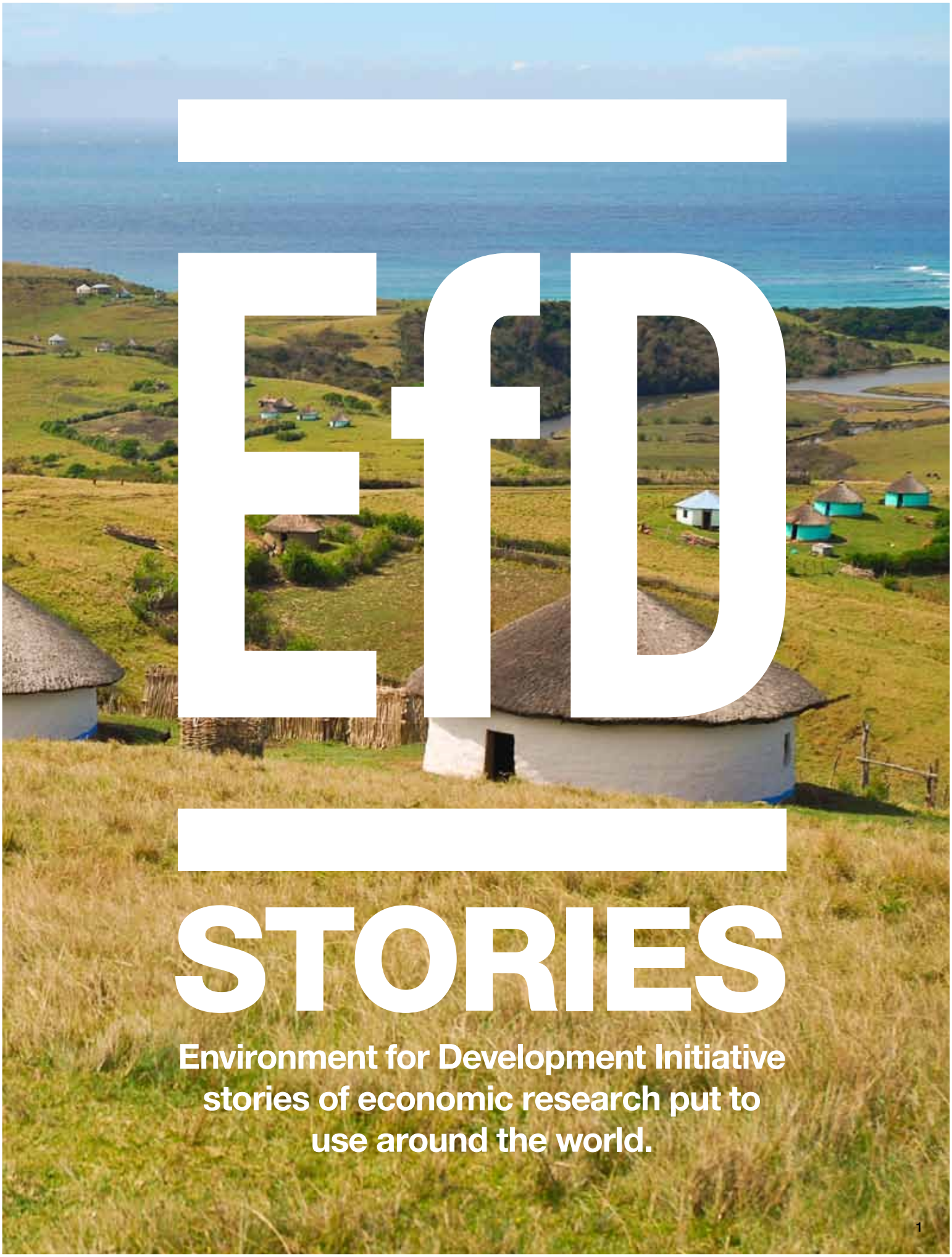

EfD STORIES

Environment for Development Initiative stories of economic research put to use around the world.

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Small-scale fishermen in Chile.

