ica, Centro de Estudios para el Desarrollo y la Participación (CEDEP).

31 Personal communication, agro-exporter representative, May 2009. This assessment correlates reasonably with a study by Chacaltana 2007, which looked at labour conditions in Ica and found daily salaries to range from US$4.7-$17.

has developed to define decent work.[32] For example 70 per cent of Ica's EAP are on temporary contracts.[33] However, even if the growth in Ica's agricultural production has brought social and economic benefits, there is a risk that these may be short lived because they are based on unsustainable exploitation of water resources.

Ica is one of the few places in the world where high quality asparagus can be produced year round, due to warm temperatures and almost no rain, which prevents the asparagus plant from becoming dormant.[34] Optimum soil conditions are obtained by conditioning the sandy surface of the desert with manures and irrigating with water pumped from boreholes. Irrigation is delivered using relatively efficient computer operated drip irrigation technology. As our research shows, the sheer scale of the enterprise means that even this apparent 'best practice' is rapidly depleting the aquifer of Ica and the linked and neighbouring aquifer of Villacuri.

With minimal domestic demand for asparagus, 99 per cent of Peru's produce is destined for export.[35] By value, the UK is the third largest importer of fresh Peruvian asparagus, behind the USA and the Netherlands.[36] This trade with the UK, at 6.5 million kilograms per year, represents 9 per cent of Peruvian exports, and is worth approximately US$20 million per year to Peru.[36] Some of this is sold directly to supermarkets with the rest channelled through brokers and agents.[37]

The UK produces its own small asparagus crop and the WWF research on footprinting reveals that this domestic crop exerts a water demand of 3 million cubic metres, or 1,200 swimming pools of water per year.[38] But this British asparagus production is limited to late spring and early summer, and has increasingly been supplemented by imports from countries where it can be grown all year, such as Peru. According to the FAO, the total volume of all asparagus imported into the UK increased from 2,442 tonnes in 1986 to 16,068 tonnes in 2005. During the same time the volume of Peruvian imports grew from virtually zero to represent the majority of imports.[39] The virtual water embedded in the UK's asparagus imports represent 9 million cubic metres per year, 3 times that of domestic production.[40] That is a water footprint equating to about 3,600 Olympic swimming pools of water each year, the majority of which is used in the Ica region of Peru. Yet Ica is one of the driest places on earth, with some parts of the valley receiving on average as little as 0.6 millimetres per year.[40] By contrast the mean rainfall of the UK is 1,126 millimetres a year,[41] nearly 2,000 times that of Ica.

The volumes of virtual water being exported from Peru to various countries through the booming fresh asparagus trade are illustrated in Figure 3.[42] The USA is by far the largest consumer, importing 105 million cubic metres of water or 42,000 Olympic swimming pools through the virtual water content of Ica's asparagus in 2008. These figures are based on an average of actual crop water requirements for growing asparagus provided by farmers in Ica (1.17 m^3 of water per kg of asparagus – see Appendix 1) which tallies well with earlier calculations of the water footprint of asparagus.

32 Maldanado 2005 cited by Rendón, E, as note 22.

33 MTPE cited by Rendón, E, as note 22.

34 Global Agricultural Information Network (2009) 'Peru: Annual asparagus report', GAIN Report, USDA Foreign Agricultural Service.

35 Díaz Rios, L (2007) 'Agro-industries characterization and appraisal: asparagus in Peru', Agricultural Management, Marketing and Finance Working Document 23, FAO, Rome.

36 MINAG 2008.

37 This information was provided by an agricultural broker in Lima and triangulated by information provided by the managing directors or other senior staff of agro-export companies.

38 Chapagain A, and Orr, S (2008), as note 8.

39 FAOSTAT, TradeSTAT (2008) 'Detailed world agricultural trade flows', FAO. http://faostat.fao.org/DesktopModules/Faostat/WATFDetailed2/watf.aspx?PageID=536 accessed 9 July 2010.

40 Mean rainfall at Pampa de Villacuri 1964-2008. Data obtained from SENAMHI.

41 Met Office website, www.metoffice.gov.uk/ as accessed 25 June 2009.

42 Data from Aduanas 2008 via CEPES.

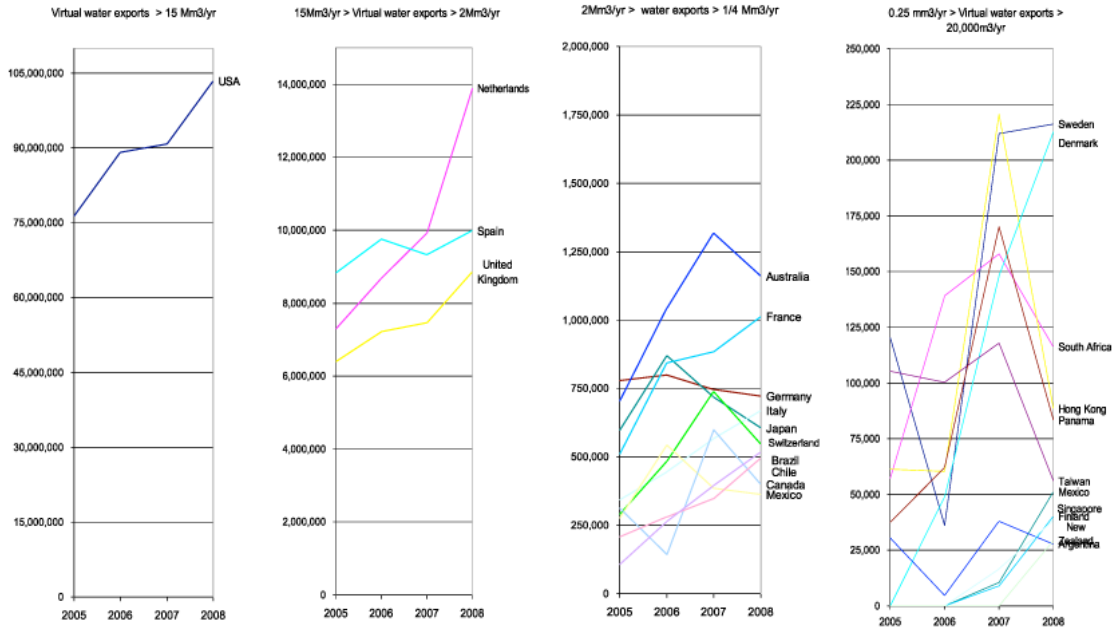
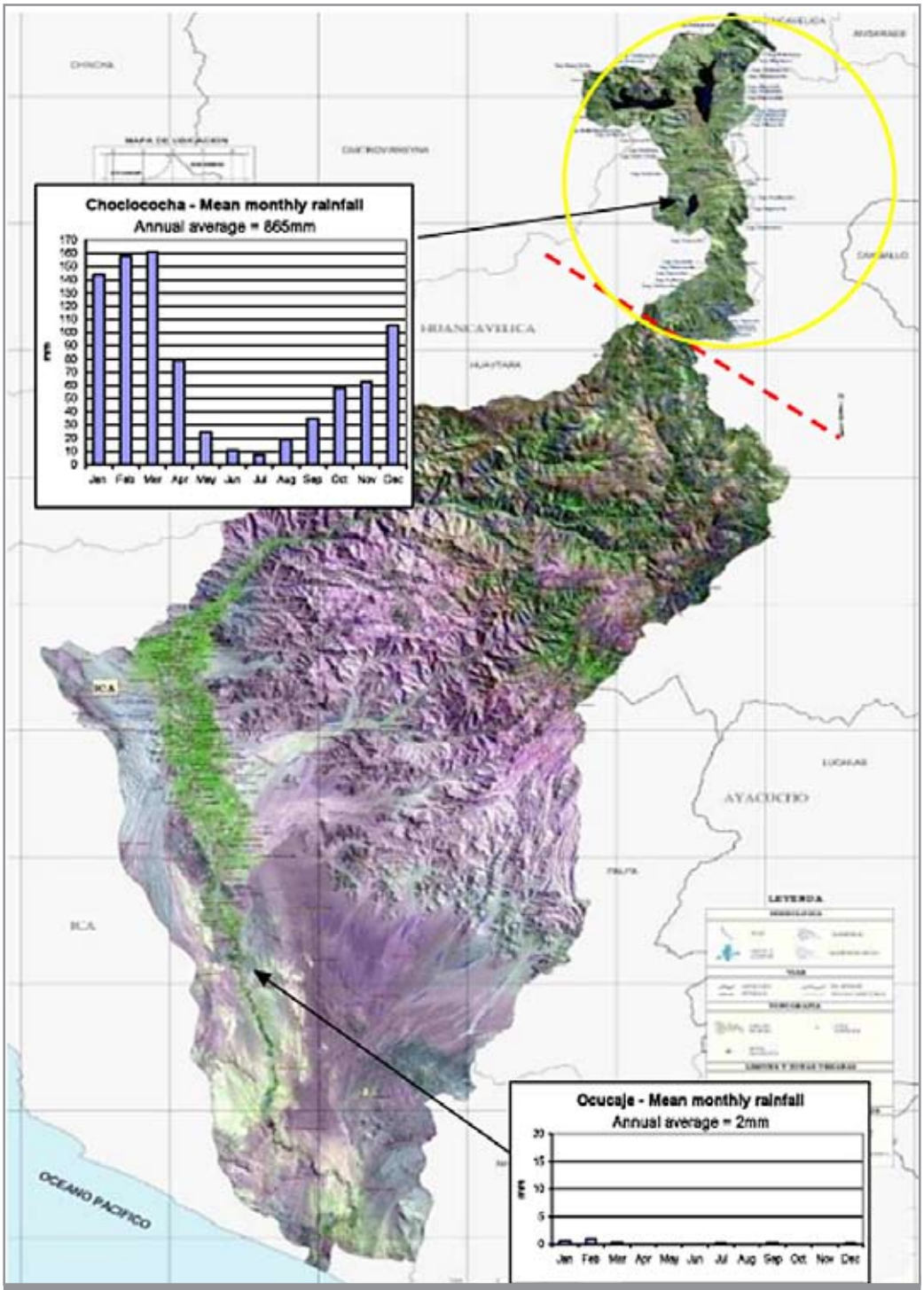


Figure 3 Where does the virtual water embedded in Peru's asparagus end up? The four charts above show the estimated annual volumes of virtual water exported to recipient countries via fresh Peruvian asparagus from 2005 to 2008. (Source: Aduanas/ CEPES 2008)

The growing demand for asparagus has inevitably led to increased water usage. Calculations based on figures from Peru's Ministry of Agriculture and from farmers in Ica suggest that the asparagus crop grown for export in Ica more than doubled between 2002 and 2008 – requiring 147 million cubic metres, the equivalent of nearly 60,000 Olympic swimming pools of irrigation water per year.

So what are the social and environmental consequences for the wider basin and its one million inhabitants of using this water to grow asparagus in the desert? Before exploring this question in more detail the research locations are described in order to situate the study and provide some contextual understanding. The study area of the Ica-High Pampas basin, illustrated in Map 2, spans the two very different 'departments' of Ica and Huancavelica. Some key social and environmental statistics are provided in Table 1 to highlight the marked differences between these two areas and these are then elaborated below.



Map 2 The Ica-High Pampas River Basin of Peru showing mean monthly rainfall totals in the Lower and Upper Basins. Note the High Pampas (indicated by the yellow circle) falls naturally to the Amazon (the dotted red line indicates the watershed between the Ica and High Pampas catchments) but the PETACC transfer channel artificially extends the Ica Basin into the coloured area shown and diverts this water into Ica Valley.

	Huancavelica	Ica	Peru
Population	454,797	711,932	28,700,000
% Urban	32%	89%	75%
% Rural	68%	11%	25%
Human Development Index	0.49 (lowest in Peru)	0.65 (14th in the country)	0.77
Life expectancy	62	73	71
% Literacy	78%	97%	85%
Average monthly income (US$)	$49 (lowest in Peru)	$ 149	$250
GDP per capita / year	$1014	$1855	$3810
% Children <36mths suffering diarrhoeal disease (2007)**	21 %	17 %	20%
Typical annual rainfall***	865 mm	<1 mm	1738 mm
Landscape type	High altitude plateaus of grasslands, wetlands, and lakes (altiplanos)	Hyper-arid desert	Variable
Sources of GDP*	Electricity and power (41%) Mining (12%) Agriculture (11%)	Manufacturing(23%) Agriculture (19%) Commerce (13%)	Manufacturing (17%) Commerce (16%) Agriculture (9%) Mining (7%)

* Instituto Nacional de Estadística e Informática-Dirección Nacional de Cuentas Nacionales 2006

**INEI – National Statistics Office 2007

*** Mean rainfall at Choclococha 1958-2008; at Pampa de Villacuri 1964-2008; FAO Data

Other data UNDP 2007

Table 1 Selected social and environmental indicators for Ica, Huancavelica and Peru

2.1 Huancavelica

Huancavelica is the poorest region in Peru, with 86 per cent of the population living below the poverty line, and has been left behind by the economic and social development seen in some other parts of Peru.[43] Much of the region lies above 4,000 metres where pastoralism is the primary livelihood activity alongside work in government power installations and privately owned mines. Huancavelica's largely indigenous, Quechua speaking rural campesino communities survive raising mixed herds composed of alpaca (Glama paco), llama (Glama llama) and sheep, for fibre and sometimes meat. They barter animal products for agricultural and other produce, and sell their labour force as seasonal workers. Transport is largely by foot and trade often requires several days of travelling. The mobility pattern required to support grazing considers the makeup of the flock, the season (rainy or dry), and the number and location of pasturelands available to each household. The land tenure system is characterised by the common property of grassland, mainly located on poor soils and dependent on rain and wetland systems, and household usufructary rights (the right to use property that belongs to someone else). A relatively dry season occurs between April and November with a rainy season usually from around late November to March. Livestock and access to pasture and wetlands are key elements in the livelihoods and productive systems for communities in these uplands.

43 Salazar, M, as note 14.

Huancavelica and Ica are intrinsically linked through the Ica Valley's demand for water. The Ica basin was in effect artificially extended by 392 square kilometres[44] in 1958 through the construction of a cut off drain in the High Pampas river basin to divert water draining to the Amazon basin through the Andes watershed into the Ica River. Since then the Tambo-Ccaracocha / PETACC (Proyecto Especial Tambo Ccaracocha) channel has brought runoff from the Pampas catchment including outflows from the large lakes of Choclococha, Orcococha and Ccaracocha into the headwaters of the Ica River via a system of channels and tunnels. Originally constructed to support irrigation of cotton around Ica, the transfer now provides a critical source of irrigation water for small to medium sized farmers in the Ica Valley. This transfer cuts through and takes water from the district of Pilpichaca which has 3,743 inhabitants across five campesino or peasant communities: Carhuancho, Choclococha, Santa Ines, Llillinta and Pilpichaca. With elevations ranging from 3,800 to 5,200 m this section of the Peruvian highlands is part of the Central Andean puna, or wet puna, with tropical alpine vegetation. Most of the lands are covered by puna grassland, native pastures comprising Calamagrostis rigecens, Festuca dolichophylla, Stipa ichu grass species and wetlands often dominated by mosaics of cushion plants. These water dominated vegetation patterns play an important role in the livelihoods of pastoralists in the mountains because grass species making up 'cushion growth' at the edges of wetlands are favoured by grazing alpaca. The topography is of a highland plateau interspersed with large lakes between higher ranges, some of which were identified by local people as once having permanent snow cover. Snow cover is now only seasonal and local people associate this change with global warming.

The area is rich in metal and mineral deposits, notably silver, zinc, and copper, and there are several active and closed mines, some of which have been associated with chronic water pollution problems. Informal trout fishing in lakes and rivers, and small-scale fish farming contributes to local livelihood strategies and dietary needs. More recently, large-scale trout farming in the highland lakes has been pursued as a business enterprise by both local people and larger-scale investors.

2.2 Ica

After rising in the mountains of Huancavelica the Ica River flows to the valley floor where it passes through the city of Ica on its way to the Pacific. The name Ica is said to be derived from the Quechua word for 'the place of abundant springs'. The Ica aquifer which provided Ica with these springs is connected to the Villacuri aquifer to the north and both are fed by drainage from the Andes. Effective rainfall in the lowlands is minimal and the valley is classed as hyper-arid, an extension of the Northern Atacama desert.

The Ica Valley runs from north-east to south-west and has long been a focus for agricultural activity. As long as 540 years ago, in pre-Hispanic times, an irrigation channel known as La Achirana was constructed to maximise the irrigation potential of the river. This surface water is used by small and medium sized farms, primarily for flood and gravity irrigation and is controlled by the Junta de Usuarios. These associations allocate surface water, collect revenue from users and use this to maintain irrigation infrastructure. There are two Junta de Usuarios in the valley, La Achirana and Ica River. The former has around 2,654 members, irrigates 12,561 hectares and works year round, whereas the Ica River Junta has 3,525 members, irrigates 19,339 hectares and is operational for seven months per year. Farmers served by both of these organisations benefit from the aforementioned PETACC Tambo-Choclococha transfer scheme which has seasonally supplemented flows since the 1950s by diverting water from the Pampas into the upper Ica River. These surface water supplies for small and medium sized farms have also been supplemented by pumping from groundwater during the driest parts of the year. Even though groundwater use has been unregulated in the past, the costs of pumping it from underground have meant that surface water has been preferred – groundwater costs between 6-14 times as much as surface water because of the fuel required to drive the pumps.[45]

44 Personal communication, PETACC engineer, 4 May 2009.

45 Rendón, E, as note 22.

Plate 1 (left) Typical Huancavelica landscape with alpaca grazing on wet puna with mineral rich rock exposed above a campesino/ alpaquero village.
Plate 2 (right) The Ica Valley from the air showing smallholdings alongside industrial-scale cropping with the channel of the ephemeral Ica River and dune formations in the desert beyond.

In the past 40 years Ica has experienced major transformations. The agrarian reforms of 1969 redistributed the lands of estates larger than 150 hectares in order to form cooperatives of ex-hacienda workers, leaving only small and medium sized farms in the valley.[46] Under these reforms cooperatives benefited from access to and control of water sources, new irrigation infrastructure, and cash cropping. Small and medium sized farms needed groundwater, wells, and export crops to fit in the valley's new agrarian structure. By the end of the 1980s there were only three cooperatives still working – all the rest had split into small parcels and associations formed around water wells. Cotton has always been a significant crop for the valley's farmers and prevailed as its main output until the asparagus boom. Cotton production has not been without its own environmental impacts, and man-made drought through overexploitation of the aquifer has caused problems in the valley in the past. In the 1960s there were as many as 1,750 wells in the valley compared to the estimated 800-900 working today.

In the 1990s neoliberal reforms swept the region, reducing the role of governments, fostering private investment and emphasising the market economy. Cotton was still the most important crop – 3,500 hectares were devoted to cotton in 1998 – but drought, inaccessibility of credit, and low international prices caused many small and medium sized cotton producers to sell or lease their lands to agro-exporters for the production of asparagus and tomatoes, which both had healthy international prices. The El Niño event of 1998 forced more small and medium sized farmers to sell their lands to repay debt, and crop prices fell further, conspiring against a recovery in cotton. In this

46 At the national level, agrarian reform abolished feudal relations and brought an end to the regime of haciendas (large land estates owned by individuals or corporations). Haciendas used tenant farm labour to conduct extensive agriculture and livestock husbandry within the estate. Under this feudal system, much of the rural farmland in Peru was controlled by a few powerful landlords.

context, investors in the new agro-export crops could enlarge their property by buying or leasing land and groundwater sources from bankrupt or debt ridden small and medium sized farmers. Land for agro-export production has also been extended by expanding the agrarian frontier: cultivation of the desert. Plates 3-8 bring to life what this 'greening of the desert' looks like.

The agro-export 'boom' contributes to near zero unemployment in Ica, and has attracted migrants from the neighbouring less well-off provinces of Huancavelica and Ayacucho. Agro-export operations require high tech drip irrigation, intensive labour and capital, bring a less diverse crop system, and concentrate land, capital, knowledge and power. With this transition, social change has intensified, with former owners, peasants, herders and independent growers becoming part of the work force and/or suppliers to agro-exporters. This recruitment of a labour force from the high Andean communities jeopardises the social reproduction of those largely indigenous communities and weakens their social organisation. Thus, Ica's agro-export 'boom' is not only transforming the environment by greening the desert, but is transforming Peru's social landscapes.

Small and medium sized farmers continue to operate in the Ica Valley growing cotton, lima beans, fruit and vegetables, nuts and grapes for wine and Pisco. These activities are supplemented by manufacturing and commerce in Ica. Table 2 summarises key characteristics of small and medium sized farmers and agro-export businesses.

	Agro-export farms	**Small to medium size farms**
Typical size	300 – 1500 hectares	< 1 – 100 hectares
Number of farms / water users	29	12 500 (Junta La Achirana) 9877 (Junta Rio Ica)
Crops	Asparagus; artichoke; avocado; grapes; sugar snap peas; pomegranates; jalapeños; mandarins; pimento; roses; tomatoes; melon	Grapes for Pisco; corn; cotton; asparagus; fruit; Lima bean; sweet potato; papaya
Markets	Supermarkets; brokers	Agro-exporters (as out growers); Local markets; Subsistence
Water source	Groundwater only	Surface water (flow from Ica River, supplemented by Pampas transfer and channelled through canals) Groundwater in dry season
Irrigation tech	Drip / pulse	Gravity / Flood (poza)
Water management	Represented by CRASVI - ostensibly regulated by ALA	Water turns decided and regulated by Juntas
Water fees	Own pumping costs only	0.033 m^3 per NS Surface water 0.4 m^3 per NS for groundwater
Profit	?	US$ 0 - 1000 per hectare
Full time employees / workers per hectare	1-2	0.4 -1.5
Water demand	Asparagus 16 000 m^3//ha/yr * Asparagus 30 000 m^3//ha/yr **	Cotton 11 000 m^3/ha/yr * Cotton 14 000 m^3/ha/yr**

Source: ENDES 2008

*data provided by Farmers

**Water Footprint calculated by Eric Rendon 2009

CRASVI – Commission of Groundwater Users of Ica Valley

↗ Table 2 Comparison of the characteristics of agro-export and small to medium sized farms in the Ica Valley

Plates 3-8

3 Ongoing expansion of the agrarian frontier for asparagus in Ica – the land to the left is under preparation through mixing desert sands with compost such as chicken manure.

4 The agro-export industry employs over 20,000 people in the valley under generally good labour conditions, largely due to the pressure brought by markets.

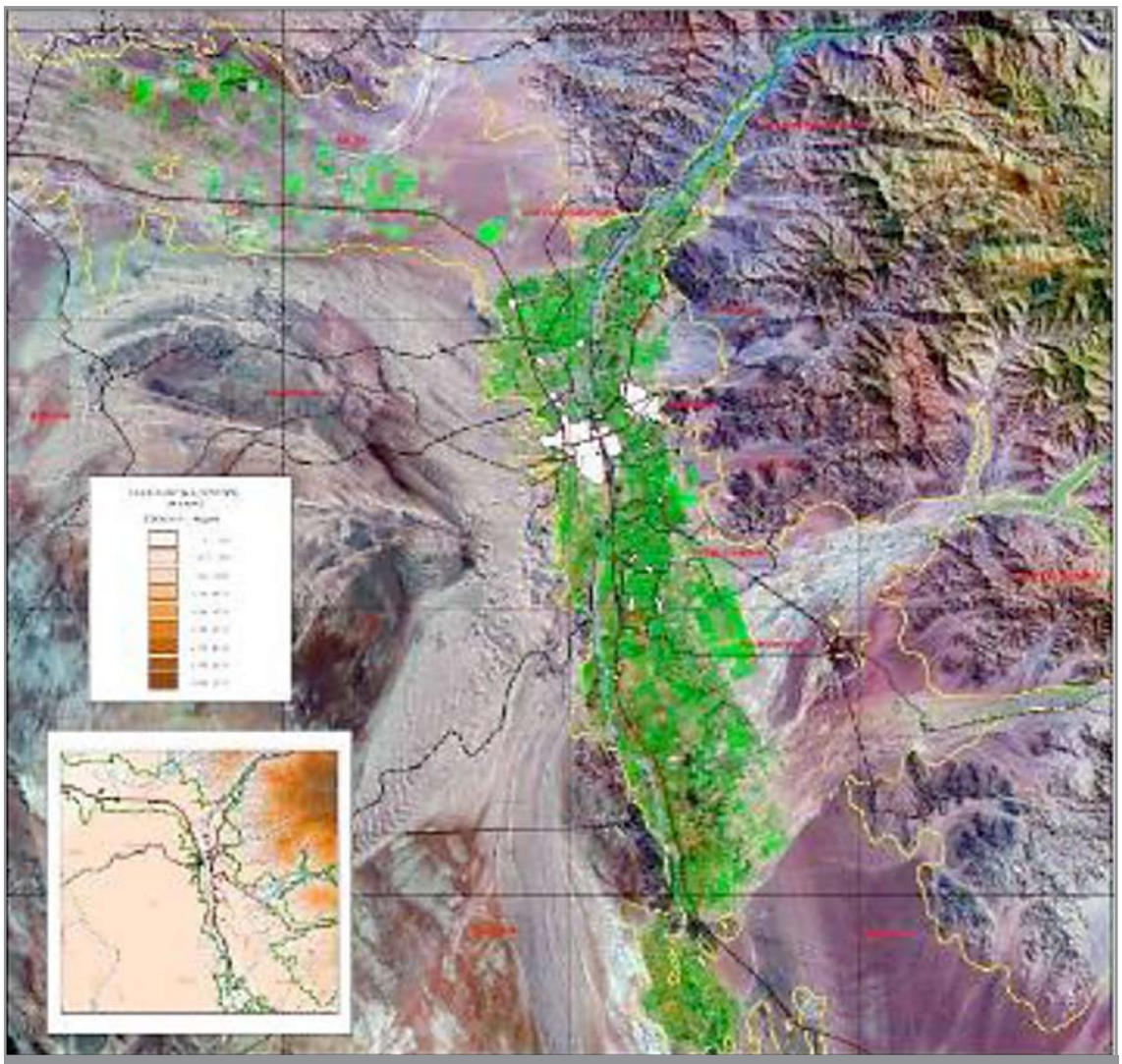
5 The asparagus crop has relatively high water demands, delivered through cosmputer controlled networks of pipes and drip irrigation.

6 Agro-export crops such as asparagus compete for land and water with more traditional farming techniques and crops such as these grapes, which generally require less water.

7 The edge of the agrarian frontier, showing asparagus crops on the left and desert on the right of the hedge and covered water canal. (Photo: Petra Kjell/Progressio)

8 The same 10 km boundary of the agrarian frontier in Ica from the air. In 2002 this area was desert.

Figure 4 is a modified satellite image of the Ica Valley showing the connected area of Villacuri to the north-west. Urban settlements are shown in white with Ica city prominent and cropped areas in green. The Ica River trends north-easterly through the mountains turning southwards once the river reaches the valley floor. Expansion of the agrarian frontier – the greening of the desert – can be seen clearly as the rectangular green blocks along the edges of the Ica Valley and in Villacuri.



↗ **Figure 4 Satellite image of the lower Ica Valley (Source: ATDR (now called ALA) Ica 2005)**

It is important to make a distinction between the nature of the water resource in the lower Ica Valley compared to the neighboring 'Pampa' Villacuri. In the latter, most of the available groundwater represents non-renewable aquifer reserves (recharged in previous episodes of wetter climate) with only a modest subsurface inflow from the Ica Valley and possibly a very occasional recharge from any flash flood flows (very rare events). Thus sustainable extensive large-scale groundwater irrigation in this area is dependent upon successful transfers of surface water from elsewhere as artificial recharge. The alternative is progressive depletion of this aquifer and this may not be all that orderly since the aquifer is threatened by patchy up-coning (upward encroachment) of saline water from below which could further reduce its useful life. The lower Ica Valley however has an alluvial aquifer which receives most of its recharge directly or indirectly from the Ica River. It has large freshwater storage potential to buffer drought impacts, which permits some

adaptation to climate and economic change. Whilst riverbed recharge is significant, irrigation water distribution and field practices are also very significant sources of aquifer recharge. Traditionally spate irrigation was widely practised in the valley whereby farmers flooded the fields from avenida (flood) riverflows to recharge aquifers and deposit sediment to improve soils. The big change with the arrival of more intensive agricultural practices – which are much more water productive in terms of US$ per m^3/ha – has been the replacement of these practices by drip irrigation and liquid fertilisation with a consequential reduction in recharge. Groundwater use in the lower Ica Valley is therefore vulnerable to significant flow reductions caused by upstream diversion or consumptive use and the basis for sustainable management must be careful use of the mean aquifer storage balanced between high and low riverflow recharge years.[47]

47 Personal communication, S Foster, 8 April 2010.

3 The social and environmental impacts of water use by the asparagus industry

Over the past ten years Ica has seen a rapid expansion of the agrarian frontier into what was once desert. This has been led by a relatively small number of agro-export enterprises growing high value crops, primarily asparagus, for the export market. The acquisition of boreholes and increased pumping of groundwater from the Ica-Villacuri aquifer to supply the irrigation needs of these enterprises have collectively pushed the water balance of the Ica basin into an unsustainable state in a remarkably short period. A recent report for the World Bank by some of the world's leading experts on groundwater management paints a stark picture.[48] It concludes that:

- cultivation of the desert caused aquifer exploitation to double between 2002 and 2007
- the exploitable groundwater reserve is 252.29 Mm^3/year
- the volume of exploited groundwater in 2004 was 315.84 Mm^3/year
- the over exploitation in 2004 was 63.55 Mm^3/year
- the tendency of the water table is descent by as much as 8-10 metres each year in some parts of the aquifer
- the aquifer system's status is one of 'negative disequilibrium' – 'overexploited'.

Based on these figures and the rate of change quoted by this study, and given the ongoing expansion of cultivation in the valley, it is estimated that the demand for groundwater may have grown to as much as 496 Mm^3 in 2008. Based on the annual exploitable reserve provided by recharge, as given in the World Bank study, the overdraft on Ica's aquifer could now be as much as 244 Mm^3 each year.[49] Figure 5 represents the effect of this change on the sustainability of the Ica-Villacuri aquifer.

The World Bank study report makes it very clear that having a total annual extraction from the aquifer in excess of the recharge is "obviously not a sustainable scenario". It is acknowledged that the aquifer of the Ica Valley-Villacuri area suffers from significant overexploitation because of over-abstraction of groundwater by agro-exporters, even by the agro-exporters themselves.[50] Figure 6 illustrates the relationship between the growth in asparagus production and groundwater levels in Ica, based on production figures obtained from the Ministry of Agriculture and on groundwater levels provided by the Autoridad Nacional del Agua (ANA, the National Water Authority). Although time series of groundwater data is limited to 1997 onwards, the available data suggest that sustainable asparagus production and water abstraction levels were exceeded sometime in 2002, which correlates with the findings of the World Bank study.

Although the overexploitation of the Ica-Villacuri aquifer is not in doubt, figures of the total volume of water stored, recharged and abstracted vary depending on the source. The figures quoted by the World Bank are drawn from the work of a multi-sectoral technical commission established by the Peruvian government in 2004 to examine groundwater use,[51] however significantly different assessments are available from other credible sources. For example a study conducted in 1962 by Tagal, referred to as the 'bible' of Ica's hydro-geology, assessed the sustainably exploitable reserve as only 50 Mm^3/yr.[52] Elsewhere, the annual 'overdraft' of the aquifer, or the amount by which demand exceeds supply, is assessed as:

48 Foster, S, Garduño, H, and Vidal, A (2008) Formulación de estrategias y programas para la gestión de los recursos hídricos subterráneos con énfasis en los valles costeros del Perú, Informe de Misión (Lima, Ica, Lambayeque, 17 a 27 de noviembre de 2008) (Formulating strategies and programmes for management of groundwater resources in the coastal valleys of Peru, World Bank Mission Report, 17-27 November 2008), GW-MATE, World Bank Global Water Partnership Associate Programme, World Bank, Washington DC.

49 See Appendix 2 for calculations.

50 All the large farmers we spoke to acknowledged the problem.

51 Government of Peru (2004) Comisión Técnica Multisectorial (Ministerios de Agricultura, Defensa, Economía y Finanzas, Energía y Minas, Vivienda, Construcción y Saneamiento, Salud y Producción), Estrategia nacional para la gestión de los recursos hídricos continentales del Perú", diciembre de 2004 (en proceso de aprobación oficial) (Multisectoral Technical Commission (Ministries of Agriculture, Defence, Economy and Finance, Energy and Mining, Housing, Construction and Sanitation, Health and Production), National strategy for the management of Peru's continental water resources, December 2004. (In the process of official approval).

52 Tagal, 1960s (date and full reference unknown). Figures based on personal communication, Director of ALA Villacuri, 5 May 2009.

50 to 80 Mm³/yr - according to the board of groundwater users in Ica
155 Mm³/yr - according to the Director of the Autoridad Local del Agua (Local Water Authority or ALA) in Villacuri
200 Mm³/yr - according to the board of surface water users in Ica and a senior representative of one agro-export company
244 Mm³/yr - based on extrapolation of figures provided in World Bank report
(see Appendix 2 for calculations).

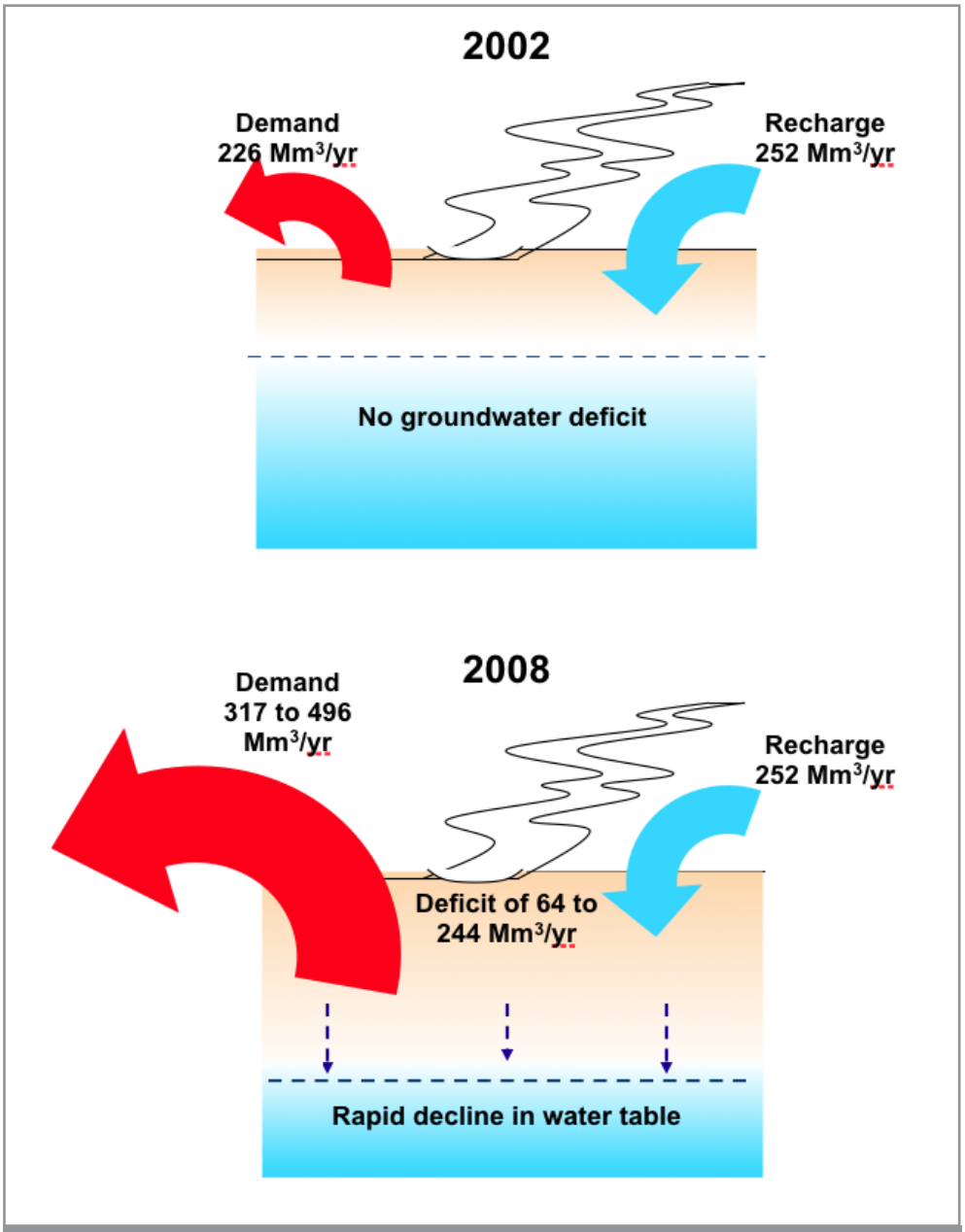


Figure 5 The effect of doubling groundwater exploitation from 2002 to 2007 on the water balance of the Ica-Villacuri aquifer (based on extrapolation of figures provided by the World Bank, 2008)

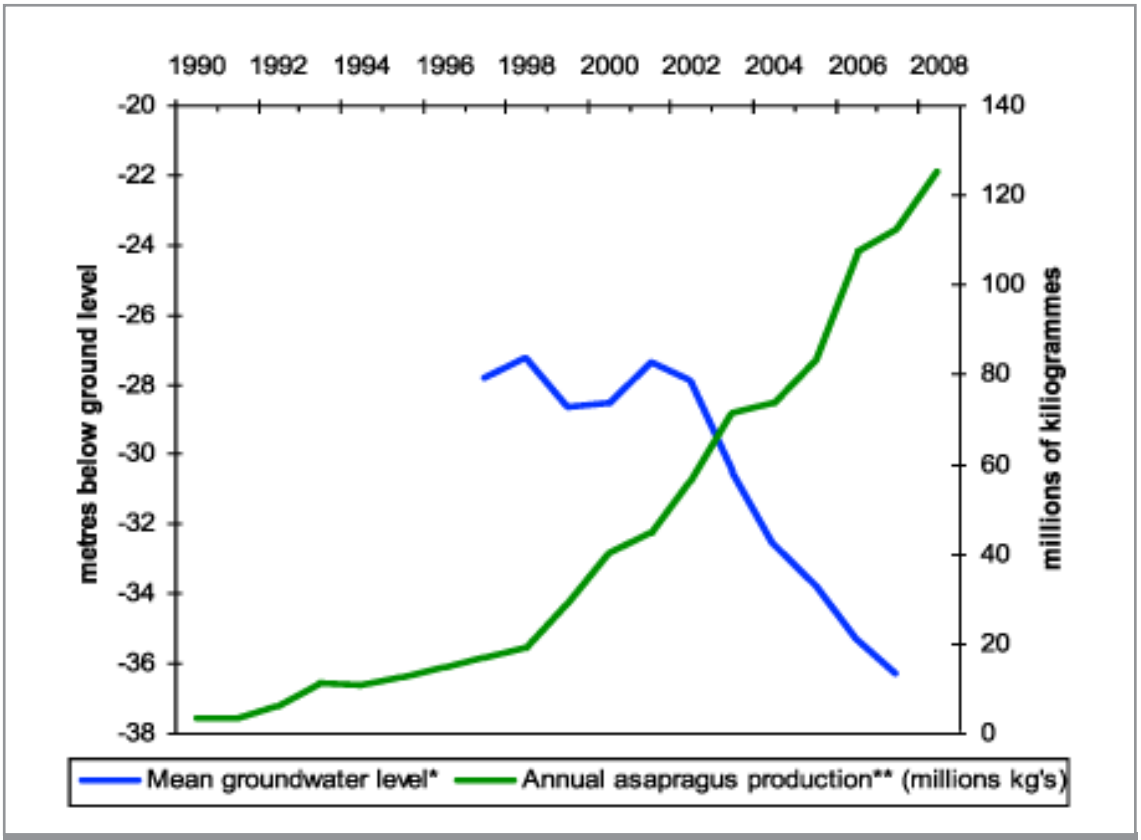


Figure 6 Relative trends in asparagus production and groundwater levels in the Ica Valley 1990-2008

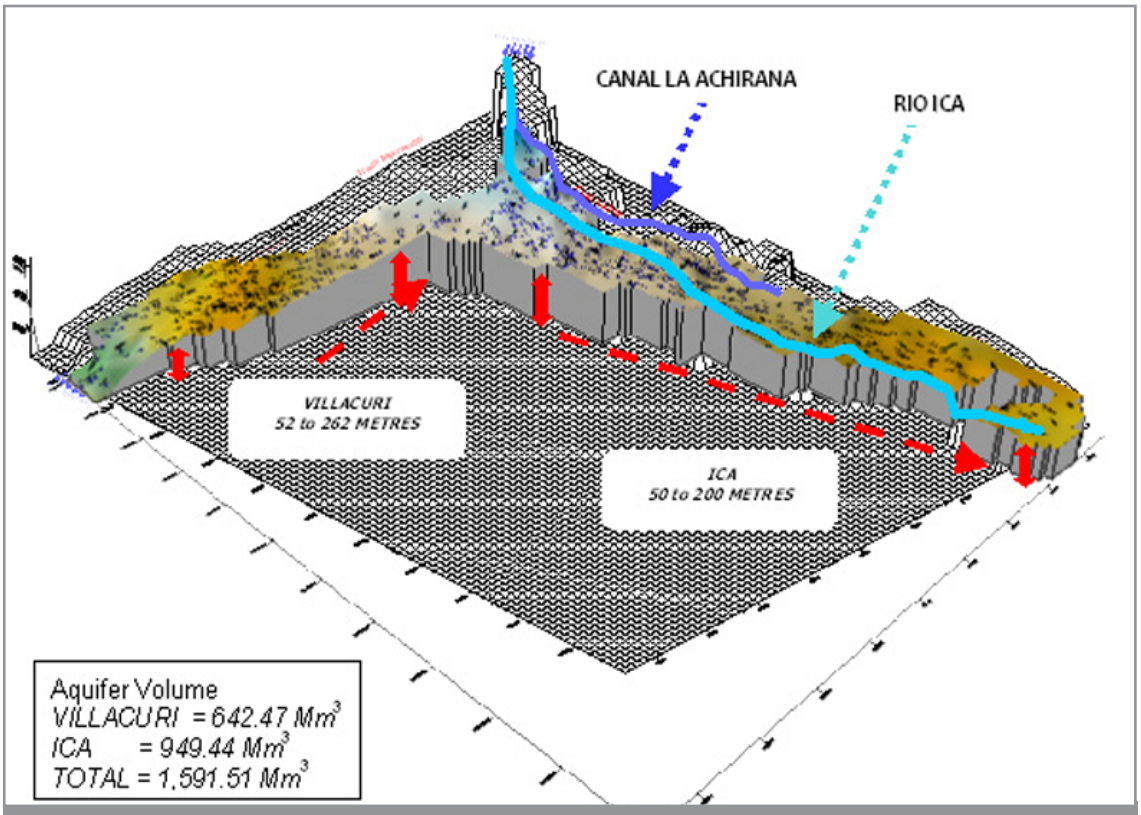


Figure 7 A three-dimensional representation of the Ica-Villacuri aquifer (Source: Guillermo Aguilar/Ing Julio Chávez Cárdenas)

As one informant told us 'people pluck figures from the air'. The Director of the ALA for Villacuri summarises the problem: "We don't know the real reserve, it's probably somewhere between 1,500 Mm3 to 3,000 Mm^3 and neither do we know for how long it will be economically profitable to extract water. What we do know for definite is that water levels are dropping fast and water costs are rising quickly."[53] Indeed, the rates of aquifer decline quoted in the World Bank study on Ica are thought to be the fastest reported anywhere in the world.[54]

In the absence of a robust contemporary hydro-geological investigation and water use inventory there is uncertainty as to how long the aquifer will last under current rates of exploitation. However based on the model presented as Figure 7 this range of disparate figures can be interpreted, and at current estimated rates of exploitation, the groundwater resource has the potential to become non-viable as a usable resource within seven to 25 years. In reality, before it is totally depleted, a range of detrimental impacts will be experienced by the users, and functions of the aquifer and the increasing depth of groundwater will exclude use by those who don't have the finances to drill deeper or the political clout to secure access. Due to the extent and rapidity of overexploitation, these detrimental impacts are already being felt and, although they affect everybody in the valley, it is the poor who are hit the hardest, as this study will explore.

There are many ways of classifying the impacts generated by unsustainable water resource use: by location, effect, outcome, source, pathways or receptors – those being impacted upon.[55] To structure this report, impacts have been grouped geographically and the stories of the people who have been affected in each place are related to illustrate the nature of these impacts. First we consider the impacts seen in the lower valley on the agro-exporters themselves, on small and medium sized farms and on the people of Ica whose domestic supplies are affected. Later we focus on the impacts seen by highland communities in Huancavelica.

3.1 Impacts within the lower Ica valley

Government and private monitoring records, the testimony of water users throughout the valley, academic research and modelling results all attest to the rapid fall in groundwater levels in the Ica Valley. Based on information provided in the World Bank study the rate of decline has reached extremes – as much as 8-10 metres a year in Villacuri and 5 metres a year in Pachacutec, mid way down the Ica Valley.[56] These upper rates of decline are the fastest rates of aquifer depletion reported anywhere in the world.[57] Based on data from borehole monitoring, the current research found a rate of between 0.4 to 1.5 metres per year to be more typical across the north and east of the valley. There is a tendency for water levels in the south and west of the valley to be more stable because of the topography and their distance from the most intense zones of exploitation. The map shown in Figure 8 presents a comprehensive picture of the water levels in Ica and Villacuri from 1997-2007 and is based on individual borehole level records provided by the ANA. The figure shows water level change over a 10 year period for a representative selection of the valley's 800 recorded boreholes.[58] Each vertical axis represents 10 or more metres with horizontal bars representing 1 metre. Borehole reference numbers are given and an approximate annual rate of decline between 2002 and 2007 at each well is annotated. Although in some places there are increases in groundwater levels in the late 1990s which could be linked to El Nino rainfall events, the picture is one of widespread decline beyond that brought by natural variation. The evidence shown in Figure 8, of rapid and widespread water table decline across most of the valley, appears unequivocal. In Section 3.1.1 the words of the stakeholders themselves are drawn on to introduce the impacts of this unsustainable resource use.

53 Personal communication, Director of ALA Villacuri, 5 May 2009.

54 See Brown, F R (2005) Outgrowing the Earth: The food security challenge in an age of falling water tables and rising temperatures, W W Norton & Co, New York, for a global review of aquifer decline.

55 See Hepworth, N and Dalton, J (2009) Understanding impacts in water resource systems, WWF International, Geneva, for a review of impacts in water resource systems.

56 Personal communication, anonymous agro-export farm manager, May 2009.

57 A summary of world rates of water table decline is provided in Brown, F R, (2005), as note 54. In north Gujarat water tables are falling at 6 metres a year.

58 References to water levels in the report are to static, or 'at rest' water levels which give a more accurate picture than pumped or dynamic water levels.

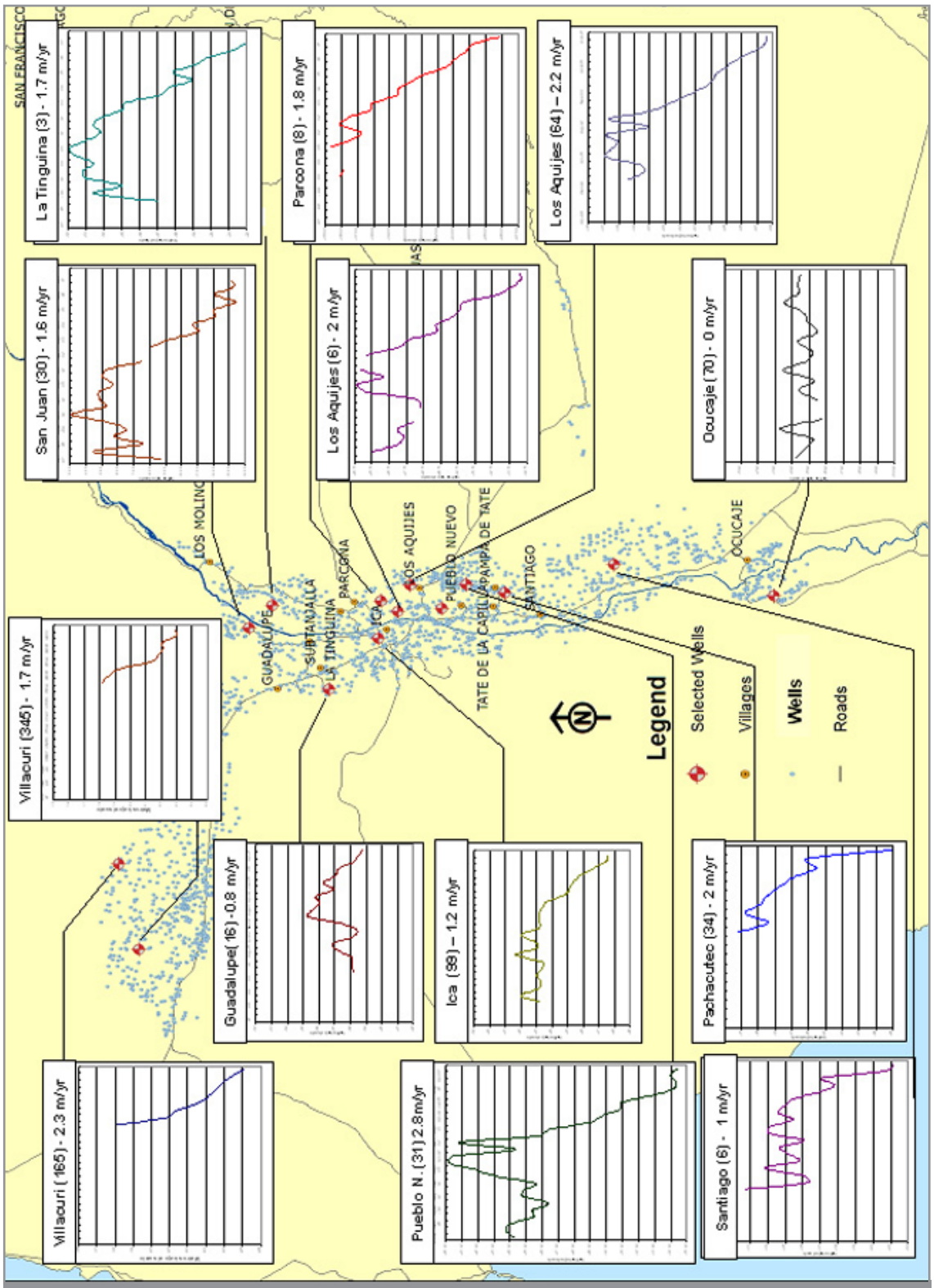


Figure 8 Groundwater levels at representative wells across Ica Valley and Villacuri 1997-2007 (Source of data: ANA)

3.1.1 Impacts within the agro-export industry

Voices from Ica: the testimony of the agro-exporters

The new entrepreneurs are ignorant, but they are big and powerful and they can do exactly what they want. The impacts of over-abstraction ... we see examples of well production going down from 80 to 20 litres per second – it's a big problem. The drying trend is moving down the valley – if we don't do something fast the valley will die. We are already investing elsewhere where the water demand is less.