The environmental economists of the Environment for Development Initiative (EfD) focus on the decisions that people make about climate and natural resources. We believe that natural resources and the environment are the basis for global sustainable development. To achieve this, resources need to be managed in an efficient and equitable way with the support of high-quality research. EfD is our network for cross-country research collaboration, research-policy interaction and academic training. We apply evidence-based analytical tools to design policies that effectively manage scarce resources. The gap between research and policy is bridged through maintaining a dialogue with local communities and policy makers. We want our research findings to have a tangible impact on poverty reduction by supporting a truly sustainable development. We hope you enjoy our stories from EfD centers across the developing world.

Africa

ETHIOPIA
Farmers are willing to pay for irrigation water. Page 4

KENYA
Subsidies delivered through the water tariff are not reaching the poor. Page 6

SOUTH AFRICA
Mixed strategy farming is best in face of climate change. Page 8

TANZANIA
Research on energy use for poverty reduction reaches grassroots. Page 10

China

Pollution tax will save lives and spur green growth. Page 12

Latin America

CENTRAL AMERICA
Rural people must deal with threats to drinking water. Page 14

CHILE
Behavior change will improve air and public health. Page 16

Farmers are willing to pay for irrigation water

How can charging money for something that was free be a good idea for poor farmers? It turns out that pricing irrigation water will help improve Ethiopian farmers' efficiency in water use, increase agricultural and food production, and make the population less vulnerable to climate change. One unique contribution of environmental economists is that they collect data from the field and then calculate what natural resources are really worth.

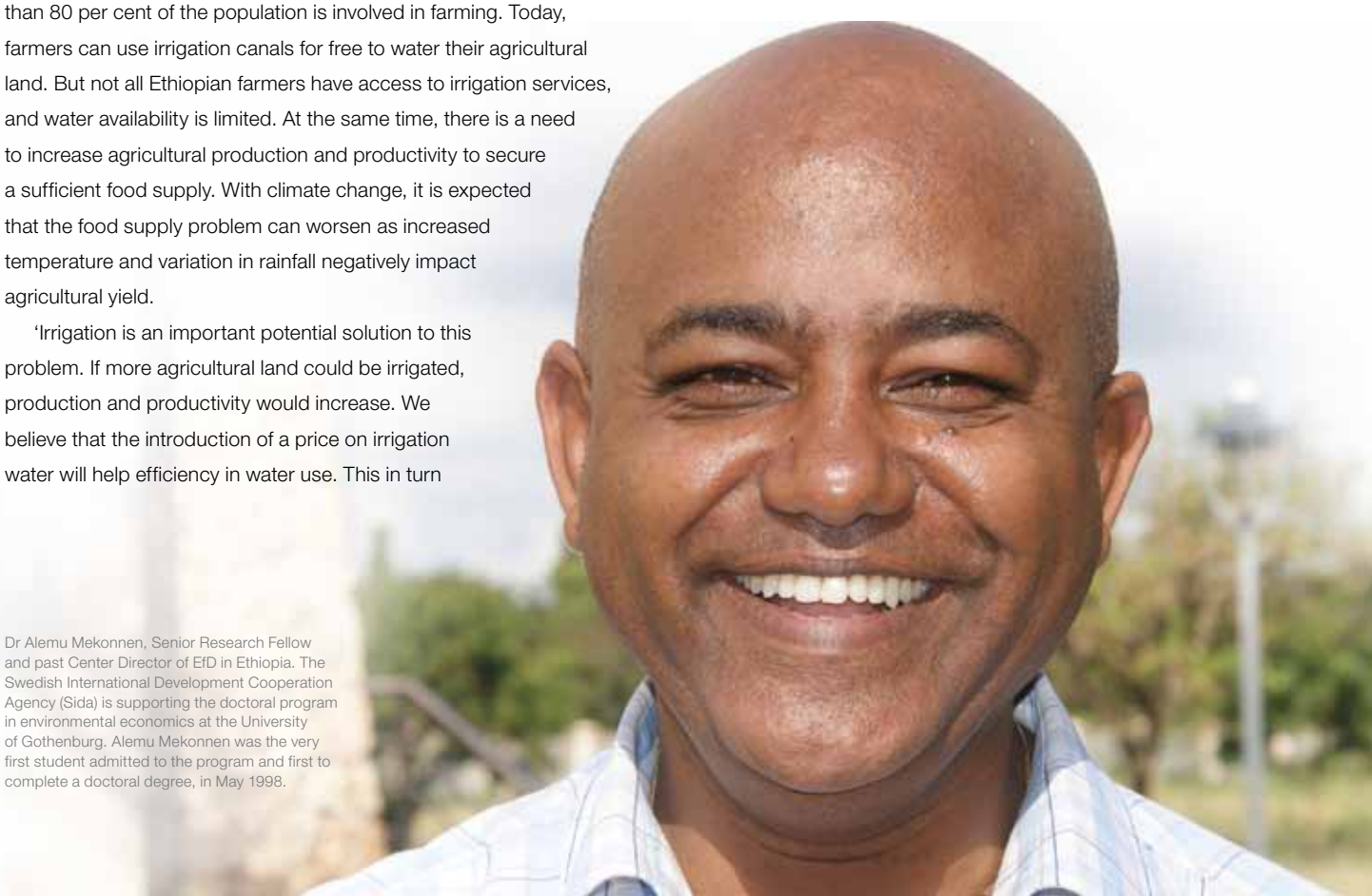
EfD researchers asked farmers directly about their willingness to pay and their preferences regarding irrigation services. Then they estimated the value of irrigation water in order to develop efficient prices.