Managing Director, agro-export company

The crisis is happening now … the wells are going down, all of them. It's a total disaster and nobody knows how long we have. We used to produce 818 litres per second from 18 wells – now we have only 650 litres per second from 22 wells. Our costs for accessing water have risen by 25 to 30 per cent. Yes, people blame us and we are getting more and more complaints. Yes, we agro-exporters are part of the problem – we need to be controlled.

Engineer, agro-export company

In the future only those with money will be able to access water. Water is the limiting factor to our business – of course if we could get more we would expand.

Manager, agro-export company

Because of this lack of regulation and the rapid decline in the water table Ica faces terrible consequences – wells are being deepened from 80 metres to nearly 300 metres – that is expensive and cannot last. What the agro-exporters are doing is not sustainable. Some farmers are seeing soils becoming salty and are shifting to salt tolerant crops.

Irrigation Engineer, Ica Valley

Interview dates 22 April-10 May 2009

The voracious use of water by agro-exporters has a negative impact, not only on their surroundings, but also on the future financial and political viability of their own enterprises. The Ica aquifer presents a classic common pool natural resource problem in that the water use of each individual farm taken alone is within sustainable limits and yet collectively, cumulative use outstrips the sustainable yield, to the detriment of all. For all agro-export enterprises in the valley there is a risk that the water they need to operate will simply run dry or become too expensive to access. Detriment is being felt in the following ways:

- **The costs of production**

Additional costs are being imposed because of a requirement to pump water from greater depths in the aquifer or from further afield. As the yield and water levels of existing boreholes fall, they dry up or 'hang' and need to be physically deepened. Exploring for new water and purchasing of additional water sources can also be very expensive. For example the title deeds to boreholes can exchange hands for as much as US$150,000. Although drilling new wells is banned this is reportedly often openly disregarded in practice. Informants highlighted the corruption and bribery of the past and the inadequacy of the deterrent when maximum fines are set at a fraction of the profits to be gained from illegal drilling.

- **Problems of water quality**

Salinisation poses a threat in two ways. Firstly, through saline intrusion, where over-exploitation of the coastal aquifer leads to inland flow of saline groundwater from under the sea, rendering groundwater unfit for use. Secondly, the gradual accumulation of salts in the soil as the intense sunlight evaporates irrigation and soil water. Asparagus is particularly vulnerable to salinity and several informants spoke of salinity or indications of elevated salt levels in groundwater, particularly in the south of the valley nearest the coast. Widespread salinisation in the Ica area is a risk which could devastate commercial farming for many years. The Director of the government's water regulator, the ALA, in Villacuri surmises: "Water quality is changing, there is more salinity but the fields are still producing for the moment."

- **Threats to the social licence to operate**

The research observed significant mistrust, fear and antagonism towards agro-export companies by individual community members, small to medium sized farmers and professionals working on these issues. Although such angst is understandable given the hydrological problems collectively imposed by the agro-exporters, some of the larger farms were consistently singled out and blamed for the community's problems. As the real or perceived source of community troubles, the agro-exporters face growing complaints and conflict with increasingly well organised groups and individuals. The sources of these conflicts lie in the catalogue of impacts brought by agro-export water use, the details of which unfold in the following sections of this report. They raise urgent and valid questions about the asparagus farmers' social legitimacy and licence to operate. It is these questions and the need for progressive answers which lie at the heart of this research.

Case study 1 provides a more detailed understanding of the perspective of the agro-exporters.

Case study 1: The experience of an agro-exporter

One of the largest and most modern of Peru's fresh asparagus producers and exporters, which focuses exclusively on premium export markets in the northern hemisphere, has a base in Ica. It accounts for 16 per cent of Peru's fresh green asparagus exports and 18 per cent of exports to the UK and is the second largest operator by land area in Ica. Part of a larger company, which was worth US$55m in 2007, it has invested in agriculture for the export market in Ica since 1999 with the help of loans and guarantees from the IFC, the commercial lending arm of the World Bank. The IFC estimates that its operations have created approximately 6,000 new, full-time equivalent jobs in poor rural areas.[59] In Ica the company grows mainly asparagus, but also grapes and some avocados, at two farms in the valley totalling 1,390 hectares and employing 2,500 people, rising to 4,500 at harvest time. The company sells to 22 countries with about 20 per cent of its output sold to UK brokers who supply supermarkets. The company is regularly audited and complies with a wide range of market standards including Tesco's Nature's Choice and GLOBALG.A.P., the Global Good Agricultural Practice standard. The company's employment conditions are generally considered good by local people and the company has invested in the community through environmental, educational and water infrastructure projects.

The agro-exporter's average water use is 14,000 m^3 per hectare which is calculated to exert an annual demand of 17.3 Mm^3 per year.[60] This is provided by four wells on their own farm and a further 22 wells which they bought from other people in other areas, from where the water is pumped several kilometres to the farm. The water level in some of their wells is going down as much as two metres a year.

An engineer told us that their water use is regulated by the ALA and that all their wells are licensed and legal. He said that limits are set on how long they can pump, but that nobody checks.

↗ **1,200 hectare site as seen from the air.**

59 IFC (2007) Annual Report 2007: Creating opportunity, IFC, Washington DC.

60 Based on figures provided by engineer - working provided in Appendix 4.

"Nobody knows how much is taken and nobody controls how much is taken – flow meters are supposed to be installed but nobody else does this. There are no limits, no standards, no control and no capacity for control. Groundwater is free and its exploitation is just random. In the […] years I have been here the authorities have never been to inspect our wells."

The CEO:
"Peru provides the world with its best example of how to mismanage water. We desperately need to rationalise water use in Ica and to manage it sustainably. In this irrational environment we are spending huge sums just to survive.

"The groundwater deficit is obvious although it is not being addressed. Elsewhere in the world, in Spain and Colorado, they have groundwater replenishment schemes but not here. One of the problems is inefficient irrigation and leaking gates. The water is not being used carefully by the traditional farmers. Cotton growers use the same on 50 acres as we do on 3,000. Informal agriculture is taking water from the river and channel to irrigate 4,000 hectares and none of it is regulated.

"Our farms are at the forefront of the science with tensionometers, dendrometers and daily growth records to check what the plant needs and technical drip irrigation to deliver those exact needs. For us, getting the irrigation right is for crop health not water efficiency. We have just spent US$12 million on high tech pulse irrigation. Cotton and Lima bean farmers aren't using this approach and they point the finger at us or complain to God. Efficiencies in water use? It is not true we can save more – big growers are already saving all the water they can.

"The solution is to work together but we don't have a common vision. Business, government and NGOs, we don't have the idea of working together. There are some bad NGOs interested only in problems not solutions.

"There is no law – everyone who has a well must send data to the government. We do but no one else does. Of 900 active wells in the valley only 60 report and 22 are ours, but then the government doesn't know what to do with the data.

"For the 300,000 people living in Ica the real problem is mismanagement of funds by the authorities. There is no money for new water supplies for the people. Those communities in the mountains, they are just forgotten. When the water transfer was built nobody considered their needs.

↗ **Workers preparing asparagus for export.**

"The new law is good – but we have the problem of no implementation. I met with the ANA and they have no budget for implementation and no staff to do the job so there will be no policing.

"We are definitely seeing an increase in salinity in the water. It's stupidity! We are very proud to be contributing to the economy of Peru and to be supporting 4,000 poor families in Ica by providing jobs. We will do what we can to get the water use right."

An engineer:
"Our strategy is, one, to deepen the wells we have; two, to look for new sources; three, to use the surface water wasted to the ocean; and four, to get recharge into the ground from water coming from the mountains. We have joined the new Junta for groundwater management in the valley with the main objective of getting more recharge. Changing crop, reducing demand and using less water? That's a business decision, not for us engineers. Asparagus pays best so we're unlikely to change.

"We need a good hydrogeological study and we need to be controlled – if it ends up being based on paying for water, of course the rich will benefit."

9

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Plates 9-13

9 The treatment plant at one of the largest agro-exporters. US purchasers demand high quality water even for irrigation, and the water used for asparagus receives treatment to higher standards and is monitored more closely than drinking water for the people of Ica.

10, 11 Water from more plentiful parts of the valley, or from where the agro-exporters have been able to buy wells, is pumped from distant boreholes, some 22 km from the farms. Here a flow of ½ cubic metre per second, an equivalent flow to that which supplies the city of Ica, is stored in the farm's reservoir.

12 The asparagus crop requires lots of water in the fernilogical stage in the run up to its harvest in order to ensure a firm spear, and farmers admit to using more water than the plants can absorb. (Anonymous, personal communication, agro-export farm manager May 2009).

13 Water is also required in the preparation and packing sheds for washing and refrigeration.

Voices from Ica: the testimony of farmers

On my farm there is one well and it has gone dry, but I can't drill another because of the ban and I'm too far from the surface water canal. As you can imagine there are a lot of angry farmers in this valley.

Representative of Ica groundwater Junta

The agro-exporters have bought all the wells so small farmers can't get enough water. About 1,000 small farmers have been forced to shift to drought tolerant crops because of increased water scarcity. If we continue like this, the Ica Valley and the whole system will collapse and there will be social unrest – the aquifer situation must be declared an emergency.

Representative of the Ica River Junta

The big guys are buying all the wells …90 per cent of the valley's wells are now in the hands of agro-exporters. If you have a good well you can sell it to the agro-exporters for US$90,000 to US$150,000.

Ica farmer

Before they came there was a lot of humidity in the soil and we didn't need to irrigate that much – the river remained wet for longer periods, now we need more irrigation.

Parecelero and ex-cooperativist, 83 years old

In the past 10 years wells have gone a lot lower, we irrigate three times a week for one hour only, but some people are much worse off. Those in Residencial Luren, Los Romanes and Nueva Esperanza must either steal water or buy it from a cistern truck. In spite of the ban on building new wells, agro-exporters keep digging. They pay bribes and authorities don't do anything if we complain. Police favour businesses and so do authorities. What can we do?

Farmer, La Tinguiña District

When we want water, now we must buy it from a well that is 6 km away. The canal leaks and the water takes about three hours to get to the field. To get one hour of irrigation, I must pay four hours of water at 45 soles per hour. Some people pay up to 55 or 60 soles per hour of water.

Farmer, San Juan Bautista

Small farmers used to let the aquifer recover for periods of time but agro-exporters pump 24/7 and don't pay a cent for water they use … their wells are running dry so they want to take the water from us … there will come a day when we have no more water to live. They will leave with pockets full of money and leave us, small farmers, in the desert sunken and doomed.

Farmer, Pueblo Nuevo

Our water is for our children and future generations – I will not sell and they will take it over my dead body.

Ica farmer

If they come for my water I will shoot them.

Ica farmer

Agro-exporters will never lose – first they'll finish all the groundwater and then they'll come for the surface water and the government makes it easy for them. Political favours are being paid off – the agro-exporters drill clandestine wells and the ones who suffer are small and medium sized farms. Our fate is to disappear.

Ica farmer

People here are quiet and don't talk because they are afraid of big businesses …and of the authorities that support them, but there is a lot to say, there is political abuse and a predation of natural resources.

Medium sized farmer, Ica

Interview dates 22 April-10 May 2009

3.1.2 Impacts on small and medium sized farmers in the Ica Valley

Our research found that the agro-export boom and rapid increase in aquifer exploitation exerts a range of detrimental impacts on small to medium sized farmers and generates significant social conflict across the valley. Physical and economic water scarcity and scarcity caused by inadequate regulatory controls are on the rise along with conflicts between farmers and agro-export companies.

The relationship between water use by agro-exporters and smaller farmers is not simple and neither can small and medium sized farmers claim to be efficient in their water use. Large agro-export farms tend only to use groundwater through relatively efficient drip irrigation whilst small and medium size farms use surface water flowing from the mountains for gravity or flood irrigation a few times a year. For most small and medium sized farms, groundwater sources provide an important 'back up' water supply at times when other water isn't available, but groundwater has always been more expensive because of pumping costs. Flood or poza irrigation is a traditional practice of banking land around fields and flooding them with a depth of water which then percolates slowly into the soil. In an area which receives almost no rainfall but has an aquifer with high transmissivity, this flood irrigation is believed to help recharge the aquifer with surface water from the mountains. Although there is limited technical data available on the extent or volume of water recharged in this way, there is potentially a close relationship and dependency between traditional irrigation techniques and recharge of the aquifer being exploited by the agro-exporters.

Physical water scarcity

Although the research did not have the resources to carry out a full borehole and well inventory, we received many reports of wells used by small and medium sized farms running dry or yielding less water in the past five years. As pointed out by the Chief Administrator of Rio Ica Junta: "The traditional depth of wells in the valley is 30-40 metres and many of the agro-exporters' wells go much deeper. As the water table falls we are seeing many more hanging wells – for example in El Olivo 10 of the 13 wells no longer reach the water table."

Most of the farmers interviewed commented that well production had gone down, that is, whilst wells were still producing, with a lower water table and less head of pressure, the pumps bringing water to the surface were less efficient and the same wells were providing less water than they had in the past (see case study 3).

Ordinary farmers we spoke to, and their representatives in the two Junta de Usuarios, told us of a further water problem which they felt the agro-exporters were responsible for. They maintained that since the agro-export boom the soil had become drier. They referred to soil humidity and claimed that the lowering of the water table had reduced this so that growing the same crop on the same soil now requires more water. Again, no quantifiable objective evidence in the form of soil moisture monitoring records is available but that this same testimony was heard from over 10 different informants farming at different points in the valley lends it some credence.

Again, a representative of the Junta summarises the implications of this physical water scarcity: "The lack of groundwater affects production and has led to farmers switching production to crops which require less water, for example around 10 per cent or 1,000 of our members are switching crops – from corn to cotton or from potatoes to fruit. Switching crops is expensive in itself. The unavailability of water denies choice to the small farmers and where new crops are less profitable livelihoods are hit hard. For example, cotton prices have dropped by 40 per cent in 12 months."

Other small farmers related the problem to food security. The World Bank study concluded that users with less than 3 ha (70 per cent of farmers in the valley) suffer from the lowering of the water table due to extractions of big agro-exporters.[61]

61 Foster, S, Garduño, H, and Vidal, A, as note 48.

Case study 2: The perspective of a small-scale farmer

Asparagus offcuts on the farm. Water cisterns in the back yard. (Photos: Petra Kjell/Progressio)

Elisa Gomez is 26 years old, has three daughters and lives with her husband and seven members of their family in the Ica Valley. The family has five hectares close to the farm of one of the largest agro-exporters in the valley, where they grow grapes for Pisco (a liquor distilled from grapes) and keep some livestock. They buy waste asparagus off-cuts from the neighbouring agro-exporter as animal feed.

They irrigate using water from the La Achirana canal twice yearly. "We pay about 140 soles per hectare and get water for 15 days, twice a year. The soil is not as productive as before and dries out in just three days, it used to last longer but now the land is so dry the water drains away much faster."

The family collect water in cylinders and in a small hollow for animals. "There are no wells in this part of the valley now – they were sold 10 years ago to the agro-exporter. Those of us who didn't sell the land suffered water shortages, so many people were eventually forced to sell anyway. The agro-exporters own all the wells now so they just wait for people to get tired and sell them cheap dry land."

Elisa is concerned about the future and feels that the agro-exporters are part of the problem. "They are exploiting too much, they don't sell on the water [that they pump from their wells] and there is no communication with the community. Sometimes we cannot bathe nor give our animals water to drink. No more wells should be drilled, because there is no water and it will run out."

Note: Names have been changed

Higher costs and economic water scarcity

Impacts on the livelihoods of small and medium farmers are also exerted by higher costs and increasing economic water scarcity in the valley. Economic water scarcity occurs where the cost of accessing water is the limiting factor rather than a volumetric lack of water per se. Again this takes a number of forms. For some farmers, they simply cannot afford to supplement their surface water allocation from the Juntas with groundwater, a practice they allegedly need to increase because they say the soil has become drier. Groundwater costs users between six to 12 times as much as surface water[62] because accessing it requires electricity or fuel to work against gravity, whereas surface water use sees payment of a one-off annual tariff to the Junta. With the decline in the water table the pumping costs of lifting water from deeper depths or pumping it further distances either increases the cost burden for small farmers or becomes a limiting factor to production for those with less financial capital.

62 Source of data: Rendón, E, as note 22. According to the Junta Rio Ica the surface water tariff is 0.033 m3/sol, whereas groundwater typically comes at 0.4 m^3 per sol.

For other farmers who own boreholes, less revenue or additional costs or economic scarcity is imposed where their wells 'hang' dry or become increasingly inefficient so that the well is either abandoned or deepened.

Case study 3: The experience of a medium sized farmer

Juan Alvarez' family has farmed in Ica for four generations on 34 hectares and employs 10 people, rising to 30 or 40 in peak seasons. He has grown asparagus since 1986, before big agro-exporters arrived, making good business producing about 9,000 kg per hectare/yr with 30,000 m^3/hectare/yr of water. He still uses gravity flood irrigation, the poza system, but is investing in new technical, drip irrigation. This new system will use water more efficiently and his motivation for saving water is the increasing depth of water in his wells. Because the water is getting deeper it uses more fuel to pump and so is getting more expensive.

"There is definitely a problem with water. I still sell water from my well to other farmers but now I can't extract as much. Some wells are drying or have dried out. These wells used to hit water at 55 metres down and gave 60 litres per second (l/sec), but now we have drilled to 108 m and only get 22 l/sec.

"Agro-exporters came after the terrorism, in the Fujimori era with new policies and lower tax that favoured big enterprise. Businesses not traditionally involved jumped into agriculture. When the asparagus boom started and the agro-exporters came to buy wells it was one big mess. They bought water rights from cooperatives, reactivated old wells and started buying rights to wells very far away and using these rights to drill new wells here in the valley, all with government permission."

Juan understands the point of view of agro-exporters but is concerned about the economic future of the region. "Big agro-business has created jobs for the poor – that's important and they shouldn't be demonised, but the reality is that they are depleting the water resources and when the water is gone they will leave. That's a problem for us small farmers – we have no money and if our wells dry, we can't keep digging deeper, it is just impossible."

He is worried about the drying of the aquifer and about what will happen afterwards. "These big businesses have economic and technical resources and receive tax exemptions and should be providing the solutions. Instead they wait for the authorities to invest with public money. Agro-exporters are now moving water from the relatively wetter parts of the valley, but what will happen when they succeed in transferring these large amounts of water? Will these areas dry out too? What they are doing – degrading the resource – is wrong."

At the well house pictured on the right, the borehole has been closed for four years but Juan does not want to sell the rights despite many offers, because he believes that the aquifer can be recharged. "About 40 families depended on this water for irrigation in the dry season and now they must look for it elsewhere. The big exporters don't give nor sell water at all.

↗ **Dried out well. (Photo: Petra Kjell/Progressio)**

"What future is there for us? We don't know, but they will leave and we won't. We've lived here our entire lives, and have put up with terrorism, earthquakes, floods and landslides. What should we do when the water runs out… Leave? We will never leave."

Note: Names have been changed

Regulatory water scarcity

Another form of scarcity is potentially imposed through the regulatory prohibition of new water sources coupled with the lucrative market in functioning wells. In 2005, and reiterated in 2008 as a response to the emerging crisis of overexploited groundwater, the regional government passed an ordinance prohibiting the drilling of new wells. Even before this, the rights to existing wells were exchanging hands for large sums, but since then, agro-exporters are said to be paying small farmers between US$90,000 and US$150,000 for their existing wells. With many smaller farmers facing uncertain futures and often burdened by debt, the sale of boreholes for these kinds of sums, many times their annual income for some farmers, is understandable. However, where boreholes were previously used communally, this accumulation of water sources in the hands of the agro-exporters creates scarcity for those neighbours of the paid off well owner who used to buy water during the driest parts of the year. With agro-exporters apparently reluctant to share water from the wells they have accumulated, this leaves small farmers in a difficult position: even if they had the funds to drill a new source, they would be acting illegally in doing so.

We heard of several alleged cases where agro-exporters had drilled new wells in spite of the ban and had paid the authorities to turn a blind eye. As one senior employee of an agro-exporter told us: "When the agro-exporters break the law, it never comes down to being fined, these things are agreed under the table." Although there is nothing to say that small and medium farmers are not drilling wells illegally, as indeed the large farmers claim, they may be less able to buy or 'influence' their way out of trouble if caught.

The authorities have had little option but to take the seemingly sensible step of banning new wells. However, at the same time they have allowed licence numbers to be transferred from old to newly drilled wells and have permitted the pumping of water from a borehole in one part of the valley to distant points. In restricting the pool of abstraction points yet allowing a free market of buying and selling with no restrictions on the amount of water to be taken from each point, or on where that water can be taken and what can be done with it, the ordinance has unwittingly handed control of the resource to those who can pay the highest price. Furthermore, without a cap on total exploitation the race will only end when the resource becomes the limiting factor. The result for the Ica Valley is hegemony over the hydrological resource which has handed control of the resource to those with most political and financial power. Based on the current track record, the agro-export companies, who are now reported to collectively own 90 per cent of the valley's wells,[63] seem unable to limit their own use of groundwater for the public good.

Case study 4: Pressure to sell water sources

Francisco Martinez, Antonio Martinez and Carlos Aguilar grow cotton, asparagus and lima beans in a village in the Ica Valley with over 5,000 inhabitants. The asparagus is sold to a middle man for US$0.40/kg, who then sells it on to agro-exporters. They use both surface and groundwater to irrigate the fields through flood irrigation, but Francisco says: "The surface water we get these days is just enough to wash your face in!"

There are currently seven wells in the area for small farmers and seven for agro-exporters, which according to Francisco shouldn't be there. Their area has good water, as it is in a depression, but still, the well they use has gone down by four metres since the agro-exporters came. Francisco says: "These wells close to ours lower the rate at which we can extract. They also make the soil drier and the humidity in the soil does not last, so we need more water."

Agro-exporters are now interested in buying their well and they have been offered US$90,000 for it, but they are not interested. They intend to keep it for their own needs and to carry on selling water to their neighbours.

63 Representative, Junta La Achirana, 9 May 2009.

"In 1998 the well used at […] was at 18 m and gave 60 litres per second and now it's at 40 m depth and gives only a third as much water. Over in […] water has gone from 60 to over 120 m.

"The problem lies with the authorities – they are incapable of dealing with it. For example the companies […] and […] transfer water from over 20 km away from their farms. That should not be allowed."

Antonio says: "Agro-exporters and many authorities are not farmers and not from here. They don't care; they will let us die here."

Note: Names have been changed

Water quality concerns

Informants reported elevated salt levels at Ocucaje and Santiago, attributing this to rapid groundwater exploitation. One small farmer we spoke to was forced to abandon a well because of high salt levels, as reported in case study 5.

Case study 5: Salty water, fear and suspicion

When interviewed, a fifth generation farmer of 10 hectares said:

"Please keep these comments anonymous – these guys are big and I could get shot.

"The big guys show up and buy land at US$20,000 a hectare and suck water from the middle of the valley, buying up wells or buying the licence number and drilling a new one. One of my wells has gone salty even though I pumped very little water. I have irrigated with this all my life. What can I do? I can't do anything! All the big guys are investors from outside – they are networked and well connected. The water management bureaucracy is sh*t – they're just a gang of thieves who can't do anything.

"I don't have money to drill deeper wells. The law is made to benefit the rich. The trick is a list of wells with papers and rights. The poor don't have the time or the capacity to do that paperwork."

Social conflict, unrest and mistrust

Discussions with the valley's disparate stakeholders during the research were sometimes characterised by the highly polarised views amongst them, by bad feeling, mistrust, accusation and counter accusation. We heard of acts of direct action[64] and protest[65] against the agro-exporters, most of which were based on genuine concern for the social and environmental welfare and future of the valley, but some of which appeared to be more motivated by financial compensation. On the one hand, the agro-exporters seemed to sometimes be unjustifiably demonised, but on the other, a handful of stories of intimidation, political manipulation and the Machiavellian behaviour of some companies received credence by being independently verified by several sources.

Such an environment of conflict and mistrust is costly to all stakeholders both in terms of time, money and missed opportunities for progress. Polarisation between stakeholders is counterproductive in dealing with the collective water management challenge facing the valley, but a major problem for reducing this polarisation has been the absence of a trusted and credible regulator. Finding a solution will benefit everybody, except those with the intention of rapidly running the resource dry for profit.

64 In October 2008 the community of Puno effectively barred a company from installing two 24" pipes across their territory. People turned out to prevent construction of two pipes which were to transfer water across the valley, which they allege their Mayor was bribed to permit. Their protest was in the name of protecting the valley's water for use by future generations (see Plate 21).

65 In January 2009 23 small farmers picketed a meeting to complain to a World Bank delegation in relation to a proposed IFC loan to support irrigation investment by one of the largest agro-exporters.


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Plates 14-21
14, 20 Small to medium sized farms employing flood irrigation to artichokes and at planting.
15, 17 Flow in the Ica River is diverted every 12 days to the La Achirana channel for use in irrigation.
18 Groundwater supplements this surface water but pump costs are expensive. Many boreholes were destroyed by the 2007 earthquake.
19 Farmers complain that overabstraction and illegal wells dry the land. This illegal borehole drilling operation was halted by the authorities. (Photo: Bruno Güemes)
21 The trench in Puno prepared for 24" water pipes, halted by community protest. (Photo taken by community member)

3.1.3 Implications for domestic water supply

Voices from Ica: the domestic supply situation

The more the agro-exporting, the more the population and the less water we have. Many wells started to extract only air and had to be re-dug deeper.

Water law is explicit about human use, the wells should be expropriated from agribusinesses and given to communities for human use if the water is proven to be going down. The primary use is first, and even the constitution states so.

Mayor

The water situation in Ica is a time bomb that will blow up soon.

Representative of CODEHICA, NGO

There was a time when the village had lots of wells and would have water every day, and the villagers could grow plants and even have gardens. But the owners of the wells owed money and sold the wells to agro-exporters. As a result the village now has less wells and less water. It's not just the agro-exporters, there is no investment in the infrastructure – the reservoir here was damaged by the earthquake. We must give water to the people who have none in Cristo Rey, Santa Lucia, La Campiña, Santa Julia, La 75 and others – who must search for water and carry it on donkeys or by foot.

Community member, Santa Vincenta

The landlord sells us water because after the earthquake our well's pipes broke. We want to fix the pipes but for that we need to dig in the landlord's land and he won't allow us. That's why many people break the pipes and steal water from landlords.

Community member, La Tinguiña District

Interview dates 22 April-10 May 2009

Water supplies for the health maintenance and domestic needs of the entire population of the Ica Valley are entirely dependent on groundwater. 185,000 people in and around the city of Ica are supplied by EMAPICA, an autonomous municipally owned water supply operator. Elsewhere district authorities governed by neighbourhood water boards provide water services.

It is important to appreciate the local context of the water supply and sanitation situation in Ica. Rapid inward migration, earthquake damage and low investment have all contributed to inadequate provision, particularly in informal peri-urban shanty towns and villages where the poorest communities live. These are primarily government responsibilities and it would be wrong to attribute these unacceptable conditions directly to the rapid denudation of the local aquifer by the agro-exporters. Indeed, we found several examples of positive proactive work by agro-exporters – investing in infrastructure and sharing water sources as a response to the often desperate water supply conditions facing local communities.

That said, there is also very clear evidence that the water footprint of the agro-export boom and rapid decline in water tables is worsening the situation through drying of domestic supply wells. In addition, there is evidence of elevated levels of groundwater pollution, in particular by nitrates. Although groundwater pollution by nitrates is often associated with intensive agriculture, again it would be wrong to lay the blame with the agro-exporters alone – traditional farming and human sewage waste will also be contributing to this contamination.

Some of the large exporters investigated use about the same amount of water and at the same rate as is provided by EMAPICA to the entire city. The exacting demands of consumers and purchasers in the global North also means that the water used to irrigate Ica's soil can receive higher standards of treatment and be of better quality than the water used to keep Ica's human population alive. This juxtaposition of high value crops for overseas markets being irrigated with huge quantities of treated water adjacent to poor communities with no reliable domestic water supply raises unavoidable questions about water equity, social justice and political priorities in Peru and more widely.

Case study 6: The opinion of an Ica water supply engineer

↗ Photo of Emapica logo

Our unnamed source is an engineer with EMAPICA, responsible for providing the people of Ica with their drinking water needs. Groundwater is used for domestic supply, delivered through 20 wells producing between 14 to 65 litres per second, drawing an average of 17 million m^3/yr per year to supply the needs of 185,000 people. Water is supplied for 14 hours each day in the city centre, though elsewhere delivery is much lower with water in taps for only one hour each day and in some places as little as one hour twice a week. Some of the poorest people in the valley do not get piped water at all.

"It's a scandal – the water table has been going down at a rate of 1 to 1.5 m/yr and it is because of the agro-export boom. I'm very worried about the new agro-exporters – they don't know how much is available or how much they are abstracting. The wells they have don't have meters on and there's no way that anybody can know how much they take.

"Two of our wells which supplied nearly 20,000 people have dried completely. The water table has dropped below the bottom of the wells. We lost them and had to drill two more. Angostura, which served 15,000 people, dried in 2002 and Los Aquijes, serving 3,500, dried in 2006. The water levels of Parcona West, the most populous district, were 36 m and have now gone down to 48 m; downtown the water level was 20 m and now it's at 29 m.

"Of course it is related to agro-exporters. 99 per cent of water is used in agriculture, one per cent for domestic supply – it's simple to understand. There are over 1,000 wells sucking for irrigation water. There's no regulation, no logistical capability in the Ministry and bribery and corruption are rife. There's political influence to leave the big guys alone – they move with central government. The law is there to stop them drilling more wells but you see new wells being sunk all the time.

"By my reckoning we have about 25 years left … Of course we need agriculture and food. The solution is to unite around the problems and to include everyone; if we do not, a water war will descend on Ica."

Impacts on domestic water supply wells

In Figure 9 below we have used data on groundwater levels provided by EMAPICA on their 20 public supply wells and projected forwards the current rate of decline to estimate the lifespan of these boreholes. We calculate that by 2030, wells supplying a third of the city's water supply will be dry. Already, since the beginning of the agro-export boom, two of EMAPICA's boreholes serving a population of 18,500 have gone dry and new, deeper wells have been drilled in their place. Based on what is known about the volume of the aquifer and current trends, the prediction by EMAPICA's engineer that the city has '25 years left' seems reasonable.

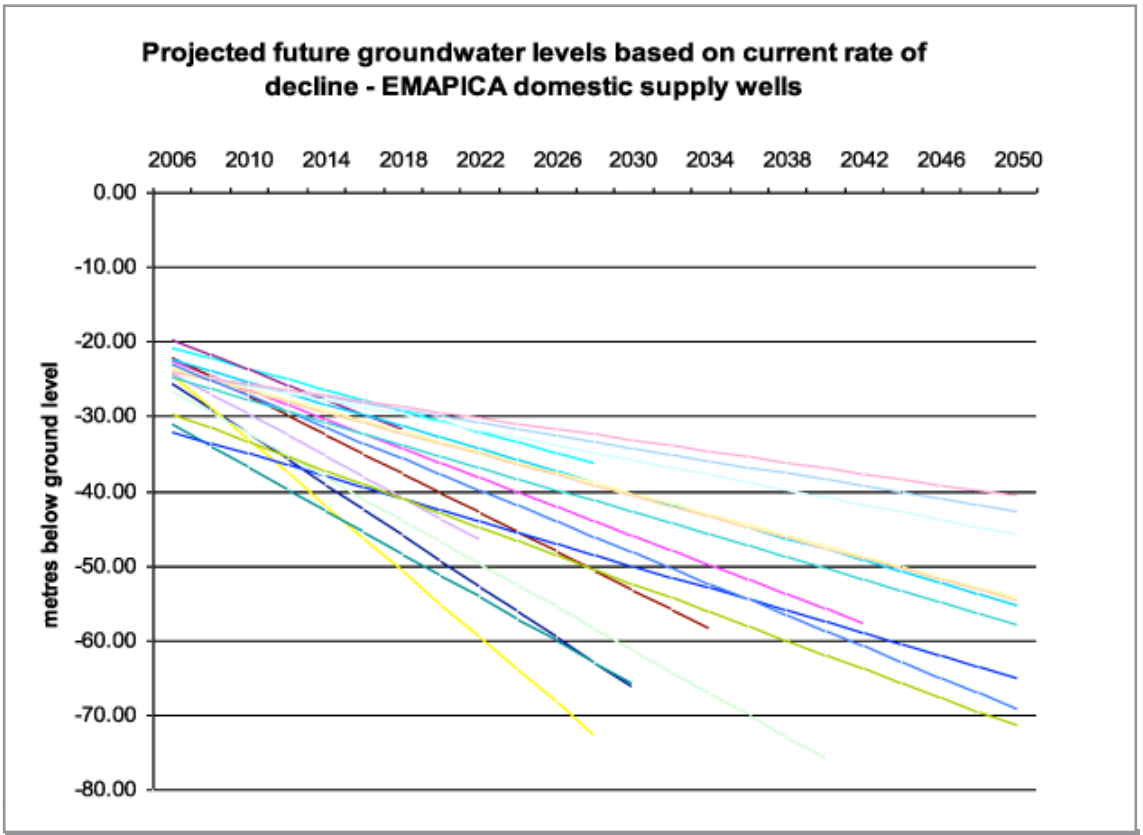


Figure 9 Projected future groundwater levels based on current rate of decline

Because of earthquake damage, mismanagement and lack of investment, the valley's domestic supply infrastructure is in a poor state, even for those lucky enough to be served by EMAPICA. The case studies provided below testify to how some poor families are already forced to survive on only 10 litres of water a day per person, as compared to the WHO recommended minimum of 50 litres per person per day for basic health maintenance.[66] This helps explain the high incidence of waterborne disease in children under three: 17 per cent, a figure which has remained static since 1996.[67] Unless checked, the declining water table trend will weaken the service further, increase costs and ultimately restrict the amount of water provided to families. Further reductions in water availability will heighten the vulnerability of the poor, particularly children, to waterborne disease. Our study suggests that partial responsibility for such human health impacts will lie at the door of the asparagus growers and their customers.

Water quality considerations

The study recorded user concerns about salinity levels in drinking water supplies and found that some wells in the south of the valley were too salty to use, but we did not find hard data on a widespread upward salinity trend. Of further concern for human health are the elevated nitrate levels identified by our own sampling and analysis. We carried out spot tests at seven sites to quickly appraise the levels of nitrate in drinking water. Nitrate is produced by organic waste such as sewage and animal manure and is an important constituent of fertiliser. Groundwater pollution by nitrate is common in agricultural areas where excessive application of fertiliser leads to leaching of the nutrient into aquifers. Nitrate is associated with blue baby syndrome or methemoglobinemia and is at high levels, above the World Health Organisation's limit of 50 mg/l, dangerous for young babies. It has also been linked to cancer and the EU set a precautionary limit of 25 mg/l of Nitrate as NO^3. The threat posed to drinking water by nitrates is significant and has led to many millions of pounds of investment to improve farming practice to protect groundwater resources in Europe through the EU's Nitrate Directive.

66 Howard, G and Bartram J (2003) Domestic water quantity, service level and health, World Health Organisation, Geneva.

67 INEI, 2007, www.inei.gob.pe

In Ica we found definite signals that pollution of groundwater by nitrates is occurring, with elevated levels at over half of the sites sampled (see Figure 10), where elevated levels are circled in yellow). Contamination can be expected in agricultural areas where fertiliser use is unchecked, but there may also be a contribution from human sewage or animal manure percolating into the ground. Nitrate is unlikely to cause a health hazard at the moment but contamination lasts for decades and unless the pollution is controlled, contamination will only increase in the future, potentially to levels hazardous to health. Nitrate pollution is controlled by adequate treatment of human and other organic wastes and through careful application of fertilisers at rates which do not exceed the crops' capacity to use the nutrient.

Case study 7: The view of Ica's poor

In Pueblo Nuevo

The village of Callejon de los Espinos was severely damaged by the 2007 earthquake. Alicia Flores's family are still waiting for rebuilding to start and for the time being share a house with four other families. In this village, each house normally receives about one hour of water three times a week. In better times they got 2 hours of water at least 4 times a week, but about four years ago the water pressure dropped off considerably. They used to be able to collect 220 litres in four barrels to see them through, but now they only get about half of this. This means about 50 litres per family of five per day, the same amount of water recommended by the World Health Organisation per person per day. This is still more than in some other parts of the Ica Valley.

↗ **Photo: Petra Kjell/ Progressio**

Like most of the people in the village, Alicia's husband works for the agro-exporters. They say that the working conditions are good, but with the current economic crisis pay has been cut, as well as some of the benefits, such as extra hours or assistance to schools. Ironically the company is teaching employees how to save water, and while this is no doubt important, they feel that the onus should be on agribusiness to cut down their water use.

The water situation is dire and they are afraid of what will happen in the future. A member of the family says: "We have seen water dropping, or at least the pressure dropping, in the past years since the agro-exporters came, but if water runs out and they leave, we will have no work and no water– what will happen to our children then?"

In Ocucaje

In San Jose de Pinilla in Ocucaje residents used to get three hours of water every 8 days, and built reservoirs or stored water in ponds or barrels. However, at the time of our visit EMAPICA, the water provider, had failed to pay its energy bill, leaving families with no water supply for almost four months. This made some of them go to extreme measures, forcing them to steal water by breaking into pipes.

A little further away is a well where the owner provides free water in return for cleaning the well. Here the water needs to be pulled up by hand in a bucket and residents spend a few hours a day collecting water, ending up with 80 litres for about eight people. The water they manage to collect is not enough for the animals they rear, who are now going thirsty. The well water tastes a bit salty, but is drinkable – though three other wells in the area are too salty to be used.

Note: Names have been changed

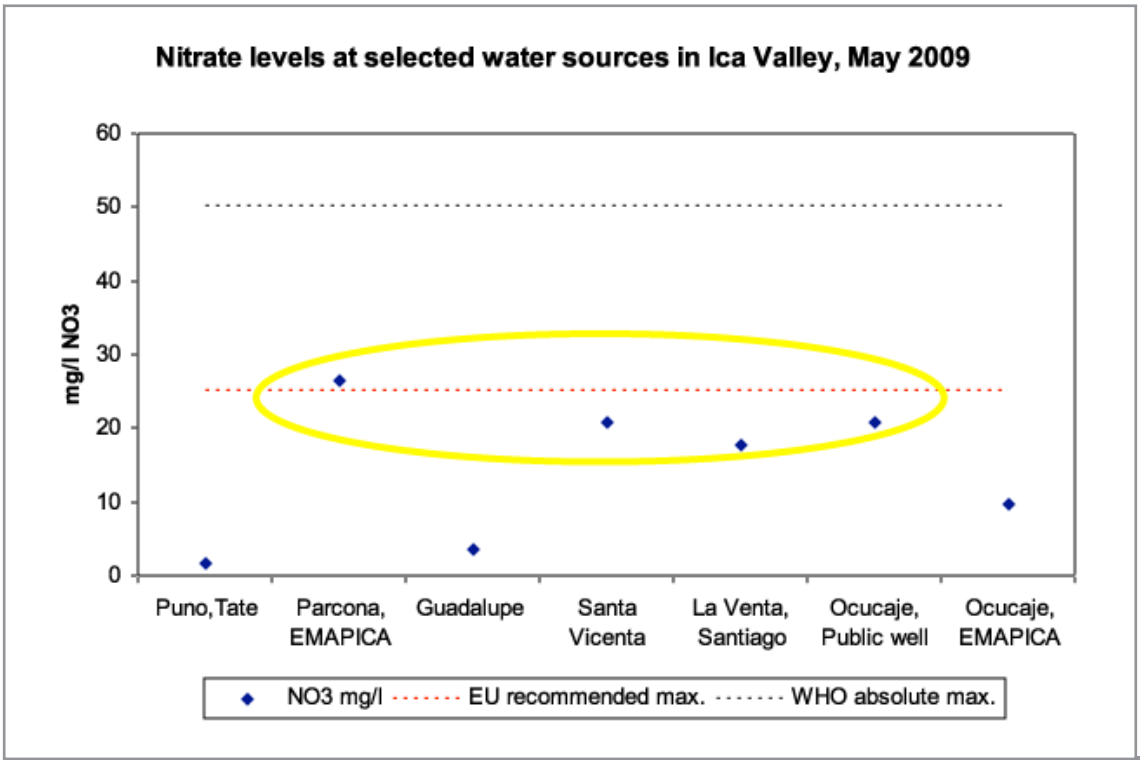


Figure 10 Nitrate levels at selected water sources in Ica Valley, May 2009

3.2 Impacts in the upstream and adjacent catchments

3.2.1 Water transfer from Huancavelica

A further impact of the asparagus boom has been to intensify demand for surface water, water in rivers, lakes and streams, upstream into the higher Ica basin and adjacent areas of the Andes. Agro-exporters use only groundwater in their irrigation systems because the sediments carried by surface water would soon clog drip irrigation systems and its use would require expensive pre-treatment. However, the thirst of the agro-export boom for groundwater has serious knock-on effects for surface water use and livelihood sustenance amongst water users higher in the basin.

By acquiring and controlling access to 90 per cent of the valley's aquifer,[68] agro-exporters have displaced much of the earlier supplementary use of groundwater by small and medium sized farms and diverted that extant demand onto surface water resources. As we have shown, many small and medium sized farms are no longer able to access groundwater and look upstream for the authorities to deliver that water from surface water supplies. By elevating demand and increasing the value of water in the valley, the agro-exporters are indirectly contributing to a race to acquire water resource rights and access. It was assumed by almost all stakeholders that water use by small and medium sized farms for flood and gravity irrigation had gone down –muscled out by the agro-exporters – but in fact our analysis of data from the Junta de Usuarios shows that their water use has also gone up by 35 per cent in 10 years.[69] By massively increasing water demand in the desert and driving the water balance of the valley and aquifer beyond sustainable limits, the agro-exporters are also forcing a process of strategic decision making about the allocation, transfer and use of bulk water in the basin and beyond. Rather than controlling demand, these decisions are focusing on diversion of natural flows in the mountains and the use of this water to artificially recharge the aquifer to remedy the overexploitation. In this section we see how that process is denying some of the poorest communities in South America the water they need as a livelihood resource, and in doing so enhancing their vulnerability to climate change.

68 Personal communication, representative, Junta La Achirana, 9 May 2009.

69 Data provided by Junta de Usuarios de Riego de Ica.

Voices from Huancavelica: water problems in the highlands

Alpaca herders don't have alternative livelihoods so grazing is important and for this they also need water. Political decisions are made on the coast and there is no investment in the mountains.

The main water need in the mountains is to irrigate grazing pasture – it's very dry so pilots with irrigated, cultivated grasses have begun. In Huaracco they have been fighting PETACC for 15 years to build a channel for irrigation of grasslands.

Representatives from Programme Sierra Centro, DESCO (Centro de Estudios y Promoción del Desarrollo / Centre for the Study and Promotion of Development)

The communities are complaining that springs, pastures and wetlands are drying – we need water harvesting and conservation – although the PETACC scheme has been there for 50 years, climate change has brought worry and pressure. In the past there was plenty of snow and plenty of water, it rained a lot but now, you can more clearly notice the drying and people are blaming Ica.

There are many water issues … pollution from mines definitely … private companies that want to do hydroelectric dams and reservoirs … but there is barely any water, especially in the dry season.

Progress is being made. Until recently Huancavelica Region had no representation in PETACC, now we have one seat on the committee of 14. We have a new environmental policy and are trying to agree and find compromise. We want reforestation to protect water sources, improvement of pastures, secondary canals and support for herders, contributing to their development through the economic welfare of Ica. But there is not much money – it stays in Lima. If the canons (payments for natural resource use) were well distributed, we would be swimming in money. Huancavelica keeps the pollution, but the money stays in Lima.

Representative, Huancavelica Regional Government

50 per cent of the mines behave well, 50 per cent don't and the problem is that national standards are relaxed. Some companies have an impact even when complying with the law. Conflicts are created – for example it is good business to own water rights where mines have concessions because they need water and you can sell it. People are speculating on water rights in mining areas – buying them up.

Representative, mining company

There are problems because of abandoned mines which were not closed properly. Poor water quality causes problems for alpaca herders – hair loss and miscarriage in their flocks. Santa Ines community have stomach problems and rashes – this is not proven but we suspect it and there is a letter to the ministry in Lima. It is a real problem – pH, lead, cadmium, zinc, arsenic. This also causes problems for trout farmers – they're not good enough for export.

Representative of MINEM (Ministry of Energy and Mines)

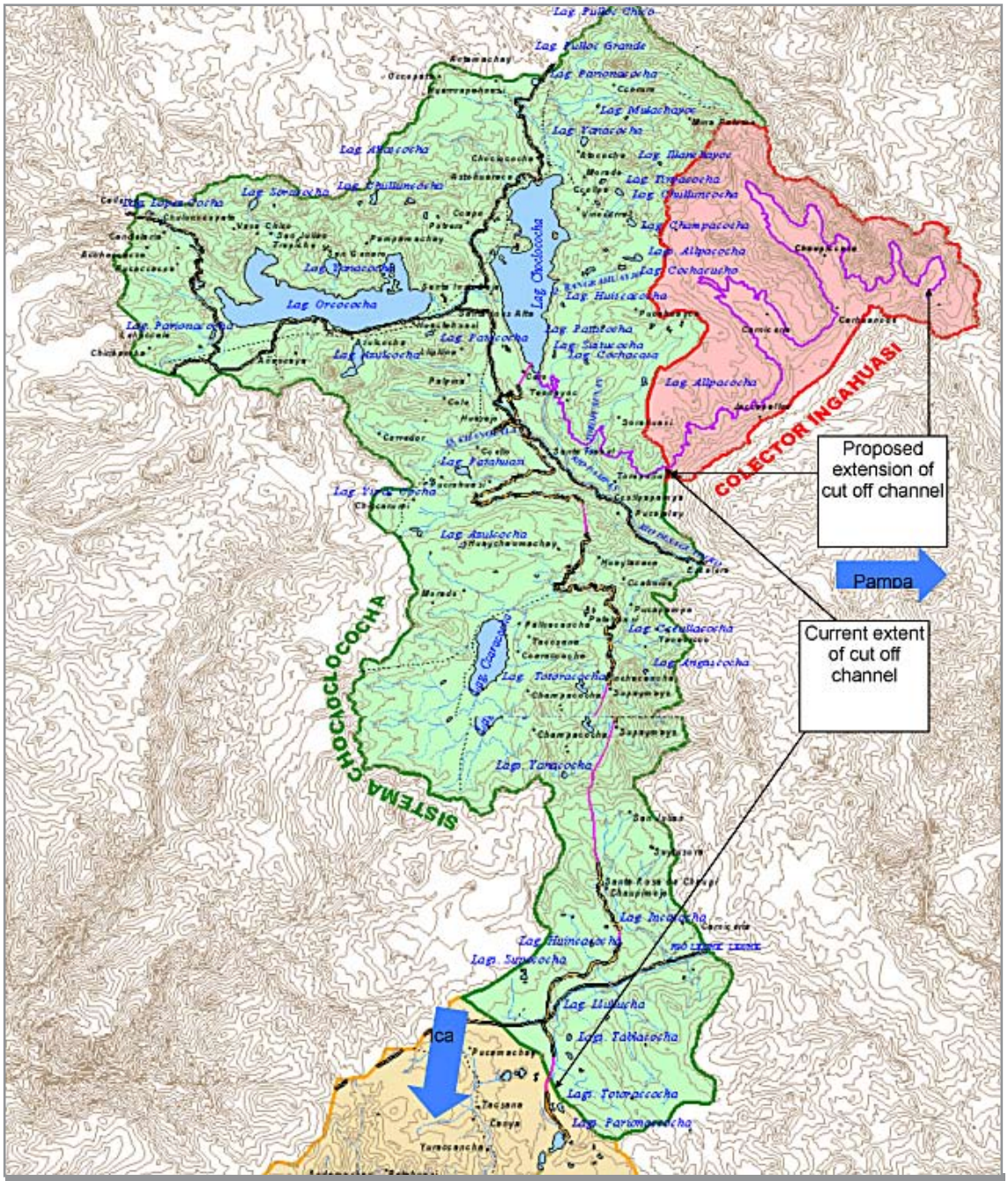
Interview dates 22 April-10 May 2009

3.2.2 Impacts of the PETACC scheme and its extension

The Tambo-Ccaraccocha Project was created by the Peruvian government to manage and administer the bulk transfer of water from Huancavelica to Ica. The infrastructure now managed by PETACC was built between 1940 and 1959 to divert flow from the Pampas River and its lakes of Choclococha, Orcococha and Ccaracocha in the Amazon basin, over the Andes watershed and into the Ica basin to support irrigation expansion. A formidable piece of civil engineering ingenuity for its time saw the original scheme damming the outflow of the Choclococha and diverting water through a 58 km long system of channels and tunnels to transfer 120 million cubic metres a year into the Tambo River at the head of the River Ica. From here it flows to the valley floor to be distributed by the Juntas of Rio Ica and La Achirana, who take 15 day turns to supply water for gravity and flood irrigation use by over 22,000 small and

medium sized farmers.[70] As well as diverting water from the lakes, the channel cuts off all the rivers and streams which would have flowed naturally to the other side of the mountains, in effect extending the Ica basin by 392 square kilometres into a much wetter part of Peru (see map 3). In 2003, the Peruvian government transferred the jurisdiction over the water systems to the Ica regional government, although the lagoons and their tributaries, as well as most of the infrastructure, are in the Huancavelica Region.[71]

It is relevant here to briefly relate how the PETACC scheme is designed and operates with reference to map 3 and the rows of plates 22 to 26.