Agricultural production is very important in Ethiopia, where more than 80 per cent of the population is involved in farming. Today, farmers can use irrigation canals for free to water their agricultural land. But not all Ethiopian farmers have access to irrigation services, and water availability is limited. At the same time, there is a need to increase agricultural production and productivity to secure a sufficient food supply. With climate change, it is expected that the food supply problem can worsen as increased temperature and variation in rainfall negatively impact agricultural yield.

'Irrigation is an important potential solution to this problem. If more agricultural land could be irrigated, production and productivity would increase. We believe that the introduction of a price on irrigation water will help efficiency in water use. This in turn means that the same amount of water can irrigate larger land areas. Then, agricultural output will increase', says Dr Alemu Mekonnen, past EfD Center Director in Ethiopia and Associate Professor at the Department of Economics, Addis Ababa University.

The Ministry of Water, Irrigation and Energy asked EfD Ethiopia to conduct a study to come up with an estimate of the value or price of irrigation water. The Ministry also asked the EfD researchers to study the management of irrigation schemes in different regions of the country.

'We found that a large majority of farmers are willing to pay a considerable amount of money for irrigation water. This means that the government has support for this kind of proposal. There are other studies that show that quite a number of Ethiopian farmers are aware of climate change. They have noticed changes in rainfall patterns and increasing temperature. It seems they really see the importance of water', says Mekonnen.



Dr Alemu Mekonnen, Senior Research Fellow and past Center Director of EfD in Ethiopia. The Swedish International Development Cooperation Agency (Sida) is supporting the doctoral program in environmental economics at the University of Gothenburg. Alemu Mekonnen was the very first student admitted to the program and first to complete a doctoral degree, in May 1998.

Irrigation water infrastructure in the Awash river basin, Ethiopia.

The estimated price of irrigation water to farmers reflects the cost of maintaining the irrigation canals. It does not cover all investment costs the government has had for establishing irrigation systems.

One possible approach to scientifically determine the price is to use the estimated cost of irrigation water supply and distribute this cost across all households. But environmental economics methods also reflect the farmers' preferences related to irrigation water, as well as their willingness to pay for different options.

'As environmental economists, we go out to the field with questionnaires and ask farmers directly how much they are willing to pay to irrigate a particular area of land. We also identify important characteristics related to irrigation and estimate how much farmers are willing to pay for the different characteristics, as well as analyse factors affecting farmers' willingness to pay', says Mekonnen.

For example, the environmental economists wanted to see how interested farmers are in the number of crop seasons. With rain fed agriculture, there is only one rainy season in the area and farmers can have only one yield per year. But with irrigation, they can produce two or even three times a year. The importance that farmers attach to frequency of watering in a crop season was also studied by the EfD researchers. They wanted to know if farmers are willing to pay more if they are able to water their land more frequently in one single season.