Map 3 The area of Huancavelica from where drainage is diverted from the High Pampas (Amazon) basin to the Ica basin (yellow) and the proposed Incahuasi extension (Source: PETACC)

70 According to the Juntas, La Achirana has 12,500 users, Rio Ica has 9,500.

71 Latin American Water Tribunal (2007) Case report: Menace to the water resources and communities as a result of the construction of the 'Ingahuasi' water collecting canal, Provinces of Huancavelica, Castrorreyna and Huaytara, Huancavelica Region, Peru, Fourth Public Hearing, Guadalajara, Mexico.

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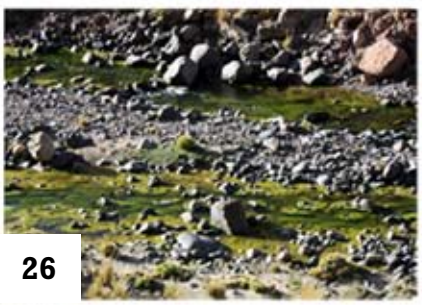

26

24b

↗ Plates 22-26 are explained in the text on page 53.

The volume of Lake Choclococha was increased by a dam to store water to transfer to Ica. The water collected is released for use in Ica from September to May. A spill way was built in to the dam so that any excess water could 'overspill' flood to the Pampas basin and follow its natural course (Row 22). As the photographs in Row 22, which were taken at the end of the 2009 wet season, show, the lake was still not full and the Pampas basin was receiving no water – the spill way is dry with all the water in the upstream catchment being stored for transmission to Ica via the transfer channel. This channel cuts across the mountains picking up all the rivers and streams along the way.

At this time of year, according to the Director of PETACC, there should be no transfer to Ica – all water should pass to the Pampas. Yet, as the photographs (Row 23 – comprising 5 pictures) show, all the flow from the Upper Pampas, draining an area of 392 km^2, is being picked up in the channel and diverted to Ica. Some of these diverted rivers are relatively large. In the middle column of the plates there is a car adjacent to the channel (indicated with a red arrow) to denote scale. The research team inspected the entire length of the channel and saw that except for two very small streams, all streams and rivers flowing from upstream were being picked up by the channel, with their entire flow diverted to Ica. This engineering design and operation is unusual in that there is little consideration or provision for 'pass forward' or environmental flow. Environmental flow is the water that is needed to perform important ecological, livelihood and landscape functions – the water for other users downstream in the Pampas basin. When we asked the engineers about this they showed us some small drainage 'vents', put in place to protect the infrastructure when the soil is water logged and told us that these were the environmental flow (Row 24, column 1). Along the entire channel there are only two engineered flow gates to pass forward flow (Row 24, columns 2 and 3, and plate 24b). The gates, which would have allowed water to flow to the Pampas, were shut despite the 'closed season' for the transfer. On later investigation we found that there are no formal operating principles for these gates. That is, nobody has quantified the downstream flow needs or provided a management system for opening and closing the gates to make sure these are met. In the absence of a 'pass forward' flow regime it appears that the Pampas River only receives water from its 392 km^2 headwaters once the full flow capacity of 15 m^3/s in the channel to Ica has been exceeded – in other words, once Ica has received its 120 million cubic metres. Only when Ica has taken this flow does spill water overflow through the concrete structures shown in Row 24. Plate 25 shows the Ccaracocha Lake, the outflow of which is also diverted into the channel, and hints at the enormous scale of the transfer across the mountains.

As presented in case study 9, the communities living downstream of the channel claim that they are deprived of their water needs by the transfer to Ica. The design of the Tambo-Ccaracocha transfer and the observations made in the field lend credibility to those claims. For example, plate 26 shows the main Pampas River some way downstream of the transfer channnel. The geomorphology of the river channel – wide and deep with large fluvially eroded boulders – suggests a historically powerful flow. Despite our visit being at the end of the wet season the flow in this river was very low. Even more tellingly, the algal weed growth shows that the river has been low for an extended period. Any significant flow would have sloughed off this weed and washed it away leaving bare rock and stones.

As the case study, selected quotes and plates 27-45 on the following pages illustrate, the people of Huancavelica lead a tough life. Livelihoods are based on herding alpaca, llama and sheep; temporary work in the mines or with PETACC; or on trout fishing and farming. Communities in Pilpachaca, the District downstream of the PETACC transfer, face some of the most extreme levels of poverty in Peru, and probably South America. The people of Pilpachaca with whom we spoke told us that whilst their own drinking water sources were relatively secure, their alpaca herds were badly affected by the drying effect of the PETACC water transfer to Ica. The alpacas, having evolved in these high Andes plateaus, prefer the moist young shoots of wet puna (grassland) or bofedales (peat or wetlands). The communities say that this wet pasture has been dried out and reduced by the transfer and that even when they try to create artificial pasture by irrigating from the channel, they are prevented from doing so by PETACC.

Irrigation demands in Ica are not the only restrictive influence on water use by these communities. Pilpichaca is also rich in metal ores and the historical operations of several mines cause ongoing mine water pollution. This pollution of several local rivers and lakes sees low levels of pH (acidic water) and high levels of toxic metals. The sampling results we obtained from the local health office listed sites in Pilpichaca which exceeded the WHO standards for toxic metals like cadmium and copper. There are real concerns about the impact on human health and several informants told us that the pollution had poisoned their alpaca herds, causing hair loss and miscarriages. A further impact is on fish. Some rivers and lakes have been rendered lifeless by pollution and in others there are questions about whether large scale trout farming, a recent economic initiative, will be viable because of the water quality specifications of the export market.

Case study 8: The experience of people in the hills of Huancavelica

Adolfo Martinez and Domingo Molinero herd alpacas in Pilpichaca but also do seasonal work for PETACC. They used to work in the mines, which paid a reasonable salary for the area.

↗ An alpaca herd and herder

"The main problem with the transfer channel is animals falling into it, but mining causes us the most problems. Alpacas lose their hair and have miscarriages when they drink water." We sampled the lake water Adolfo referred to, below the Caudalosa Grande mine, and found an acidic pH of 4.5 (rainwater usually has a pH of 5.7). Monitoring by the Regional government shows high levels of cadmium in the same body of water.

A member of the Santa Ana community said the main problem they face is that the alpaca fibre price is low and there is no help for them. They would like to use water from the lake to expand their grazing areas but there is no money: "Who would pay?" The community collectively sold one hectare of the lake for US$15,000 to a Chilean company to set up a fish farm.

↗ Pilpichaca town centre

An old lady from the Choclococha community told us: "Water here is polluted. Animals that drink the water die because it's acidic. The lake level also fluctuates because of the hydroelectric power station and ruins former grasslands."

A herder in Pilpichaca told us: "The PETACC channel takes all the water and the lack of water means there is less pasture for us."

The district governor told us: "The canal affects us because all the water from the hills goes to the canal and on to Ica. The intakes take all the water away. If there was no canal, the water springs would flow, the oconales (wetlands) would be green, and our animals would be fat and strong, but now the land is dying.

"The transfer also affects us because poor people fish trout from the river to survive by selling or eating them, but now the river is more and more dry, the water warms up quickly and the fish die.

"The mining affects us. They are better these days, but before, San Genaro and Caudalosa [mines] threw everything in [Lake] Orcococha. There used to be trout, now there is nothing, it's a dead lake.

"We want the canal to let some water come down to us to keep the rivers flowing. There are two or three gates and they won't open them. Everything goes to Ica. We asked for some drainage through a pipe, but they said no, that they need it. PETACC won't explain why they don't let us get water; they only say that water needs to get to Ica, that it is a requirement … we are willing to share water, but not to give everything away.

"We would like to build reservoirs and irrigate pastures. If we have better grass, we can start promoting our alpaca meat for sale in the cities. It's good quality and has no cholesterol. But the animals are too skinny now, we have bad meat and bad fibre so we cannot improve our economy.

"PETACC does nothing at all, not even small collaborations. They say that there is no budget, all they do is employ some people, but temporarily and nothing else."

Note: Names have been changed

Within this context, where the actions of outside interests are already denying poor mountain communities the power to make decisions about their water use, the asparagus boom brings further water contests and conflict. However, these conflicts are not at all widely known in the Ica Valley. The overwhelming response from the people of Ica, when posed with the question of what to do about the valley's water deficit, is to bring more water from Huancavelica. Their main strategy is to increase supply from the mountains and to collect and store flood water from the hills to prevent what they view as wastage to the ocean. Rather than using less water, they suggest that the groundwater deficit can be made up for by bringing more water from the hills and recharging the aquifer. Although the technical and scientific viability of this approach is questionable and unproven, they hope that by encouraging water to percolate into the ground, either through more irrigation or via specially constructed recharge lagoons, they can store flood water in the ground for use in dry periods. The testimony cited below illustrates the primacy that this solution has in the minds of most water users and of the professionals tasked with solving the problem.

The PETACC transfer is being improved and expanded to make up for the groundwater overdraft and water deficiencies in Ica.

Director of PETACC

We must bring more water to recharge the aquifer.

Agro-exporter

Downstream farmers are asking for more water, that is why we are increasing the channel size, extending it and reducing leakage – we want to leave it open all year. It will be five years before it's all fixed.

PETACC Engineer

Agri-business are trying to bring water from the highlands as well as drilling. Everybody is asking for water from the highlands … and upstream is subordinate to downstream.

Economist, Civil Association for Water Management

Interview dates 22 April-10 May 2009

In order to meet the additional water demands of the Ica basin the PETACC scheme is currently the subject of a US$31 million dollar investment programme to renovate and extend the PETACC transfer.[72] The extension plans and engineering works under way involve upgrading of the channel's capacity from 15 to 18 m³/s; replacement of stonework with concrete to prevent leakage; construction of a 73 km extension, the Incahuasi channel; and the building of a new dam on the Tambo River. When complete, these works will deliver an additional 130 Mm³ of water per year to Ica, taking the total transfer to Ica up from 120 Mm³/yr to 250 Mm³/yr.[73] However, these plans are controversial because of existing and expected negative impacts for downstream communities in Pilpichaca and the Pampas basin. These controversies are explored within case study 9.

Case study 9: The Carhuancho water conflict

Water demand in Ica is responsible for plans to extend the PETACC canal into the mountains by a further 74 km to collect flow from the Carhunacho basin. This part of the improvement works will bring another 60 Mm³/yr into the Ica Valley. Known as the 'Incahuasi' scheme, this proposal is the source of significant local and now regional conflict. We were told that initially the scheme was rejected by the community in Carhuancho. They had wanted to see 'pass forward' drains built into the channel to allow them to irrigate pasture, but PETACC had allegedly refused. With the support of local NGOs the Carhuancho community took their grievances to the LAWT in 2007. Although the tribunal is non-binding and Peru is not a signatory, the judgment of the case[74] is significant:

"The absence of a basin management plan hampers the proper and equitable use of soil and water resources for all [the] basin's inhabitants.

"The decrease in the water flows and the wetland and grassland deterioration caused by the PETACC project during the years of its execution and the water diverted to the PETACC project, through the construction of the Incahuasi collecting canal, will cause damage to the environment through the disappearance of wetlands and the local inhabitants' economic and social wellbeing."

The LAWT resolved to:

"Hold the Tambo-Ccaraccocha Project (PETACC) responsible for the destruction of the natural water system and a fundamental ecosystem for the livelihood of the local communities.

"Censure the Peruvian national governmental authorities, the Ica regional authorities and the Tambo-Ccaraccocha Project for their lack of commitment in fulfilling their national and international duties, as well as for their harmful actions and omissions against life, health and nature."

The judgment recommended that construction cease until an environmental, social and economic impact assessment had been done with the participation of the affected communities, and measures to mitigate the negative impacts on the damaged ecosystems had been implemented; and that a comprehensive basin management plan be carried out and implemented.

The Incahuasi project and judgment is still hotly contested, as shown by the quotes below.

"The solution for water is the new transfer from the mountains, PETACC sold us the dream – we didn't know of these conflicts with the alpaqueros (alpaca herders)."

Farmer, Ica

72 Lahmeyer Agua y Energia S A, the company involved in this programme.

73 Personal communication, Director of PETACC, 6 May 2009.

74 Latin American Water Tribunal (2007), as note 71, Judgment available at http://www.tragua.com/english/hearing/2007/verdicts/ing_caso_peru.pdf accessed 9 July 2010.

"The project is paralysed because the community won't accept it. When grasses are dry, the canal takes too much water away and the animals die. All the springs have been directed into the canal."

Manager of Natural Resources, Huancavelica Regional Government

"Carhuancho has 300 comuneros [community members] and we are 1,000 people in total. PETACC is taking all our water and wants to take our lake of Yanacocha away. But we alpaca herders need the water for the animals to eat grass and drink. They have already taken too much water away for things like asparagus that use too much water. We will not accept the Incahuasi project.

"You must tell the world that Ica takes the water and leaves us nothing, with no help, damning us. By law, they should ensure we have the resources we need but they only give us temporary jobs. The big agribusinesses are taking hold of the resources, but what about us? What can we do?"

President, Indigenous Community of Pilpichaca

"Water isn't really a problem for alpaca farmers but they have the idea of getting compensation. The scheme is going ahead."

PETACC Engineer

"The complaints of Carhunacho and Pilpichaca are not valid. We only collect water in the rainy season and in the dry season the gates are open. Plus they get leakage. There is no EIA but now we are beginning a study.

"The tribunal? Peru is not a signatory and PETACC was not invited to give evidence. When only one party is present the recommendations are flawed. For example we were not even constructing, we were still at the planning stage. The case let us all down.

"Before 2006 Huancavelica never complained. This is all just NGOs stirring the pot!

"Who regulates PETACC? We have a board of the government of Ica, INADE (Instituto Nacional de Desarrollo, the Peruvian National Institute for Development), Ministry of Agriculture and growers in Ica, but technically nobody regulates PETACC. Huancavelica has no say in it."

Director of PETACC

This evidence suggests that poor communities in the mountains of Huancavelica are denied the use of water to support their already fragile livelihoods because of the demands for irrigation and the impacts of mining. It also shows that the rapidly increasing water demands and the groundwater deficit driven by the asparagus boom in Ica is diverting even more water out of Huancavelica, with potentially significant consequences.

However it is also important to recognise that the role of water and impact of the channel on alpaca pastures is disputed, and that the transfer to Ica could be sustainable if the environmental flow needs downstream in the Pampas were quantified and provided for. But no technical study or EIA on the issue has ever been carried out. As a result, stakeholders are 'working in the dark' and without doubt this puts the livelihoods of the poor and biodiversity in the mountains at risk, fuels contested claims and fans the flames of conflict to the detriment of all. These problems and contested claims are intensified by unusual weather conditions, and the significance and implications of climate change deserve special attention.

↗ **Plates 27-37**
Llama (27), sheep and alpaca (30) are the main livelihood resource of the poor in Huancavelica. Their preferred and natural grazing is the wet puna or bofedales (28, 29, 34) which requires wet ground – alpacas and llamas having evolved on this type of pasture. To develop economically and build resilience to climate change, upland communities are attempting to maintain and create ideal pasture through low tech water management and irrigation of grasslands. Trout contribute to local dietary needs and food security (36) and make a growing contribution to the local economy, through commercial farming (33 – Choclococha), informal fishing by the poor (35) and traditional small-scale farming (37).

Plates 38-45
The San Genaro (38) and Caudalosa Grande mines (39, 41) drain to Orcococha (40) and then to Choclococha Lake. Water quality sampling (42) in Orcococha shows the low pH (acidity) and elevated levels of toxic metals associated with minewater pollution, which local herders allege poisons their animals. Although environmental management and regulation of the mining sector has improved in recent years, abandoned mines still cause significant pollution in the streams and rivers of the High Pampas catchment (43, 44, 45).

4 The implications of climate change

Voices from Peru: a changing climate

There is much less snowfall now than when I was a child. We used to get 3 days of constant snow and it was so deep. Rains used to begin in October and last until March – now they begin only in January. We also get more cold snaps.

Member of Choclococha community, age 63

Temperatures are down with more freezing snaps, rainfall is more intense and snow peaks are gone. Water comes all at once and without snow, it all goes at once. [These] impacts have caused emergencies for alpaca farmers. Frosts kill the animals, they get more disease – particularly liver flukes. They need support to adapt – medicine, shelters, water harvesting for pastures and [better] organisation – but there are no funds.

Community worker, DESCO

All the hills used to have snow all year round up to the 1970s but this has disappeared.

Member of Choclococha community, age 83

There are more frosts and more cold winds and cold nights.

Pilpichaca resident

↗ **Locals report that these hills used to be snow covered much of the year, and that the alpaca pastures are drying up.**

It is hotter in the day and in the nights and the early mornings it gets way too cold. Before, the temperature was more constant. It is hotter on average … Cerro Palomo was always covered in snow; now the snow won't last.

Now we have strong showers and the water does not stay like before when it snowed. The snow used to melt slowly, infiltrating water all year long, now it flows suddenly in big avenidas (floods).

To adapt we've made sheds to keep animals from freezing at night and in the droughts we move the herds higher up, but some die because there is no grass for them.

Pilpichaca resident

All of those peaks you see over there would have been covered in snow in the past but it's gone and there is less water everywhere.

Herder, Pilpichaca

Minimising impacts of climate change will be through maintaining diversity of livelihood options. With no options for diversification there will be death.

Chair of Biology Department, National Agricultural University, Peru

Interview dates 22 April-10 May 2009

The report has mapped out a range of impacts associated with the increased use of water within the agro-export industry and has explored how these are felt by communities who are heavily dependent on water availability for their wellbeing. In assessing these impacts it is prudent to consider the implications of climate change and to appraise its role in exacerbating or ameliorating the problems. This is particularly useful to assess the most appropriate adaptation responses, that is, the policies and actions that are needed now to prevent negative impacts from the climate change which has already been set in train.

Peru has been shown to be particularly vulnerable to extreme weather, with global assessments revealing it to be consistently badly affected in terms of the destruction, damage and death caused by climate events.[75] Elsewhere, assessments of climate change in the Andes suggest that as temperatures increase, the Andean ice caps and glaciers will melt and that flow in rivers fed by the Andes will increase in the short term and then become increasingly dry and 'flashy' (a tendency to go from low flow to flood conditions and back again rapidly after a rainfall event).[76] If glacier melt through summer disappears, rivers will have less flow during dry periods, and with winter precipitation no longer stored up as snow, but flowing off all at once, the tendency will be for more floods in winter.

However, as a leading expert researching climate change in Peru points out: "It is dangerous to extrapolate knowledge about what will happen from one part of the Andes to the next. We need to be very prudent in our predictions. Because of the proximity of the Amazon basin – a climate engine – the complicated relief of the Andes, and the complexity added by the Humboldt current, Pacific structures and El Niño, the whole region is highly sensitive and difficult to model with any certainty."[77]

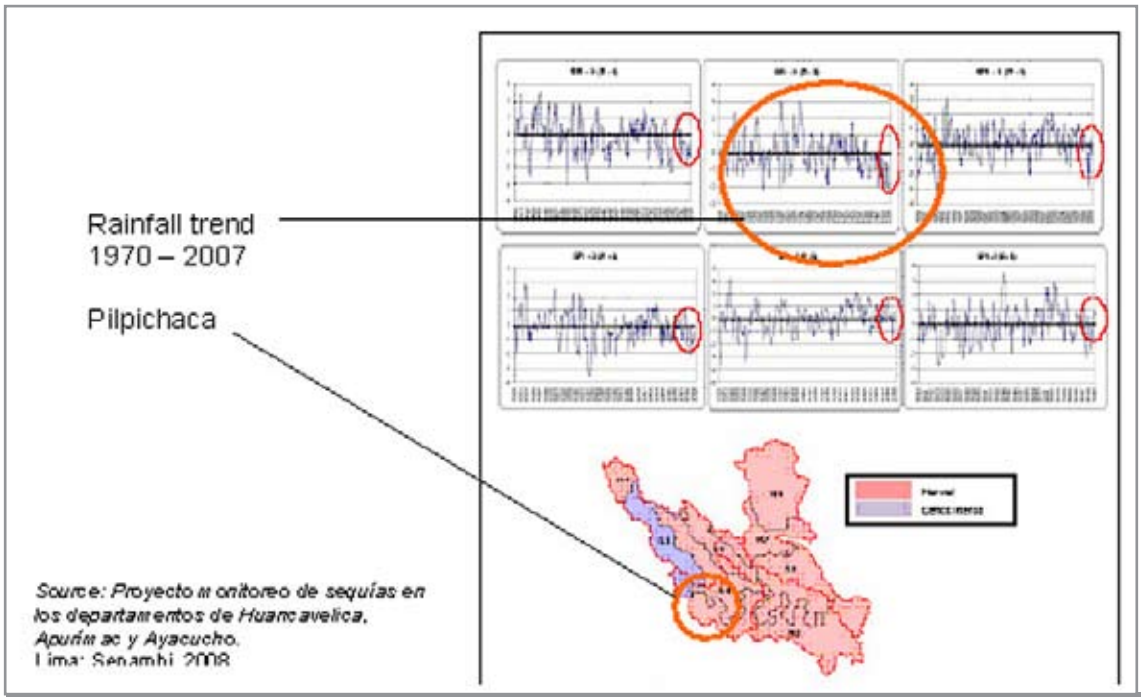

Figure 11 Extract from a recent study by SENAMHI showing past rainfall averages for sections of the Andes. The chart circled shows the averge precipitation received from 1970-2007 in the area shown on the map which includes the district of Pilpichaca at its southerly tip.

75 Adger et al (2004) New indicators of vulnerability and adaptive capacity, Tyndall Centre, University of East Anglia.

76 Bates B C et al (eds), as note 2.

77 Personal communication, Dr Thomas Condom, 25 April 09.

This is particularly true at a local scale where rainfall can vary dramatically from one side of a watershed to the other. The difficulties of predicting future climate in the Ica-Pampas basin are illustrated by the highly variable record of past rainfall in both space and time. Figure 11 shows an extract from a recent study by SENAMHI[78] which shows a marked recent decline in rainfall for a section of the Andes which includes Pilpichaca at its southernmost tip. The resources available to this current study meant that detailed climate change analysis and modelling could not be carried out. But annual rainfall records for the Ica-Pampas basin have been analysed (Figure 12) and these tell a different story to the SENAMHI work. Dating back to 1955, these suggest that at Choclococha in Pilpichaca, there has in fact been a slight rising trend in annual rainfall. In the downstream catchment there are no obvious trends. Rainfall is sporadic, and so little is seen as to make it almost irrelevant in terms of its value to agriculture. Knowledge of how rainfall will change and how the impacts may play out for agriculture and livelihoods is therefore sketchy.

Although a rising global temperature trend is beyond doubt, the changes that this will bring to average temperatures in the mountains of Huancavelica are also uncertain. As pointed out by a leading climate change expert: "For each high valley we don't know if temperature will go up or down. We therefore shouldn't over emphasise the role of glacier melt. Most of the water flowing in rivers is from precipitation and for total run-off, glacier melt is not so important. For maintaining base flows in the dry season, it is critical. There are no glaciers feeding the Ica basin, but the peaks are high enough to receive regular snow fall." [79]

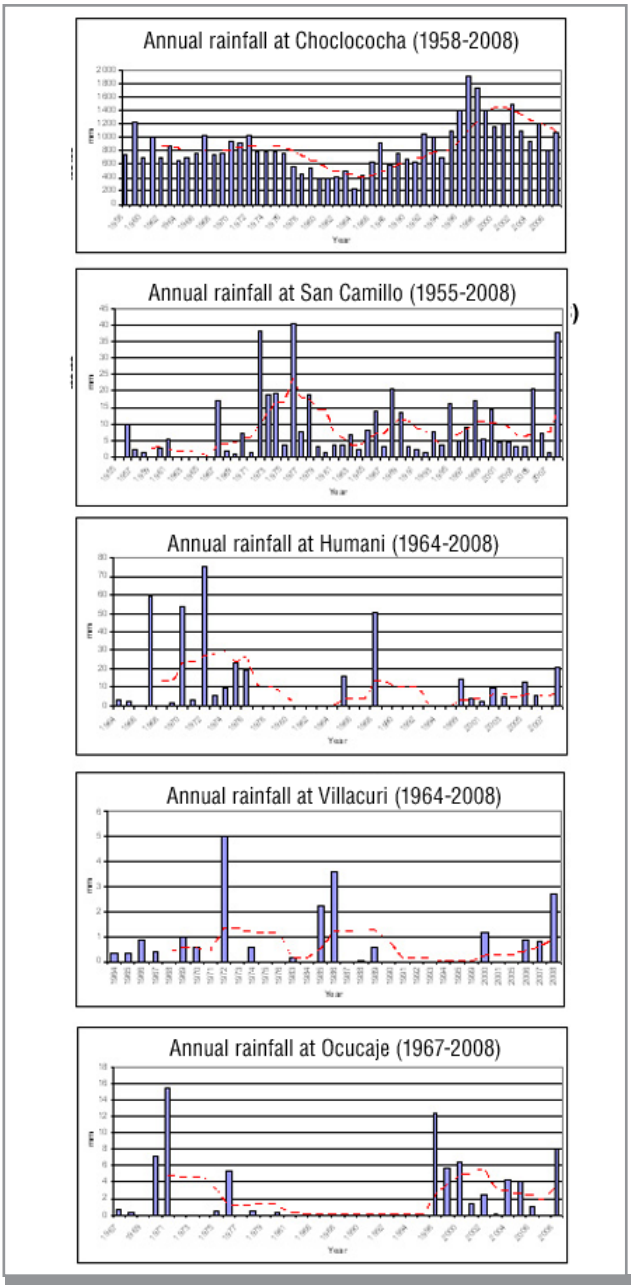

Figure 12 Available annual rainfall records for locations within Ica Valley with a five year running mean trend-line (here arranged by height above sea level of gauging station) (Source of data: SENAMHI)

78 SENAMHI (2008) Proyecto monitoreo de sequías en los departamentos de Huancavelica, Apurímac y Ayacucho, (Project to monitor droughts in the departments of Huancavelica, Apurímac y Ayacucho), SENAMHI, Lima.

79 Personal communication, Dr Thomas Condom, April 09.

Taken in total, the scientific assessments available, certainly in relation to the Ica-High Pampas basin, are not so useful in terms of predicting future climate trends. What they suggest instead is that there will be increased variability and almost certainly some form of change in rainfall and temperature, though the direction and rate is unknown. The testimonies of informants in Huancavelica reflect local perceptions of how the climate has been changing and what the impacts of this have been. In summary, they told us that it was generally warmer so that it didn't snow as much, but what snow did fall didn't last. They also said that the wet season was getting shorter and that rainfall was getting more intense and that there were more cold 'snaps' of well below freezing temperatures – know locally as 'friaje'. Without access to detailed meteorological records and analysis it is difficult to verify these claims beyond doubt, but the fact that similar reports came from informants in different parts of Huancavelica give their stories legitimacy.

Informants also said that the problems brought by these changes in the weather are mainly felt by their herds, with more disease, mainly parasitic liver fluke in herds,[80] stock deaths caused by freezing temperatures at night, and less pasture because of less or more sporadic precipitation, or less gradually released water from snow melt.

The implications of climate change may not appear serious for the people of Ica. Changes in snow cover or rainfall intensity are unlikely to be felt downstream where storage infrastructure lessens the climate 'signal'. The main question raised by valley farmers was: 'How can it get worse when there is already no rainfall?' However, the implications of climate change for poor communities in the mountains, already struggling to eke out livelihoods based on natural resources in harsh climatic conditions, are potentially very significant. Already there are indications that their herds, a major livelihood resource, are suffering, and given existing levels of poverty, poor communities in the mountains are highly vulnerable to any kind of climate change. As a Peruvian expert on adaptation to climate change points out, one of the main ways of building resilience to climate change impacts is to build diversity and choice into livelihoods. Providing more wealth and financial capital to cushion family incomes against climate shocks, and nurturing livelihood diversity based on reliable access to a variety of natural resources assets, are critical strategies which require high priority if the poor are to be spared the worst impacts of global climate change.

If Peru is to adapt to climate change without the social fallout of pushing the poor deeper into poverty, the policy implications of this analysis are clear. Firstly, mountain communities must be supported in order to strengthen the livelihood assets and choices available to them. Secondly, they must be provided with secure, sufficient and equitable access to natural resources. Thirdly, the natural resources they depend on must be managed effectively and sustainably for the good of all.

Our research suggests that the asparagus boom in Ica is having the opposite effect on poor mountain communities: eroding livelihood assets and choices, reducing levels of access to water and driving unsustainable management. Although their exact water needs are uncertain, the poor communities of Huancavelica are justified in their complaints of lost water. Inadequate consideration and engineering of the channel infrastructure means that downstream flow needs are neglected. The Tambo-Ccaracocha transfer and ongoing and proposed extensions limit the potential adaptation responses and increase the vulnerability of mountain communities by reducing the flows of water in the Pampas headwaters. Water needs in the mountains are also compromised by minewater pollution.

Progressive responses to this situation are proposed once the root causes of the impacts being wrought by the asparagus boom have been considered in more detail.

80 Increased incidence of liver fluke in livestock has been linked to climate change elsewhere in the world and is thought to be linked to increasing temperatures, milder winters and wetter conditions (see Fluke Facts, Merial, http://uk.merial.com/producers/fluke_facts.pdf accessed 9 July 2010). This doesn't immediately correlate with the testimonies about how climate has changed in Huancavelica and the issue should be the focus of further research.

5 What are the root causes of these impacts?

This report demonstrates how the unsustainable exploitation of water resources in the Ica Valley has a negative impact on small and medium sized farms, contributes to water scarcity and inequity for the poor and contributes to social conflict in the Ica valley and beyond. It also traces these impacts to a growth in the volume of asparagus exported, primarily to developed countries. Peru's ability to meet this demand has been promoted by substantial investment schemes, which have contributed to a rapid expansion of the agrarian frontier in the deserts of Ica.

The water footprint of the asparagus trade can be considered unsustainable given the hydrological contexts and concurrent demands for water in Ica. It raises serious and pressing questions about responsibility and due diligence in Peru and beyond. Unless considerate action is taken, in the short to medium term, the overexploitation of the aquifer may extinguish the water resource upon which over a third of a million people[81] depend for survival.

According to the majority of stakeholders in Ica, the favoured solution, which has already been set in motion with multi million dollar backing, is to transfer additional bulk water from the other side of the Andean watershed. These stakeholders want to try to recharge the Ica aquifer using this water by deploying largely untested technology and yet more irrigation. This environmental engineering 'solution' is high risk, not least because rates of evapotranspiration or onward flow may exceed rates of downward percolation. Alongside uncertainties regarding its likely success, the designers and implementers of this supply side solution have not taken into consideration or provided for the water needs of the indigenous mountain communities who depend on the same water they are taking. It thereby has a direct impact on the livelihoods of some of the poorest and most vulnerable communities in Peru.

A further added pressure is that these communities are also reporting being impacted by climate change, a problem which they have had no hand in, but for which the developed world's greenhouse gas emissions are largely historically responsible. Furthermore, the asparagus trade itself is further contributing to greenhouse gas emissions, with air freighting of Peruvian asparagus around the globe emitting approximately 8,157 tonnes of carbon dioxide per year for UK trade alone.[82] However, the debate on the moral validity of carbon emissions and food miles is complex and evolving, and the net life cycle impacts and trade-offs for the world's poor and the environment of boycotting airfreighted food are not clear cut.[83] Although further investigation of the net impacts of the asparagus trade are outside of the scope of this work, a recent report by the International Institute for Environment and Development (IIED) and Oxfam concludes that the food miles approach "doesn't provide a robust enough basis for judging whether the contents of your food basket are environmentally friendly" and that "by buying imported fruit and vegetables, consumers could be making a choice that supports the livelihoods of poor farmers half a world away."[84]

The benefits which the asparagus industry is bringing in return is therefore an important aspect to consider before making any conclusions on the impact of the asparagus trade. The agro-export industry has created employment in Ica for over 10,000 relatively poor Peruvians and the foreign exchange of £140 million[85] per year is much needed by a country like Peru. A loss of the industry per se could therefore have detrimental effects on poverty rates. Notwithstanding this, fresh Peruvian asparagus is exported to countries like the UK, where it sells for an estimated retail value of £55 million each year – a significant gap compared to its estimated street value in Ica of £1.54 million.[86] While an increase in salaries and improved labour standards on asparagus farms have been reported, it can be argued that the real winners are not poor communities in Peru, but the agro-exporters themselves, their investors, agents and brokers and ultimately the supermarkets. However under current rates of aquifer overexploitation even these benefits can only be short term gains. There is

81 The population of Ica Valley, INEI data.

82 Based on air freight calculator provided by www.carbonadvicegroup.org accessed 26 June 2009.

83 See for example Soil Association (2008) Air freight consultation, Second feedback statement, Soil Association, Bristol, UK.

84 Chi, K R, MacGregor, J and King, R (2010) Fair miles: Recharting the food miles map, IIED/Oxfam, London and Oxford, UK.

85 Based on Aduanas data 2008.

86 According to Aduanas, in 2008 Peru exported 6.4 million kilogrammes of fresh asparagus to the UK. In a UK supermarket, 1 kg of fresh Peruvian asparagus sold for £8.59 in June 09. At the farm gate in Ica 1 kg of asparagus sold for 40 US cents – 24 pence in May 09. See Appendix 3.

therefore an urgent need to identify and address the root causes of the unsustainable aspects of the asparagus water footprint, to the benefit of both the industry itself and the poor people who depend on it for their livelihoods or are negatively impacted by its high water extraction rates.

In order to signpost potential routes for progress, the set of interrelated factors which have contributed to the hydrological crisis unravelling in Ica need to be fully understood. These causative factors have been grouped into the 'failure of regulation' and the 'failure of responsibility'. As has been indicated in Figure A in the Executive Summary, the water problems in Ica inevitably open bigger debates about potentially systemic failures within models of globalised trade and the trajectory of development in places like Peru. Whilst these are vital discussions that the study recognises as highly relevant, the resources available to the research and its scope limit their necessarily deeper consideration and exploration.

5.1 Water supply vs demand

Before exploring these root causes it is important to consider the effects of the current focus on increasing supply rather than controlling demand by stakeholders in Ica. Some insist that the problem has been caused by a lack of investment by government in the infrastructure required to supply the growing demand for agricultural water. The belief is that the deficit can be compensated for by capturing flood run-off to the ocean and bringing additional water from the mountains. Figures are quoted, of an average 100 Mm^3 of 'wasted' flood water flowing to the sea each year, and of an additional 130 Mm^3/yr which can be diverted from the Amazon basin. Certainly, if it is possible to capture, store and use this water in a way which is sustainable and economically sensible then it should be pursued as one part of an overall strategy. But, notwithstanding the potential for the transfer to impact on mountain communities, there are four reasons why the popularity of this 'solution' is dangerous.

Firstly, it diverts attention away from the more urgent need to control demand; secondly, it appears to be based on an assumption that traditional irrigation has gone down and that increasing this again will lead to recharge, when our research shows that water delivery by the Juntas to small and medium sized farms has actually increased by as much as 35 per cent since 1997.[87] Thirdly, the science and technology behind artificial aquifer recharge is uncertain in the climatic and hydrogeological contexts of Ica, and the assumption that recharge will deliver is a risky premise on which to gamble business and social security. Lastly, there is no guarantee that the additional water won't just drive further expansion and short term profiteering in the desert – as one agro-exporter told us: "Sure, if we had more water we would expand." Rather than focusing only on bringing more water supply to the valley, it needs to be recognised that the overwhelming cause of the problem is uncontrolled demand – and it is here too where the solutions must be focused.

5.2 A failure of regulation

Water resource use the world over requires robust regulation to reconcile the needs of all water users within the hydrological limits of sustainability. In doing so it must protect the essential ecological and social functions of water and prevent conflict. In this section we explore the interrelated set of reasons why water resource regulation in Peru has failed so badly.

As explained in the introduction, best practice models for water resource regulation have been semi-codified in the principles of IWRM with reforms toward this model ongoing all over the world, including Peru. IWRM has evolved from a perception that water management has been 'unintegrated', with economic sectors and ministries managing and using water independently; development of water resources taking place without consideration of impacts; water quality issues disregarded or disconnected from issues of quantity; groundwater exploited without concern for hydrological linkages with surface water (and vice versa); land-water interactions overlooked; ecosystems impaired and social equity disregarded.[88] IWRM is a simple recognition that the interconnectedness of the water cycle, particularly at river catchment and aquifer scales, requires that the full range of water uses and their needs should be considered together to avoid negative impacts and to optimise the benefits of water use equitably across society.

87 For calculations see Appendix 7. Data from Junta de Usuarios annual returns, Ica.

88 Molle F (2008) 'Nirvana concepts, narratives and policy models: Insight from the water sector' in Water Alternatives 1(1), pp 131-156.

The model these reforms are based on depends on regulatory control of water resource transactions, that is, abstraction of water from rivers, lakes or groundwater and the disposal of wastewater. Simply put, if you want to take water from the environment or put waste water into it, some authority acting on behalf of the 'public good' should be able to assess the resource availability, determine whether your proposed actions are acceptable, provide you with a legal agreement for that activity within a set of limits and then monitor your actions against a set of conditions. If you breach those conditions then the authority has a choice across a graduated set of responses ranging from constructive compliance assistance to punitive enforcement action, depending on the seriousness of the impacts. Use priorities are agreed at a national, regional or basin level to guide trade-offs when demands overlap. Ownership of the water resource is usually vested in the state with the system administered by a basin authority, with varying levels of stakeholder participation and subsidiarity in decision making.

Within this system the water user is charged to cover the administration costs of determining the application, with an annual fee for water use levied to cover ongoing costs of inspection and monitoring. In return for payment, the authority tries to ensure that the wider water resources are used within sustainable limits, protecting the licensed use from degradation and deterioration. Annual fees are often based on a sliding scale so that the large water users pay higher fees. Fees and charges provide another regulatory tool through which to apply economic controls on water demand. The system can be self-financing or partially so, with grant support from government.

A further element of an idealised regulatory system is a requirement for EIAs to be carried out for developments and projects which could have significant impacts. In many countries EIAs are required under planning law rather than water law and aim to ensure that development is within sustainable limits.

This model has proved to be relatively successful in many parts of the world. In some countries, including Peru, some elements, such as the requirement for abstraction rights, have been on the statute books since 1969. Even so, some important pieces of the puzzle have been missing and a set of interrelated factors have worked against effective implementation. Peru is not alone in these difficulties and reforms under the name of IWRM are under way all over the world to supplement, patch up or overhaul existing systems.

Historically in Peru, water resource management has been in the hands of the agricultural sector and the Ministry of Agriculture. The water law of 1969 was designed as part of ongoing agrarian reforms. Up until 1989, Technical Authorities of Irrigation Districts (ATDRs) managed most of the country's water resources under the Directorate of Water in the Ministry of Agriculture. But there were problems – they had limited capacity and in 1989 a tide of complaints and even riots forced the government to hand over water management and tariff collections to the water users themselves, under elected boards called the Junta de Usuarios. The Juntas still manage infrastructure and decide water turns between irrigators, and farmers pay them a tariff depending on farm size and crops grown. With a view to driving economic growth through agricultural industrialisation, water use for irrigation was heavily promoted and in the 1990s water use was even subsidised and irrigation infrastructure built by government. The Juntas have become a politically powerful lobby. Accountable directly to the users themselves they may perform well in their allocative role within irrigation systems, but ultimately they are a service provider to farmers and cannot be expected to effectively regulate water resource use amongst different competing sectoral uses.

Because of this bias within water management towards agriculture, compared to other important sectors (industry, public health, hydroelectric power, mining and environment) and in the face of conflicts about water, Peru has undergone a lengthy period of legal and institutional reform towards a more integrated and effective system. The new water resource law (Ley de Recursos Hidricos, Nº 29,338) was passed in early 2009. It is elaborated in the National Water Resources Policy and Strategy of 2009[89] and together they provide a promising framework for IWRM. The new semi-autonomous regulator, the National Water Authority (Autoridad Nacional del Agua

89 Ministry of Water (2005) Política y Estrategia Nacional de los Recursos Hídricos en el Perú (National policy and strategy for water resources in Peru), Lima, Peru.

or ANA) will work through a system of 14 river basin Water Administrative Authorities (AAAs), who will decide on water allocations, advised by a Basin Council of Stakeholders. AAAs will have a local operational presence through Local Administrative Authorities (ALAs) who will carry out enforcement work. There are still a few loose ends in the law; for example the exact relationships and functional split of the AAAs, ALAs and Juntas is not clear. Also, although the law sets water use for human health as a priority, it gives only a vague framework for subsequent priorities, suggesting that productive use should be prioritised based on criteria of efficiency, employment and environment impact. Worryingly, this potentially disregards other priorities, such as the social impact and needs of smaller producers who may not be considered as efficient as large scale producers. Other parts of the law seem progressive: strengthening the requirement for water rights; providing power to the ANA to fix water use retributions (payments to the state) and bringing under one authority (the ANA) responsibility for both water quality and water quantity.

Implementation of strategy and capacity building for the ANA is being supported by international finance institutions through the 'Water Resources Management Modernisation Project',[90] with US$25 million to be spent in five years with loans from the World Bank (US$10 million) and Inter-American Development Bank (IADB) (US$1.5 million). The project will target special support to a selection of basins, one of which may be Ica.

To assess the likely success of these promising reforms and support programmes, the causes of the past failures which have lead to Ica's problems provide a useful lens for analysis. They are reviewed here.

5.2.1 Absence of regional or basin planning

EIA exists in Peru but not for agriculture; too many vested interests thought it would restrict them.

Ica academic

A group of Peruvian investors bought this land in 1997 … before, it was communal land ... we had to come here and extend the agrarian frontier as all other sites were taken. There was no planning control, we just bought it.

Ica agro-exporter

There are no planning rules or requirements for EIAs in the agricultural sector. The government backed away from this because they were afraid of serious political trouble from agro-exporters and small scale farmers. They thought there would be huge political fall out and that implementation and enforcement would be impossible.

Ex-Senior Officer of CONAM, Lima

There has been no logic in the past in relation to asparagus growing. Land acquisition takes place with no discussions about water – it has been speculative. Short term investment for short term returns. They don't need permission. Hotels, mines, everything else yes, but agriculture no. Agricultural planning is flawed with a lack of coordination between local, regional and national government. There is no national planning authority – it was done away with through neo-liberal reforms as a condition of aid. It used to be the National Institute of Planning but this was disbanded in an attempt to shrink government and let the market control and provide solutions. Clearly the market has failed to do so.

There was a lot of inward migration to Ica with people escaping the Shining Path in the 1980s. There was no land and no work for these people and a political imperative to provide jobs. The decision to grow asparagus came from investors themselves and from government keen to deal with migration.

Senior Researcher, Instituto de Estudios Ambientales, Pontifica Universidad Católica del Peru (IDEA-PUCP)

Interview dates 22 April-10 May 2009

90 World Bank (2008) Peru-Water Resources Management Modernization Project, Project information document, Report no: AB3856, World Bank, Washington DC.

One of the main causes of the Ica water crisis has been a lack of rational planning and development control. It would seem logical for a country seeking to develop its economy and its resources to go through a process of assessment which flags where available resources are, the viable options for development and the facilities required to see that such development progresses smoothly. In respect of water, river basin planning is a critical tool. It considers existing uses of water, the hydrological baseline and problems facing users to assess exploitable water reserves and set priorities for the basin. This process is most effectively carried out with the involvement of water user stakeholders from the basin. Participation helps to make sure that relevant information is considered, that stakeholders have ownership of the plan and implementation and that there is a reasonable level of representation and transparency in important decisions.

Basin plans usually feed into regional and national land development plans so that the government can guide investors and infrastructure investment towards the most suitable locations – to where the water is. On top of this, prior to development, there must be an EIA which considers all the potential impacts and benefits to guide approval decisions and to set controls and compliance mechanisms to prevent negative impacts. Yet, despite the importance of these processes for both economic and social welfare, they have not been used to guide agricultural development or the large water transfer schemes like PETACC.

The irony is that as the World Bank study shows, there are many valleys on the Pacific coast of Peru which have plentiful groundwater reserves, more than enough to meet the demands of the asparagus industry.[91] But because of laissez-faire planning and a failure of development control processes, the agro-export boom has concentrated around Ica – probably because of the available labour force, transport links and cheap desert land. Planning control could have used legal mandates to direct agro-export investment to areas where water was available. But as the testimony provided alleges, capture by powerful interests and political imperatives has waived any form of control over large agricultural development, viewing it, rather obtusely, as an impediment rather than an essential process to growth.

5.2.2 Inadequate legal and institutional frameworks and a lack of enforcement

The Juntas and Ministry are not interested in conserving water. Their job is to sell as much as they can.

Ica farmer

Enforcement never happens! Everything is settled under the table.

Ica agro-exporter

Yes, we have written water rights but it's a fly-by-night system. It's all very informal with no checking or inspections.

Ica agro-exporter

These big guys are expanding and drilling wells. The ban is a joke. There are lots of tricks to make it look legal.

Ica agro-exporter

Use and price doesn't reflect the real costs or value of water. Agriculture gets it at low price – there is no payment for water from the ground.

Junta, Ica

Interview dates 22 April-10 May 2009

91 Foster, S, Garduño, H, and Vidal, A, as note 48.

There have been serious flaws both within the legislation itself and the institutional arrangements for its implementation, which have conspired against sustainability and equity in Peru's water management. For example, control of water resources has largely been in the hands of the users themselves, through Juntas and the Ministry of Water. In the Ica-High Pampas basin, power is in the hands of more powerful users in Ica, who control use in Huancavelica. Within this scenario, whilst allocation of irrigation water amongst farmers may work effectively, incentives to control or cap total demand and to provide equitable access to other sectoral users or other regions are absent. Concurrently fulfilling the roles of poacher and gamekeeper has left the Ministry of Agriculture, the Juntas and the regional government of Ica with untenable conflicts of interest.

As already described, the unrestricted ability to move, buy and sell water rights amongst users and to switch licence numbers between sources has contributed to the overexploitation of the resource. Water right ownership is concentrated in the hands of a few and there is even speculation over water resources, with people buying water rights in the hope that they can later sell them for a large profit. Whilst water markets can have an important role in matching supply to demand, flaws in the legislative regime and the failure of enforcement and compliance have led to a de facto open access race to use the resource.

The failure to enforce the drilling ban is a good example of this. We were told that of an estimated 800 wells in Ica at least 150 are illegal and should have been closed. In addition although all borehole drilling companies must be licensed and controlled by law, out of five operating in the valley, only one was licensed.[92]

In spite of these issues there are signs of progress. Most significantly, a new and relatively comprehensive water law is now on the table and the local ALA has been established. New arrangements are already showing promising results. For example, Figure 13 includes a copy of the front page of an April 2009 Ica newspaper. It documents the first ever actions of the new head of the local water authority, who closed down an illegal drilling operation in the valley.

↗ **Figure 13 Voice of Ica, front page, April 2009; the illegal drilling rigs in question, still quarantined; and a copy of the regional government resolution prohibiting new wells in the valley (Photo: Bruno Güemes Delgado)**

92 Personal communication, Ica Regulator, 5 May 2009.

However, many challenges remain in making these reforms work for all water users, and a deeper understanding of why earlier institutions and regulations have failed and enforcement has not happened is required so that the same mistakes are not repeated.

Inadequate capacity, resources and information

The World Bank report highlights that in 1980, there were 4,000 water management professionals employed by government, but now there are only 150. To do their job, organisations tasked with delivering water resource management require sufficient numbers of motivated and capable staff, financial resources, equipment, vehicles and data. Ica has shared the underinvestment and staff shortages outlined by the Bank, which has denied the regulators these capacities. The new Head of Ica ALA is enthusiastic that he can bring change and plans to create a borehole monitoring and control office. But he also points out the meagre resources available to his office and, together with the doubts of others, this seems ominous.

> We only have a budget of 500,000 soles (about £100,000), four personnel, one working truck and one broken truck, and access to two lawyers.
>
> **Head of Ica ALA**
>
> ALAs are supposed to monitor, but where is the revenue? The ALA has no capacity, no vehicles and no logistical ability – they don't understand the hydrological balance.
>
> **Representative, Civil Association for Water Management**
>
> The new law is good – but we have the problem of no implementation. I met with ANA. They have no budget for implementation and no staff to do the job. There will be no policing.
>
> **CEO, agro-exporter**
>
> Interview dates 22 April-10 May 2009

One cross-cutting cause of the crisis in Ica has been a dearth of reliable information on water availability and use. The wildly varying figures of exploitation, exploitable resource and overdraft quoted to the team demonstrates this. Without reliable and freely available data, effective regulation and planning is difficult and an environment open to politically or commercially motivated misinformation is cultivated. The regulators desperately need the resources and capacity to acquire the data and information they need. Similarly the public and businesses require information on the water resource in a form they can understand, to support informed decision making and action.

Lack of capacity, including information, has been rooted in a lack of political will to provide the revenue needed to do the work of regulation. The new ALA Head is hopeful of change because water resource regulation is mentioned by name in the national budget for the first time and he intends to raise some money through fines. Another source of funding could be charges for water use. In the past there was no charge by the government for water resource use. But even now that there is, there is little incentive for local authorities to collect these fees because funds tend to be kept and spent centrally. Linking the fees paid by users more closely to the revenue delivered to regulate and monitor at a basin level could provide more incentives for collection and better match funding revenues to workloads. Unregulated water use and people not paying their water rights fees denies the government cash which could be used for regulation. We were told by an academic[93] that despite a recent World Bank supported project to register water rights, of an estimated 200,000 water resource users in Peru, only 30,000 had legal permission and paid fees and that even SEDEPAL, the water supply and sewerage company in Lima, don't pay.