'Our hope is that our estimates can be used by the Ministry as inputs for further work by them. For example, the Ministry may introduce a price for irrigation water, in which case it can use the results from our study to set the price', says Mekonnen.

The results of the study were presented at a workshop organized jointly by EfD Ethiopia and the Ministry of Water, Irrigation and Energy. It was opened by the State Minister, H.E. Engineer Wondemu Teklie. In addition, the minister attended the workshop and awarded EfD Ethiopia a certificate in recognition of its contribution to the research on 'economic valuation of irrigation water' and 'institutional sustainability of the irrigation sector in Ethiopia'. The research was acknowledged as a pioneer contribution toward the sector's efforts to become research-based.

The workshop was held in May 2014; read more here: efdinitiative.org/news/events/workshop-conducted-irrigation-water-pricing-and-institutional-sustainability-irrigation

Researchers involved

Abebe Damte, Zenebe Gebreegziabher, Fitsum Hagos, Alemu Mekonnen

An enumerator and NCWSC marketing associate during the household survey.

Subsidies delivered through the water tariff are not reaching the poor

Like many water utilities across the globe, Nairobi City Water and Sewer Company implements an increasing block tariff. Recent research conducted by EfD Kenya, however, finds that the increasing block tariff implemented in Nairobi does not effectively target subsidies to low-income households. Estimates suggest that non-poor households receive over 80 per cent of the subsidies.

The failure of targeting subsidies to poor households is due to the fact that all customers are subsidized at current prices and the poorest households in Nairobi do not have a connection to the piped water and sanitation network.

'Policy makers need to balance multiple objectives when setting water tariffs, including cost recovery, economic efficiency, equity, and fairness. Our work suggests that the increasing block tariff is not an effective means of targeting subsidies to the poor', says Dr Richard Mulwa, a Senior Research Fellow at EfD Kenya, and senior lecturer at the Center for Advanced Studies in Environmental Law and Policy, University of Nairobi.

'Our key policy message is that policy makers should use the water tariff to pursue financial and economic objectives and use other policy instruments such as means-testing to deliver subsidies to the poor', adds Dr Mulwa.

Policy makers find the increasing block tariff appealing because of the perception that it can be used to simultaneously ensure that low-income households have access to a certain quantity of water at a price determined to be affordable, while achieving cost recovery objectives

by charging higher volumetric prices for water use in excess of the lifeline block.

According to Global Water Intelligence's 2013 global survey of water tariffs, the increasing block tariff is the most commonly used water tariff across the globe. Indeed, over 70 per cent of the water utilities in developing countries surveyed implemented an increasing block tariff. The increasing block tariff often includes a 'lifeline block' where customers are provided a certain quantity of water, typically between 6 and 20 cubic meters per month, at a highly subsidized volumetric price. In Nairobi, the lifeline block is 10 cubic meters (m3) per month. The tariff in Nairobi includes three other usage blocks (11-30 m3/mo., 31-60 m3/mo., and >60 m3/mo.) with the volumetric price for water use increasing from one block to the next.

However, the increasing block tariff typically fails to meet the objectives of targeting subsidies to low-income households for several reasons, explains Dr Mulwa. First, utilities in developing countries often sell water below the full cost of providing service, resulting in all customers, not just those whose water use falls in the lifeline block, receiving a subsidy. Second, the lifeline block is based on the assumption that low-income households use less water than high-income households. This may not be true when low-income households have larger household sizes than higher income households or when low-income households are more likely to share a water connection. Finally, the poorest households in developing countries often do not have a private piped water connection. As a result, they cannot benefit from subsidies delivered through the water tariff.

'This is precisely what we find in Nairobi. We see a low correlation between household income and water use among households with a private piped connection. The poorest households in Nairobi also live in informal settlements and very few of them have a piped water connection. This, combined with the fact that the tariff does not cover the full cost of providing service, results in poor subsidy targeting', says Richard Mulwa.