93 Personal communication, Ica academic, 8 May 2009.

Of course effective use of these resources for the public good depends on political freedom and the probity of those tasked with regulation. As the new ALA Head points out, these have also been in short supply in the past:

> Groundwater management has been a disaster, with no control whatsoever. In Ica, politics and power play a role, and of course so does corruption.
>
> I need to visit the agro-exporters but I cannot enter their sites. I have the authority in the law but I have no power. I went to Lima and threatened to resign if I didn't have the political support to do this job.
>
> **Head of Ica ALA**

Corruption, capture and legitimacy

Alleged corruption and 'capture' of the regulatory authority are real issues which have rendered the water management regime a vehicle for overexploitation in the past. Accusations of corruption abounded and were not restricted to any one set of stakeholders. It was alleged, for example, that small farmers were selling the same wells several times over with false documents.[94] The World Bank[95] and stakeholders place beating corruption as a high priority for addressing the water problems in Ica:

> Corruption is the cancer that is rotting Peru. It's here in Ica's water.
>
> **Ex-Mayor, Ica**
>
> Corruption will persist and weaken the new law.
>
> **Representative, Civil Association for Water Management**
>
> Corruption was a huge problem but the new guy in the ALA is good, so he has social authority and legitimacy. The last guy was allowing illegal well drilling under the cover of cleaning wells. The whole country is corrupt – it's serious.
>
> **Representative, Commission of Groundwater Users of Ica Valley**
>
> There has always been a water rights requirement for groundwater but there has been a lot of corruption. It's a rough game – the Tacan ALA chief ended up in a coma for two years for trying to stop a well being drilled. They get around 1,500 soles a month (£500) – the salary is too low. Corruption is everywhere here but the new ALA chief here is good. He has guts, but he needs help.
>
> **Representative, Commission of Groundwater Users of Ica Valley**
>
> Interview dates 22 April-10 May 2009

Regulatory capture is a further barrier to equitable application of water resource law. It is perhaps more insidious than corruption because it covers manipulation of the legal framework with a veneer of legality. It is also very difficult to substantiate or prove claims of capture. Informants throughout the Ica Valley and in Lima attested to the political power and influence of the agro-export industry. In particular, one large agro-exporter was accused of having the law changed in their favour, to permit the movement of water from wells over long distances and to move wells from one place to the next.[96]

94 Personal communication, agro-export farm manager, 3 May 2009.

95 Foster, S, Garduño, H, and Vidal, A, as note 48.

96 Personal communications, several sources Ica and Lima, 22 April-9 May 2009.

There is also a fear that the new ANA will remain beholden to political masters in the Ministry of Agriculture, or be manipulated by different Ministries to deliver outcomes beneficial to one sector or another:

> They don't have enough power, and it's intentional that they are subordinate and have weak decision making power. It's very damaging because although investment is important, we don't have the balance right. Decisions are made for the benefit of private interests rather than for the good of everybody. Investment is not sustainable because ministers allow speculation.
>
> **Lima academic**

Closely related to this is the issue of the perceived legitimacy of the regulators and the law. Where users do not recognise the legitimacy of regulators, either because they see them as corrupt, as working for powerful elites or specific sectors, as incapable, or don't believe in the value of their work, then this plays a very significant role in the levels of compliance and cooperation. Of course the law upon which the regulators base their work needs to be seen as just, but even with a reformed regime there are doubts as to whether the new regulators can carry off their role:

> Social and cultural acceptance of the new law is not there, the ALA Head is not acknowledged and has no legitimacy – he may have authority but no power whereas, say, the Director of Agriculture or the President of the Junta does have. This has not been considered. It's a weakness and is a consequence of the role which water plays for the government. The public perception is that the government is servicing patrons as opposed to managing users. There is capture there.
>
> **Representative, Civil Association for Water Management**

The new law already faces problems of legitimacy. There is a belief amongst some stakeholders that the new water resource law opens up water management to privatisation, and the Juntas, some NGOs and politicians have fuelled this perception. There have been incidences of public unrest, strike action and demonstrations. As a prominent Peruvian expert on environmental law points out:

> Congress messed with the law. They had no real time to consider it and made small changes with chaotic results. Some congressmen, with the protection of small farmers in mind but without knowing the main issues of the law, proposed that the words 'water should be administered for the public good and not for profit' should appear. When this 'not for profit' was dropped they claimed it was a privatisation law. NGOs and local communities are now backing these accusations and there have been strikes in Cuzco and San Martin.
>
> But these concerns are not really valid. The new law actually decreases the power of the private sector in decision making. For example, the Juntas become part of the Basin Council. But they still say it is privatisation. Some of them believe it, but equally, for some it is just political gamesmanship.

Some stakeholders shared this view:

> The Juntas are stirring up trouble and telling people the law is privatisation. It's misinformation and politically motivated – the Juntas want to keep hold of power.
>
> **Ica farmer**

Others didn't:

> There are legitimate fears that the new law, in introducing the option for private operators to own and operate major water projects, could hand control of access to water to an independent profit oriented enterprise.
>
> **Lima academic**

So controversy has accompanied the introduction of the new law. Some of it is apparently politically motivated and some is based on valid concerns about negative impacts of private control, or continued sectoral control of water.

5.2.3 Prospects for the new law

For the new water resource law to be effective these issues of capacity, resources, information, authority, corruption, and legitimacy need to be addressed.

The new water law and institutional regime promises positive change and is a real opportunity to deliver more equitable and sustainable management. But there are uncertainties and these are summarised here with suggested responses:

- The law seems to suggest that water use which creates jobs and is efficient should be prioritised above other types of use. This could lead to the prioritisation of water use based on the economic values of water rather than its social values. Based on the criteria suggested, the interests of large investors who can afford efficiency measures appear to be placed above the interests of poor communities who may depend on water for their livelihoods. Such a prioritisation system based primarily on the economic benefits of water use could drive social and environmental change which has little benefit for the majority of people in the basin.

It would be prudent for the government to elaborate and strengthen this prioritisation regime to ensure that the livelihoods of the poor are more explicitly protected, whilst also recognising the important role of water for economic growth. The NGO and research community also have a role to play through civil society oversight. They need to monitor prioritisation decisions and trade-offs to ensure that social equity issues are considered and that the 'public good' is served.

- The law does not adequately reconcile issues of conflicting regional interests, decentralisation and the role of Basin Councils. For example there is lack of clarity about the interfaces between the AAAs, ANAs and regional government and the role of Basin Councils. With recent heavy emphasis on decentralisation of power to regional government in Peru, some stakeholders think that giving the ANA power over regional governments goes against the grain of these reforms and will face political challenges.

It is vital that some supra-regional authority has responsibility for adjudication where water is shared by more than one region. It will be critical for the new institutions to quickly work out how their relationship with regional government will work – and again civil society needs to provide objective oversight to blow the whistle where obvious bias occurs. Given the juxtaposition along the coast of poor indigenous regions upstream providing water flows to the drier, wealthier coasts with increasing water needs, these potentially difficult relationships require urgent attention. The basin authorities and ANA must have the capacities they need to resolve contested water issues and the political clout and probity to escape manipulation by different regions. Equitable and active representation by the regions on the Basin Councils will also be critical.

- The ANA is still ultimately reporting to the Ministry of Agriculture and claims of continuing bias continue. Similarly there is disquiet from some stakeholders that the new law is a vehicle for water privatisation. Both these claims have serious potential to undermine authority and bring rejection of the reforms.

Perceived legitimacy is a problem that the ANA will have to shake off quickly by demonstrating its autonomy and intention to work towards the public good. Ensuring equitable access to the law will be a challenge – a great deal of work will be required to make sure that the small and medium sized water users and the poor understand the benefits of having their water use formalised. Without good outreach, communication and logistical provisions to reach all users equitably there is a risk that the new water law could merely provide preferential 'access' to water for the powerful. Here again is a critical role for NGOs, who hold the trust and ears of poorer communities and stakeholders distant from centres of power. If the new law is to work for poor communities, then they will need to understand its practical implications clearly, based on effective communication – without political spin.

- To make the law work ANA will need capacity, resources, political space and strong civil society oversight to ensure it is working for the public good and is incorruptible. Civil society will also need the same provisions in order to provide that oversight. It is not clear whether those resources and capacity will be forthcoming. Although the World Bank support is promising, World Bank support programmes in other countries of the world have had mixed success, in part due to a heavy reliance on consultants to deliver the work and in part due to a failure to address extant corruption and capture.

Meeting the information and capacity needs of the emergent ALAs, AAAs and ANA and providing them with the political space and probity controls to do their jobs effectively need to be top government priorities. Only an autonomous and well resourced basin authority working for public benefit can reconcile the difficult challenges facing water management in Peru. If they are not well resourced then impacts and conflict can only escalate. Civil society needs to be provided with the resources to fulfil its important oversight role, including tracking funds through the system; accountability against performance indicators; use of donor funds and revenue gained from water user fees – monitoring whether funds for water resource management are used to the benefit of all Peruvians rather than a select elite. Without concurrent support for civil society involvement, the World Bank's investments in the Water Resource Modernisation Programme are unbalanced and will fail to deliver equitable benefits. It will be important for the 'noise' being made by many NGOs on water and climate change issues to be converted to a targeted and credible voice. A united coalition of interested NGOs should be encouraged, with particular efforts to prevent political polarisation from compromising pragmatic progress for the poor.

5.3 A failure of responsibility

Alongside regulatory failure, failures of environmentally responsible business practices and corporate social responsibility can also be seen as one of the root causes of the water problems facing Ica and Huancavelica. These are failures not just by the agro-export companies themselves, but by those investing in them and insuring them and by their downstream supply chain, including the UK supermarkets.

5.3.1 Agribusiness

Many agro-exporters set up in Ica prior to 2002, before the aquifer became unsustainable, and they related their growing concerns as others moved in or expanded to use the limited shared resource without regulatory control. Our assessment does not attribute responsibility to all the agribusiness enterprises in Ica. There are some which have attempted to do what they can to avoid or remedy the crisis; however, there are other examples where questions can be raised regarding business practices that involve setting up operations or expansion based on resource use which is ultimately unsustainable. In the regulatory and planning control vacuum seen in Ica in the past, there were few external incentives for businesses to conduct pre-development appraisals. Nevertheless, given the hydrological conditions in the Ica Valley one would assume that an essential step in establishing the viability of an agricultural business would be to make a detailed assessment of water availability and trends. In contrast, businesses have moved into asparagus growing in Ica since the overdraft became obvious, which suggests that either information on water availability and trends was not available, or that the businesses have primarily been interested in short term returns given the limited water supplies, or that they are confident that they have the economic and political clout to win access to further water in the future.

5.3.2 Investors

Water usage and availability are increasingly recognised as risk factors for businesses that can have severe impacts on both long and short term profitability. In the case of the desertlike conditions in the Ica Valley and the substantial water needs of asparagus farming, it would seem that a prudent first step for any lender, investor or insurer would be to require a comprehensive assessment of long term water availability and of the water risks posed. Nevertheless, our analysis suggests that although the exploitation of the Ica aquifer began to exceed sustainable limits around 2002, investors and banks have continued to support expansion of the agrarian frontier since then. Furthermore, new farms continue to appear – the site shown below in the south of the valley was established in 2006 and was expanding at the time of our visit.

↗ **Ongoing expansion of the agrarian frontier in Ica – greening the desert.**

According to one of South America's leading researchers on water: "You have to ask what kind of businessmen these people are. Most investors are interested in a quick buck – pump the water whilst you can and make a quick profit."[97]

International investment has played an essential part in the substantial growth of asparagus production. The crop was first introduced to Peru on a small scale in the Viru valley (in the region of La Libertad, north-western Peru) in the 1950s to serve the Danish market. Thereafter the growth was slow and largely limited to La Libertad until the late 1980s. Through funding from the United States Agency for International Development (USAID), the Ica Farmer's Association sought to replace traditional crops with export crops and to explore the US export market. Asparagus was deemed the most promising crop, due to the prices that could be obtained when out of season in North America. Both seeds and experts were flown over from California for advice on crop management, packaging and exporting, paving the way for production on a large scale. Based on the success of the initial trials, the boom ensued, based on high quality and profitable crops for the export market.[98] The preferential treatment the industry enjoys from the US has helped the industry to access its biggest market. In 1991, the US government introduced the Andean Trade Preference Act (ATPA), where the import tariffs on many agricultural products were eliminated in a bid to turn the countries away from coca cultivation. As a result Peruvian asparagus is exempt from import tariffs.[99]

Additional support for agro-exporters has been secured by international financial institutions, such as the Inter-American Investment Corporation (IIC)[100] and the IFC, the private sector investment arm of the World Bank Group. The IFC is a member of the World Bank Group and its activities are closely coordinated with the development objectives of World Bank institutions. It assists in financing the establishment, improvement and expansion of private sector enterprises by making loans and investments "where sufficient private capital is not otherwise available on reasonable terms". The IFC's share capital is provided by its member countries of which the UK government is a board member.[101] The IFC's vision is that "people should have the opportunity to escape poverty and improve their lives". A fundamental part of the IFC's mission is its commitment to sustainable development and it recognises the significant credit, liability and reputational risks of investments which come through inadequate consideration of the environmental and social impacts of lending.

The IFC has established Policy[102], Procedures[103] and Performance Standards[104] on Social and Environmental Sustainability to "ensure that the costs of economic development do not fall disproportionately on the poor and vulnerable and that the environment is not degraded, and that natural resources are managed efficiently and sustainably". The standards form the basis for the Equator Principles, which are used by leading banks in applying high standards of environmental and social due diligence for their project finance activities.[105] The IFC also discloses information on all its investments including the environmental and social reviews of the first (1999/2000)[106] and second (2004)[107] transactions with asparagus growers in Ica. In addition, the IFC is a founding partner of the Water Footprint Network, which aims to promote the transition towards sustainable, fair and efficient use of fresh water resources worldwide.[108]

97 Personal communication, Teresa Oré, Lima, 24 April 2009.

98 O'Brien, T and Diaz Rodriguez, A (2004) Improving competitiveness and market access for agricultural exports through the development of food safety and quality standards: the example of Peruvian asparagus, Agricultural Health and Food Safety Program of the Inter-American Institute for Cooperation on Agriculture (IICA).

99 Shimizu, T, as note 26.

100 See for example IIC (2003) Investment summary, IQF del Perú, Project PE1116A-01, www.iic.int/projects/view.asp?id=37 accessed 9 July 2010.

101 IFC, Financing FAQs, www.ifc.org/ifcext/about.nsf/Content/Financing_FAQs 9 July 2010.

102 IFC (2006) Policy on social and environmental sustainability, April 2006, IFC, Washington DC, p2.

103 IFC (2009) Environmental and social review procedures V3.0, February 2009, IFC, Washington DC.

104 IFC(2006) Performance standards on social and environmental sustainability, April 2006, IFC, Washington DC.

105 See www.equator-principles.com/ accessed 9 July 2010.

106 IFC, Environmental review summary, project 9528, http://www.ifc.org/ifcext/spiwebsite1.nsf/2bc34f011b50ff6e85256a550073ff1c/60c6a79f396723e3852576c10080d114?opendocument accessed 9 July 2010.

107 IFC, Environmental review summary with attachments: Corrective Action Plan, project 23010, http://www.ifc.org/ifcext/spiwebsite1.nsf/2bc34f011b50ff6e85256a550073ff1c/09e4e7035bc6a4c0852576c10080cc4b?opendocument accessed 9 July 2010.

108 See www.waterfootprint.org, accessed 9 July 2010.

Part of the IFC's mandate in Peru is to "invest in industries with strong competitive advantages such as agribusiness and tourism" and "support environmentally and socially sustainable growth (natural resources sector)". The IFC has been particularly engaged in the growth of the 'new agribusiness', diversifying Peru's exports, going from a net importer of agricultural goods to a net exporter, focusing on non-traditional crops. It declares itself "one of the pioneers in supporting the diversification and competitiveness of the agriculture sector", which includes long or short-term support to major asparagus agro-exporters.[109] [110] Furthermore, the World Bank and the IFC's portfolio in Peru engages in, for example, water and sanitation, water connections in poor areas, water management and water rights, as well as analysis of the considerable environmental challenges in Peru, including the emerging water deficit.[111]

Despite the IFC's perceived comprehensive approach to ensuring social and environmental sustainability in its investment portfolio, it has received a number of complaints from civil society organisations concerning the weakness of its performance standards.[112] The problems with the performance standards and their enforcement were highlighted in Ica in 2009 when a loan to a major agro-exporter, which included "hydraulic improvements", was approved through a streamlined procedure. These 'improvements' proposed to "reduce the stress on the aquifer"[113] by transferring bulk water across the Ica Valley from one site to another, taking water from current wells, or "with the permission of government", through four new wells or surface water from the river.[114] The technical rationale for how the interventions would reduce stress on the aquifer was unclear. The Compliance Advisor Ombudsman (CAO)[115] received several complaints, including some from water user associations in Ica, and the loan was put on hold pending further investigation. The complaints in particular raised concerns about the project's impact on the Ica aquifer and on the municipalities and smaller growers who depend on it for their livelihoods. These are in line with the findings of the World Bank's mission to investigate the water problems of Ica, which concluded that current groundwater use in Ica is "obviously not a sustainable scenario",[116] Furthermore, the World Bank study found that "the main observed conflicts are caused by the water use of new agribusinesses which impacts on already established farmers", and where "users of three hectares or less suffer from the lowering of ground water tables caused by the abstractions of large agro-exporters".[117] It concluded that these problems have been brought about because the authorities lack power and that there was "no local capacity to attend to these issues".

Of further concern was that the IFC at the time of the loan approval had mainly performed physical evaluations of the company's operations, however, the Environmental Assessment (EA) to address ground water availability was still in process and a public disclosure and outreach programme was only at the planning stage. Questions can therefore be raised about the level of implementation of the IFC's own standards. There was an agreement among complainants that the company in question was not solely responsible for depletion of the aquifer; however, during the CAO investigation the company officially withdrew its request for IFC support for this proposal. Based on the investigation, the CAO has proposed recommendations for next steps, which are at the time of writing being considered by the parties.[118]

109 International Bank for Reconstruction and Development and International Finance Corporation (2006) Country partner strategy for the Republic of Peru for the Period FY07-FY11, World Bank, Washington DC.

110 IFC, IFC loan to help Peru's Sociedad Agricola Viru expand and support economic development in local communities, 16 November 2007, IFC, Washington DC, www.ifc.org/ifcext/pressroom/ifcpressroom.nsf/PressRelease?openform&FD13828FE8F99785852573950005E62D9 accessed 9 July 2010.

111 See note 109.

112 See for example Bretton Woods Project (2009) 'Concerns over IFC's upcoming performance standards review', 22 September 2009 www.brettonwoodsproject.org/art-565337 accessed 9 July 2010.

113 Compliance Advisor Ombudsman (2009) Ombudsman assessment report: Complaints regarding the Sociedad Agricola Drokasa S A, Project #26821 ('Agrokasa'), Ica Valley, Peru, December 2009. Office of the Compliance Advisor/Ombudsman, International Finance Corporation and Multilateral Investment Guarantee Agency, p3.

114 See Compliance Advisor Ombudsman, CAO cases - Peru / Agrokasa-01/Ica http://www.cao-ombudsman.org/cases/case_detail.aspx?id=139 accessed 9 July 2010.

115 The CAO is the independent recourse mechanism for the IFC and the Multilateral Investment Guarantee Agency (MIGA), which reports directly to the President of the World Bank Group. Its mandate is to address complaints brought by communities or individuals affected by IFC or MIGA projects, and to enhance the social and environmental outcomes of these projects. See www.cao-ombudsman.org/ for further info.

116 Foster, S, Garduño, H, and Vidal, A, as note 48.

117 Foster, S, Garduño, H, and Vidal, A, as note 48.

118 Compliance Advisor Ombudsman, as note 113.

The significant financial support provided by the IFC to one of Ica's largest agro-exporters inevitably raises questions about the adequacy of its social and environmental safeguard measures and their implementation. It illustrates that the IFC's safeguard measures have failed to assess or act on some of the risks attached to its lending. Specifically, it failed to consider the contribution of its loans to the collectively driven overexploitation of the aquifer or to address the multiple social and environmental impacts which this has brought. In conclusion, it is apparent that investors are overlooking the sustainability of the common pool of water resources upon which the agro-export business as well as local people depend, and that this is having significant social and environmental repercussions, particularly for the poor. This suggests that lending and investment safeguard measures need to be reviewed and enforced in respect of water resource sustainability. The IFC is currently reviewing its Policy and Performance Standards on Social and Environmental Sustainability,[119] and early drafts show that water is one of the priority areas for improvement. This provides an opportunity to demonstrate much needed leadership for other investors as well as for insurers and banks, in an area of increased concern. It is essential that the final approved standards give proper consideration to water resource issues in the IFC's investment decisions and that it promotes a participatory approach, including the voices and needs of poor and vulnerable communities that are affected by its investment decisions. Furthermore, it is essential that the improved standards are rigorously implemented without exceptions. In addition, it is essential that the IFC urgently reviews its current portfolio to ensure similar problems to those in Ica are not appearing in other investments. This responsibility does not lie with the IFC alone. The World Bank, and the UK government as an IFC board member, have a responsibility to ensure that safeguard measures adequately provide for sustainable water resource use.

5.3.3 Retailers

The failure of responsibility and due diligence 'upstream' by investors is mirrored by a failure of corporate responsibility and market standards 'downstream' in the supply chain. The potential impact of these market standards was made clear by our discussions with the agro-exporters themselves:

> Change is being driven from abroad. The UK/EU market has changed the way firms operate. Companies are taking up new protocols to secure their market and this has brought a silent revolution in the way things are done. For example, 20 years ago, if you said you were to provide a bathroom in every field for the workers you would be called crazy: now it is second nature.
>
> **Managing Director, Ica agro-exporter**
>
> In Peru, the law is not king – the market is king, even the President has less power than the market.
>
> **Ica farmer**
>
> We have a huge set of standards that are audited each year, GLOBALG.A.P., Nature's Choice, British Retail Consortium (BRC), Tesco, Hazard Analysis and Critical Control Point (HACCP), British Anti-Smuggling Coalition (BASC). We must have these to stay in business, but they only touch on water.
>
> **Site Manager, Ica agro-exporter**
>
> Interview dates 22 April-10 May 2009

Information about market trends is rapidly communicated through brokers, distributors, importers or even retail stores themselves.[120] In response to higher consumer awareness and expectations, as well as importing country regulations, voluntary market standards – the minimum conditions of production which must be in place for producers to enter the market – backed up by third party auditing and certification, have had a huge impact across global supply chains.[121]

119 See IFC, Review and update of IFC sustainability framework, www.ifc.org/policyreview accessed 9 July 2010.

120 OECD, as note 21.

121 Díaz Rios, L, as note 35.

Certification was initially considered an additional cost with no clear benefits to the asparagus industry, but verifiable quality and safety standards are now considered essential for accessing and gaining competitive advantages in international markets, and the Peruvian agricultural export sector prides itself on high quality crops, based on good agricultural practices and rigorous food safety standards. As a result agro-exporters are now certified under multiple schemes, with one of the largest Peruvian exporters of fresh asparagus reported to have been certified under no less than eight different schemes.[122]

The most commonly used schemes by agro-exporters are Peruvian Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP) and the Hazard Analysis and Critical Control Point (HACCP) system for food safety, but other certification schemes have gained importance as market strategies for differentiation.[123] Larger firms in particular have adopted additional standards, such as environmental sustainability and social responsibility procedures.[124] Operators in the European market are reportedly particularly strict on social accountability standards. One major UK supermarket, for example, requires certification and sends its own auditors to inspect.[125] Individual supermarket standards, as well as sectoral voluntary certificates, such as GLOBALG.A.P., featured amongst the many awarded to agro-export producers in Ica during our research. Although they entail a great deal of time, effort and investment, growers were committed to compliance and viewed attaining these standards as essential to gain market access.

GLOBALG.A.P. (formerly known as EurepGAP) is a private sector, voluntary standard for certification of agricultural products globally, and is marketing itself as a key global reference for GAP. It is a pre-farm gate standard, which means that the certificate covers the process of the certified product being produced from farm inputs like feed or seedlings, and all farming activities until the product leaves the farm. GLOBALG.A.P. is a business-to-business label and therefore not directly visible to consumers. It was initiated in 1997 by retailers belonging to the Euro-Retailer Produce Working Group (EUREP), where British retailers were driving the process in conjunction with supermarkets in continental Europe.[126] Members include the majority of Europe's main supermarkets, as well as producers and suppliers.[127] Peruvian agro-exporters originally opted for this standard to be able to satisfy the requirements of the main European supermarkets.[128] It is designed to reassure consumers that food is produced responsibly, by minimising the environmental impact of farming operations, reducing chemical inputs and ensuring a responsible approach to worker health and animal welfare. The scheme provides a system of checklists and 'must haves' for farms to be certified, along with sector specific criteria, including for fruit and vegetable production. Our analysis found only a few references to water within the standard checklists and, where available, specifications are primarily concerned with the quality of water used in the production process.[129] There is, however, a general requirement for a risk assessment which shows that "the site is suitable for production … with regard to … the environment"[130] and some further guidelines for water that specify that an evaluation should include authorisation for use, which should in turn include environmental impact and rights of other users. This is primarily for new sites and only used for other sites should the risks have changed.[131] Should the rapidly receding water levels in Ica be recognised as a change of risks by certifiers, this could open up new demands on asparagus producers in order to acquire certification.