Dr Richard Mulwa, Senior Research Fellow, EfD Kenya

The research was conducted by EfD Kenya in collaboration with Nairobi City Water and Sewer Company, working with its Monitoring and Evaluation Manager, Mr Mbutu Mwaura. The findings were presented to the Ministry of Environment, Water, and Natural Resources; Athi Water Services Board; and the Water Services Regulatory Board at a Water Policy Day organized by Environment for Development in Kenya in collaboration with the Kenya Institute for Public Policy Research and Analysis (KIPPRA) on 27 October, 2014.

Researchers involved

David Fuente, Moses Ikiara, Jane Mariara, Richard Mulwa, Mbutu Mwaura, and Dale Whittington

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Ngethu water treatment works, Nairobi's main water treatment facility.

Mixed strategy farming is best in face of climate change

The South African node of the EfD network, the Environmental Economics Policy Research Unit at the University of Cape Town is working towards influencing South African policy in four key areas: climate change, biodiversity conservation, marine fisheries, and energy. One of the recent studies identified mixed farming as a crucial strategy to adapt to climate change, particularly for small farmers.

'Policy must be informed by the best possible information available. The Environmental Economics Policy Research Unit (EPRU) isn't just trying to provide this to government, but to guide decision makers as they develop policy', explains EPRU director Prof Tony Leiman.

The team, based at University of Cape Town (UCT), School of Economics, works closely with industry bodies in these areas, but also collaborates with researchers at other key South African institutions, and with universities in Kenya, Tanzania, Mozambique and Namibia.

A recent study by EPRU shows that South Africa's agricultural policy should support a mix of crop and livestock farming amongst subsistence farmers in order to make them more resilient to the impact of climate change. This is in contrast with government's existing approach, which supports small farmers to diversify only their crops in order to adapt to changes in climate.

'The study reflects the experience of 1121 subsistence farmers in all nine provinces across South Africa,' explains EPRU's Dr Byela Tibesigwa. 'These are farmers whose main output is used directly in the home, and where they have few, if any, inputs which they buy. Only a minor proportion of the farms' produce is sold.'

These kinds of small farmers are particularly vulnerable to shifts in climate because they depend on rain-fed agriculture and have limited ways to adapt to changing farming conditions.

'We looked at how crop-only, livestock-only, or a mix of crop and livestock farming could be impacted by rising temperatures and changes in rainfall between now and 2080', says lead researcher on the study, Dr Byela Tibesigwa. 'We were particularly concerned with how this could affect household income, as well as diet.'

The take-home message for policy makers is that they should try to encourage a greater mix of crop and livestock farming for these small scale operators, rather than focusing on greater diversity in crops only.

These findings were presented at the African Climate Conference: Advancing African Climate Science Research & Knowledge to Inform Adaptation Decision-Making in Africa, in Arusha, Tanzania. Tibesigwa conducted the research along with EPRU's Prof Martine Visser and Dr Jane Turpie.

Supporting fisheries policy as government flounders

Environmental resource scientists offer government valuable support in terms of guiding evidence-based policy for managing marine resources. This is particularly true at a time when the national fisheries

Subsistence farmers in the Eastern Cape, South Africa, tend to have mixed farming strategies.

Dr Byela Tibesigwa, Research Fellow of EfD South Africa/EPRU.

department has lost key scientific personnel, and when there have been lengthy delays in the re-allocation of long-term fishing rights.

Leiman explains that EPRU researchers regularly engage with the fisheries department on these matters, hoping that their findings will filter through to decision makers.

EPRU members were amongst the academics, fishing communities and industry that government officials consulted with earlier this year, when they began redrafting the Marine Living Resources Act of 1998. Leiman says this is currently a 'flawed document'.

'Unfortunately, much still remains to be done, and the current management of inshore fisheries, in particular the conversion of small-scale private rights to communal ones, has been a source of serious controversy', says Leiman.

Leiman and his team are amongst the scientists, computer modelling experts, social geographers and environmental economists who are working together with academics from UCT, Rhodes University and the University of the Western Cape to help guide government policy making.