Another standard reported to be in use by agro-exporters was Nature's Choice, which has been developed by Tesco to ensure that produce is grown safely with minimal environmental impact.[132] This standard has been rebranded as Tesco Nurture, with an added on-pack logo designed to more clearly communicate the programme's ideal to consumers.[133] However, there were no content

122 Díaz Rios, L, as note 35.

123 Díaz Rios, L, as note 35.

124 OECD, as note 21.

125 OECD, as note 21.

126 See GLOBALG.A.P. for further info, www.globalgap.org/cms/front_content.php?idcat=19 accessed 9 July 2010.

127 UK supermarkets that are members of GLOBALG.A.P. include Sainsbury's, ASDA, Somerfield, Marks and Spencers, Tesco and Morrisons, see http://www2.globalgap.org/members.html?memtype=retail accessed 20 July 2010

128 O'Brien, T and Diaz Rodriguez, A, as note 98.

129 GlobalG.A.P., EUREP GAP General regulations, Integrated farm assurance, Version 3.0-2, September 2007.

130 GlobalG.A.P., EUREP GAP Checklist, Integrated farm assurance, Version 3.0-2, September 2007.

131 GlobalG.A.P., EUREP GAP Control points and compliance criteria, Integrated farm assurance, All farm base, Version 3.0-2, September 2007.

132 Interviews 22 April – 10 May 2009. See also OECD, as note 21.

133 Barker M, 'Tesco accreditation scheme believe in Nurture over Nature', The Grocer, 7 March 2009 http://www.thegrocer.co.uk/articles.aspx?page=articles&ID=198132 accessed 19 July 2010

changes to the Code of Practice at this time.[134] On Nurture's website it is described as "an exclusive, independently accredited, quality standard that assures you, our customer, that Tesco fruit and vegetables are grown in an environmental and responsible way".[135] Although the Nurture standard is a step in the right direction, for example requiring that water abstractions are from authorised sources and within permitted quantities, it still falls short in several areas. As an example, it does not require any consideration of the sustainability or status of the water resource being used for production, or of needs of or impacts on other water users or water functions.[136] As such, it would not help prevent the dire situation such as that which has arisen in Ica.[137] In many developing countries where authorisation systems for water extraction are flawed, inequitable, subject to manipulation or simply don't exist, compliance with the standard could still give the impression of 'responsible use' even where water use has severe impacts on the environment and other users.

A positive aspect of Tesco Nurture is its mandate to continual improvement. On its website it promises to "strive to develop and improve our standard to ensure we continue to meet and exceed your expectations on quality and environmental standards".[138] This presents an opportunity to review the standard to ensure the water-related issues seen in Ica are fully addressed.

Impact of standards on water use in Ica

While it is apparent that the influence of standards has driven the asparagus business towards improvements in quality and food safety, as well as labour standards, and many agro-exporters are also involved in community schemes, it is also clear that the existing standards have to date collectively failed to adequately acknowledge wider environmental and social impacts, most importantly consideration of whether the water used in production will exert negative impacts on other users in the basin or aquifer. In the case of the Ica Valley, this means that despite the intent of these standards to promote sustainable resource use in farming, they have to date failed to act as a sufficient guard against the overexploitation of the local water resource. In this respect it is evident that they fail to comprehensively consider the sustainability of the most fundamental resource in farming – water – and the impacts of its overuse on local communities around the world.

The positive impact on the local population also deserves further scrutiny. While it is clear that the asparagus boom in Ica has provided significant employment opportunities in the valley, the main beneficiary of the unsustainable use of water in Ica appears to be the corporate sector. To illustrate this, the value chain of water embedded in Ica asparagus has been analysed. Each kilogram of asparagus grown uses around 1 m^3 of water and for each kilogram of asparagus cut and collected the farm labourer receives approximately £0.025 (two and a half pence). In contrast, a kilogram of Peruvian asparagus sells for £9.10 (or even £19.90 per kilogram for asparagus tips) in a UK supermarket.[139] So using a cubic metre of water in Ica to grow a kilogram of Peruvian asparagus for sale in the UK, the farm labourer receives as little as 1/780th or just over 0.1 per cent of the final retail price of the crop.

Despite these apparent failures of existing standards, their widespread use and uptake provide a potential opportunity for progress. As pointed out by our informants in Ica, market standards have brought positive social change, 'a silent revolution', particularly in terms of employment conditions for farm workers. It is also evident that in the case of GLOBALG.A.P. there are opportunities to give broad based water related impacts a more prominent role in the certification process; however, it is clear that the water situation in the Ica Valley has not yet been deemed a risk factor. There is therefore an urgent need to review and supplement market based standards so that they contribute to genuinely sustainable water resource use.

134 Tesco Nurture Scheme, Protocol & Code of Practice, November 2006, Issue 2 http://cogent.controlunion.com/cusi_production_files/SISI_files/FL_012510084222_Regulation_TNC_Official_Protocol_-_Code_of_Practice.pdf accessed 19 July 2010.

135 Tesco Nurture, 'Nurture and its Values' http://www.tesco.com/nurture/?page=nurturevalues accessed 19 July 2010.

136 Tesco Nurture Scheme, as note 134.

137 Visual inspection of a selection of London based Tesco stores in July 2010 indicates that all Peruvian asparagus in stores carries the Nurture logo, which is likely to include asparagus from Ica.

138 Tesco Nurture, 'Our Promise', http://www.tesco.com/nurture/?page=nurtureforward accessed 19 July 2010141 Tesco Nurture, 'Our Promise', http://www.tesco.com/nurture/?page=nurtureforward accessed 19 July 2010.

139 See appendix 6 for calculations.

6 Opportunities for progress

This report demonstrates how the water footprint of a developed country can 'tread' on the poor and vulnerable in developing countries. The water crisis facing Ica and Huancavelica provides a potent case study of how virtual water flows coupled with inadequate water resource management, safeguards and standards can exert negative impacts on poor communities in the developing world. The research also highlights how economic production based on these water footprints can be an important contributor to national GDP and local job creation. We emphasise that simplistic solutions, such as not eating food from the developing world, must therefore be avoided. More sophisticated responses are called for.

Our analysis of the root causes behind these impacts provides insights into the potential routes of progress towards more sustainable and equitable water use. It helps us understand how we can make sure that water footprints fit the 'shoe size' available, so that water demand and use can be kept within sustainable limits and local water needs and functions protected. These insights are valuable for understanding and acting on the impacts seen not just in Peru but more widely. The lessons learnt here have global relevance because:

- The virtual water trade and water footprints of the developed world are already significant and extend to – and continue to expand in – developing countries.
- The weaknesses of water resource regulatory authorities and difficulties in implementing regulatory control over water resource use are common problems in developing countries.
- The failure of corporate responsibility measures, lending safeguards and market standards to adequately consider water resource sustainability are key factors exacerbating the unsustainable use of water resources.

This report does not aspire to provide 'solutions' to the water problems of Ica. Evidence from 30 years of development studies makes it clear that externally imposed solutions are dangerous and that answers must be generated, owned and implemented by local stakeholders, with external support where necessary. Rather, this study aims to provide ideas to facilitate the changes needed and to highlight opportunities for progress both on a local and global level. Ultimately those changes need to see the realignment of water supply and water demand in the basin. This can be done through:

- Controlling the groundwater demand within Ica by reducing the water used by agribusiness, backed up by robust regulation and enforcement based on reliable information, including an inventory of all existing uses.
- Facilitating this reduced demand by switching to crops which require less water, or which generate more income using less water, and increasing the efficiency of water use (NB we heard from researchers that the irrigation demands of asparagus could be cut by half, but this was disputed by growers).
- Facilitating this reduced demand by ensuring that commercial users pay a realistic price for water and by supporting demand management by all users.
- Supplementing supply and providing additional flexibility through investment in storage infrastructure where this is sustainable.
- Increasing supply through basin transfers but only once environmental flow needs have been rigorously assessed and provided for, including needs for adaptation to climate change.
- Increasing recharge of the Ica aquifer through artificial means where this has been proved technically viable and cost effective.

The hazards of focusing overtly on supply side solutions have already been described as having the dangers of regulatory demand management prejudicing the poor rather than the powerful because of the alleged corruption and regulatory capture. To attain these changes in an equitable way, a step change in incentive systems is necessary to drive stakeholders towards more sustainable management. Insights into potential opportunities for progress that emerged from this case study were refined and developed by stakeholders during participatory sessions at the closing deliberative meeting. They have been categorised here into the roles which must be played by science,

regulation, civil society, investors and retailers, and the donor community. In addition, they have been divided into national and international recommendations; however, it should be noted that many of the recommendations are cross cutting.

6.1 National level

6.1.1 The role of science

A lack of readily available data, targeted research and understanding of the resource and its use risks management decisions resulting in perverse outcomes. A key part of making progress will be a much better understanding of some of the issues described within both the social and natural sciences. The role of high quality research, objectively packaged findings and freely available information is particularly important given the political polarisation and misinformation of the past. This should include:

- Hydrogeological and hydro-meteorological baseline data throughout the basin.
- A full inventory of current use and use trends and modelling of future demand scenarios through the development of decision support tools.
- An analysis of the functions and values of water throughout the basin, including a better understanding of the role water plays in supporting the livelihoods of herders in the mountains.
- Quantification and provision of downstream and environmental flow needs below the PETACC transfer.
- Technical and economic viability assessment of large scale recharge of the Ica aquifer.
- Assessment of the performance and efficacy of regulatory frameworks, such as the number of licences issued and compliance against them; and the feasibility of technological and economic tools for demand management.
- Development of tools, indicators and measures to support equitable allocation of water, which helps balance and integrate social well-being with economic valuations.
- Review, testing and development of Payment for Ecosystem Services schemes to assess the viability of and type of arrangement which could benefit Ica and Huancavelica.

Specifically, on climate change:

- Develop understanding of how climate change, livelihood vulnerability and resilience interact in the Ica–High Pampas Basin.
- An assessment of adaptation support options and financing mechanisms, including the adequacy of the National Adaptation Strategy.
- Exploration and piloting of micro-insurance schemes to protect poor communities from climate related crop failure and livestock impacts.

6.1.2 The role of regulation

The new water law provides the fundamentals for an effective water resource management regime; however, lessons from failures of the past need to be heeded. In addition some commentators and stakeholders are concerned that the new law gives the green light for privatisation of water. These concerns should be responded to. For example, it should be shown that the fact that the new law requires payment to the government for water resource use is not a form of privatisation but rather, if used properly, a tool for generating revenue for water resource management. In particular, to be effective the emergent water resource management regime – the ANA, AAA, and ALAs – will require:

- Political autonomy and independence.
- Sufficient financial, technical and human resources, including an indirect revenue stream for local work provided by water resource use fees (called ‘retributions’ in Peruvian law).
- Clear operational and strategic mandates and mechanisms to objectively resolve water competition and priorities between sectoral Ministries, big business and regional government.
- Strict, binding and transparent accountability and probity rules and mechanisms – including for example a National Enforcement Policy which provides for consistent and proportional compliance action and use of penalty instruments.

- Social legitimacy associated with actions which bring positive change and demonstrate a commitment to the public good, providing faith in the water management system.
- Meaningful oversight by a Basin Council – provided for under the new law – which is active and genuinely representative of water stakeholders.
- Strengthening of allocation prioritisation criteria which more clearly set livelihood and health needs for the majority of the basin above profitable water use for the few.
- The resolution of privatisation concerns, possibly through elaboration of checks and balances on private involvement within daughter regulations to the main law.

With specific reference to planning and development control:

- Large-scale agricultural development must be subject to a robust and enforced regime of EIA and Strategic Environmental Appraisal.
- Linked to the above, a system of rational development planning at a national, regional and basin level should be instituted as a matter of urgency, to guide investment towards locations with adequate resources.

We recommend that the Peruvian government take immediate steps to regulate and plan for the future of agricultural development in the Ica Valley. The primary objective of that intervention should be to arrive at sustainable agribusiness in the Ica Valley and to prevent environmental harm and the collapse of the industry, as well as addressing social considerations in the interests of supporting the health and wellbeing of the local community. The urgency of this action may call for a government commission – with clear terms of reference – to identify the sustainable limits to production and to quickly introduce the necessary legal and other controls to prohibit unsustainable growth. Given the role of the UK's water footprint in the picture – with British consumption accounting for around 20 per cent of the 'problem' – the UK government and its development agencies should consider cooperating with the Peruvian government in this work.

6.1.3 The role of civil society

The oversight role of NGOs and the media is a powerful tool in the democratisation of the management of natural resources, providing incentives for improved performance and accountable governance. Within Peru's new water management arrangements these roles and the capacity to fulfil them need to be nurtured. This will require open and cooperative government and constructive, non adversarial engagement by the NGO sector which focuses on dealing with the shared risks brought by poor water resource management. Given the nature of the issues, the workload and resources required in their resolution, the existing polarisation around the issues, and the current negative perception of NGOs within the Peruvian government, the challenges facing civil society support for water resource management in Peru are formidable. Organisations such as IPROGA (Instituto de Promoción para la Gestión del Agua / Institution for the Promotion of Water Management), CEPES, and the Civil Association for Water Management (Agua-C) are already working hard on these issues, but to fulfil the demands brought by the de facto globalised access to Peru's natural and water resource base they must have resources and capacity commensurate with the tasks. These include:

- Capability to undertake Social Accountability Monitoring in relation to application of the new water law, the work of ANA, and the government and donor funds being channelled into the water sector. Sophisticated contemporary approaches to monitoring who the winners and losers are in the application of government policy provide NGOs with a powerful platform through which to advocate for pro-poor change at local, regional, national and international levels. Budget tracking and performance monitoring by civil society organisations and NGOs provide opportunities to influence government and to contribute to progress in water resource governance and the response to climate change.
- Working with the media to flag issues of non compliance, corruption, capture and unsustainable water resource exploitation in a responsible and tenacious manner.
- Formation of a united civil society lobby on water issues. Civil society needs to be strong but is currently fragmented on water and social justice issues in Peru. Coordination of efforts through a national network receiving international support would greatly strengthen civil society to play a more positive role in the sector.

- Communication and outreach is needed to counter misinformation on or ignorance of the implications of water management, water rights and water law within poor and remote communities and to counter the risk that the law will preferentially benefit the rich and powerful.
- Review and input to EIAs to ensure water, poverty and climate change linkages are adequately covered.
- Facilitating representation in Basin Council and basin planning processes by disadvantaged or unrepresented groups and monitoring the efficacy and equity of this representation.
- Attracting and targeting climate change adaptation funding to support the poorest and most vulnerable.
- Misinformation and mistrust contribute to water conflict in Peru: there is a role for NGOs in conflict resolution and conflict avoidance.
- Contributing to the research and science agenda discussed above.

6.2 International level

6.2.1 The role of investors and retailers

We have heard convincing testimony that the market is the most powerful driver of change and of better standards in Peru's agro-export sector. As the Managing Director of one agro-export farm told us: "The market has brought a silent revolution in labour standards." This demonstrates that there is real opportunity here. However, as this research shows, these standards currently fail to adequately consider the sustainability of water resources. Reforms of the regulatory regime may take many years to address Ica's problems, but the flexibility and responsiveness of the private sector means that by harnessing ethical consumption through better standards, progress could be delivered much more rapidly. To realise this potential there is an urgent need to develop and adopt new production and purchasing standards or revise existing ones to ensure robust protection against unsustainable water resource use and complement other efforts to control demand.

Attempts are currently being made to develop standards that better address the complexities of sustainable water resource management. A recent report by the Food Ethics Council and Sustain[140] highlights the work of the AWS as playing an increasingly prominent role in the coordination of global efforts to develop a standard for sustainable water stewardship. It concludes that the stewardship approach offers the best basis for addressing water issues. The AWS unites the efforts of some of the world's biggest conservation organisations with organisations in Europe, Australia, Africa and America, under the common goal of developing a water stewardship standard.[141] By providing a transparent benchmark of best practice it is envisaged that the standard will be used by producers, investors, insurers, purchasers, retailers and consumers as an independently verified indicator of sustainable water resource use. As a founding member of the Water Footprint Network, the AWS is working closely with the Network to ensure that the political momentum generated by footprinting debates is translated into meaningful and coherent market standards. The AWS will also adhere to the International Social and Environmental Accreditation and Labeling Alliance (ISEAL) Code of Good Practice for Setting Social and Environmental Standards. Such a standard could play a major role in remedying the situation in Ica, providing incentives for change. We do not claim market standards as a panacea for the type of problem seen in Peru. There are lots of outstanding questions about how small and medium sized farmers might be affected if the costs of acquiring these standards are high. However we are convinced that they have the potential to play an important role in preventing or remedying similarly catastrophic scenarios in the future.

Within these efforts there are clear responsibilities for investors and retailers – in particular, they should:

- Be aware of and act on the risks and negative impacts exerted by water resource use in developing countries. In particular, retailers should be fully informed of their impacts and the roles they can play in their remediation.

140 Segal, R and MacMillan, T (2009) Water labels on food: issues and recommendations, Food Ethics Council and Sustain, UK.

141 For further information, see www.allianceforwaterstewardship.org accessed 9 July 2010.

- Be aware of the potentially negative impacts on labourers of damaging knee-jerk responses such as boycotting Peruvian asparagus or other products.
- Contribute to the development of a working water stewardship standard. Key questions need to be considered through piloting of the standard, including whether the standard would be most effectively awarded only to those working in a sustainable system, or to the champions and pioneers leading the shift to sustainable production in places like Ica.
- Consider a leadership role for Peru in the development of innovative responses such as the AWS efforts. The problems facing Ica are common to many parts of the world but the rapidity of their onset is unique. Peruvian and Ica stakeholders have an opportunity to turn their water problems into a world-leading demonstration site for how collaborative efforts and innovation can underpin sustainable economic and social progress.
- Urgently review existing safeguards and environmental and social sustainability performance standards to ensure that these enable investors and retailers to meet their responsibilities for sustainable water use. Retailers and investors should also assess their current portfolio. Furthermore, the standards must be rigorously enforced, with all parties ensuring that they are complied with.

6.2.2 The role of the donor community

Ultimately, sustainable water resource use and allocation can only be secured by effective public policy on water. Governments must take responsibility, must act and must be held accountable for ensuring that water resources are managed for the collective 'public good' of their citizens. Nevertheless, the opportunities outlined here require external financial and possibly technical support. To avoid the negative impacts of the global trade in virtual water, developed country governments should support more effective water resource management in developing nations through their Official Development Assistance policies and programmes; through technical assistance; and through support to social accountability monitoring in natural resource management.

The support being provided by the World Bank and the IADB for the Peruvian government to implement a new water resource management regime is an important contribution. However, within this support there is insufficient recognition of the role that civil society has to play for the reforms to work for the benefit of the poor. Within plans for implementation, no provision has been made, financially or strategically, for the essential role of civil society. Civil society groups, non-governmental organisations, research institutions and the media can play an important role by keeping a watchful eye to ensure that water laws are applied to protect the poor and the environment. Such groups require support for monitoring and communication work, to cap corruption and to ward off resource capture and over-exploitation. We therefore call on the UK government to step up its support to civil society and research groups working for social accountability and equity in developing countries, so that the benefits of economic growth are sustained and shared by all.

Further, as we have shown in our analysis, unsustainable water resource use and associated social conflict and inequity, such as that being played out in the mountains of Huncavelica, will be exacerbated by human induced climate change. In order to meet their implicit obligations to dealing with the climate change impacts already seen in Peru, the donor community should reassess their support strategies in light of this report's findings to avoid pushing poor communities deeper into poverty. Developed countries, where the majority of greenhouse gas emissions originate, have a financial and moral obligation to support countries like Peru and its poorest communities in their efforts to adapt to climate change. The UK should extend its leadership role in supporting climate change adaptation and, given that the impacts of climate change will be felt through changes in the distribution and availability of water resources, we call on the UK government to specifically focus additional support to effective and equitable management of this most precious resource.

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Appendix 1 Calculations for water off take of asparagus exports from Ica – relating asparagus consumption to water demand in Ica

Chapagain and Orr's calculation of the water footprint (WWF, 2008) of asparagus relates relatively well to the water used by farmers in Ica to grow and process the crop.

The WWF report estimates that fresh asparagus exports to the UK represent the importation of 8.5 Mm^3/yr of virtual water. The majority of asparagus originates from Peru, which in 2008 exported 6,403,042 kg of fresh asparagus to the UK (figures from Aduanas (Customs), Peru).

If we assume that all asparagus imported to the UK comes from Peru then the estimated volume of water used to grow 1 kg of fresh asparagus = 8,500,000 / 6,403,042 = 1.33 m^3

According to farmers in Ica, growing asparagus demands 16,000 m^3/ha/yr of water and typically yields 17 tonnes of asparagus/ha/yr.

Elsewhere farmers didn't see quite such a good return and reported using 14,000 m^3/ha/yr of water to yield only 10 tonnes of asparagus/ha/yr. This possibly reveals the crop's sensitivity to water availability, although many other factors could influence this crop output to water ratio – including informant bias, and the fact that there are few accurate records.

Using these estimates the volume of water required to produce 1kg of asparagus ranges from:

Farmers' low estimate = 16,000 (m^3/ha/yr water) / 17,000 (kg/ha/yr asparagus) = 0.94 m^3

Farmers' high estimate = 14,000 (m^3/ha/yr water) / 10,000 (kg/ha/yr asparagus) = 1.4 m^3

An average figure of 1.17 m^3 of water for 1 kg of asparagus has been used in the calculations in this study and this is a safe and conservative estimate in the absence of the exact calculations used by Chapagain and Orr.

Appendix 2 Estimated annual aquifer use

If aquifer use doubled between 2002 and 2007 and was 315.84 Mm^3/yr in 2004 then the abstraction increases by 20 per cent each year.

Year	Units
2002	315.84/1.4 = 225.6
2003	225.6 *1.2 = 270.72
2004	315.84
2005	360.96
2006	406.08
2007	451.20
2008	496.32

Appendix 3 Calculation of asparagus retail value

US$1 = £0.61

Value of asparagus at farm gate in Ica = US$0.4 per kg = £0.24/kg (May 09)

Value of asparagus in UK supermarket, London = £8.59/kg (June 09)

For agro-export produce of 9,000 tonnes:

9,000 tonnes = 9,000,000 kg

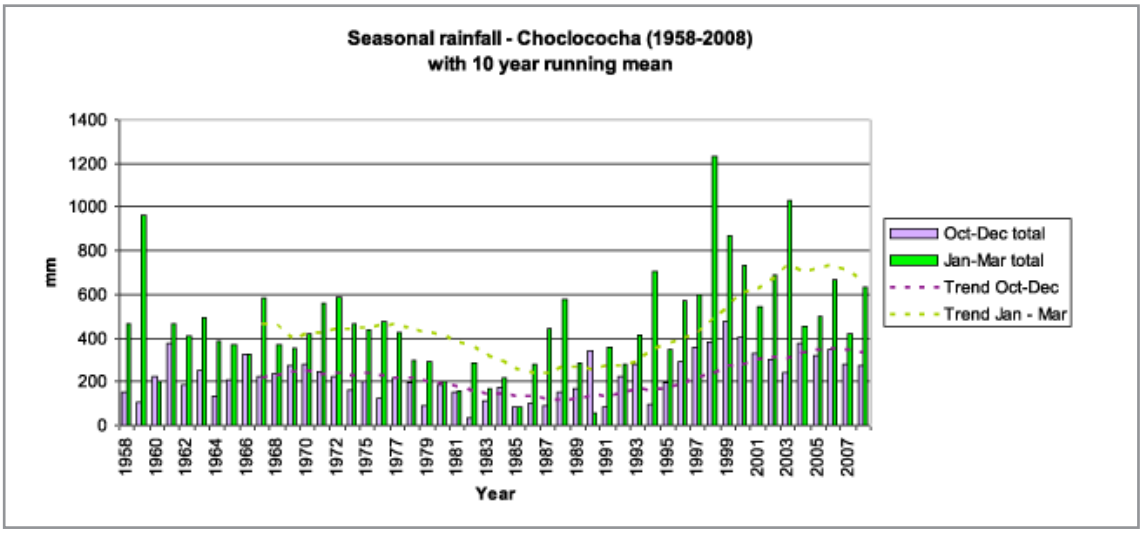
Ica street value = £2.16 million

London retail value = £77.31 million

Appendix 4 Total annual water demand at agro-export farm

	Site 1 Ha	Site 2 Ha	crop need m^3/ha/yr	Total m^3/yr
Asparagus	97	762	16,000	13,744,000
Grapes	74	286	9,000	3,240,000
Avocado	-	26	11,000	286,000
Total				17,270,000 m^3/yr

Appendix 5 Seasonal rainfall in Choclococha



Appendix 6 Breakdown of relative value to labourer vs shelf price

We were told that workers get 500 soles net/month. If they harvest more than 145 kg per day they get more. We can therefore reasonably divide the daily salary, at a six day week, by this piece rate for kg picked = 19.23 soles/day therefore per kg = 19.2 / 145 = 0.13 sol/kg. Converted to £ = £0.27.

Appendix 7 Increase in irrigation water distributed by Junta de Usuarios del Distrito de Riego de Ica

Data of monthly flows allocated – from official correspondence provided by Junta office, dated 10th August 2007.

Total water distributed 1997 = 24,960,289 Mm^3

Total water distributed 2006 = 38,690,110 Mm^3

Increase = 35 per cent