EPRU has assisted Statistics South Africa (StatsSA), the national statistics service, in developing consistent accounting techniques for measuring and monitoring fishery activities in the national accounts (measures such as GDP, through which government keeps track of all economic outputs) using the United Nations accounting conventions.

'Fisheries management here is based on an ongoing computer modelling process using catch and research data to update the estimates of fish stocks year on year,' explains Leiman. 'We have tried to make the link between the model and the national accounting process.'

The EPRU was recently involved in producing the unpublished report for the country's chief marine body, Marine and Coastal Management, in which they gave a critical review of the design, compilation and interpretation of satellite accounts for the country's fisheries.

Leiman also has a paper due out soon, in which he argues that over-estimating Namibia's fisheries stocks leads to allocation of fishing quotas that are too high to be sustainable. This, he says, can compromise the long-term profitability of the private sector fishing industry by encouraging an over-investment in its fleet and related infrastructure.

South Africa's small-pelagics fishery faces a reduction in the minimum total allowable catch following ongoing stock declines.

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News article

http://www.farmersweekly.co.za/article.aspx?id=65945&h=Mixed-strategy-farming-helps-beat-climate-change-)

Researchers involved: Anthony Black, Anthony Leiman, Byela Tibesigwa, Jane Turpie, and Martine Visser

Research on energy use for poverty reduction reaches grassroots

Dr Stephen Kirama, EfD Research Fellow in Tanzania, with a head of household respondent during the research work conducted in the Southern Highlands of Tanzania on small hydropower plants.

To make hydroelectric power work better in rural communities, EfD Tanzania researchers decided to have in-depth contact with the grassroots through community-based and civil society organizations. Findings from a study on management of the hydropower plants in the southern highlands region show that rural electrification has proven to boost farmers' earnings: Electric power increases the processing and value addition of agricultural products, which helps farmers fetch premium market prices.

Research findings by Dr Stephen Kirama, EfD Research Fellow in Tanzania, show an increase of the processing and value addition to agricultural products such as sunflower, timber and coffee due to the extension of electricity services in rural areas.

'Besides increases in production and revenue, communities in these areas are highly motivated for further energy usage to alleviate poverty', Dr Kirama told the Tanzanian Daily News on August 14, 2014.

Small hydropower projects are going on in many villages. These projects provide modern, low-cost energy services to households and business enterprises. Electric power is also supplied to schools, hospitals, health centers and public offices.

'EfD Tanzania in 2014 took quite an interesting turn in its policy interactions in research and consultancy activities', says center coordinator Dr Razack Lokina. 'When we focus our policy interactions mostly on government agencies and large organizations, active and fruitful contact with the grassroots is not realized. So, for 2014, the policy interaction has added close working collaborations with community-based organizations and civil society organizations in addition to non-governmental organizations', says Dr Lokina.

EfD Tanzania applied this new approach to several energy-related issues, including small hydropower to deliver rural electricity, as this has a significant impact on growth and development.

For instance, in the Southern Highlands of Tanzania, Dr Stephen Kirama and Mr Salvatory Macha interviewed local hydropower operators and users in collaboration with ACRA-CCS, an Italian non-

governmental organization working in Tanzania since 2006. ACRA-CCS is an independent organization working to remove poverty through sustainable, innovative and shared solutions. It supports a micro-hydropower supply system that is owned and operated by LUMAMA, a community-based organization in the southern highlands, its acronym formed as a combination of three village names: Lupande, Mawengi and Madunda.

The research involved seven small hydropower plants managed by different community-based organizations. One finding of the research was to advise the small hydro producers, which are now working independently, to form a network. In addition, for the sustainability of the small hydropower plants, the best agricultural practices as well as environmental protection measures are vital, both upstream and downstream. In this regard, the major recommendation is strengthening tree planting campaigns, and conducting awareness seminars to ensure environmental sustainability of water catchments.

Rural electrification boost farmers' earnings

DAILY NEWS Reporter

RURAL electrification has proved to be efficient driver in promoting value addition particularly of agricultural products that helped farmers to fetch premium market prices.

Statistics from Rural Energy Agency (REA) shows that there are 16 small hydropower projects operating since 1970's and 13 projects with a total capacity of 24 MW which are in various

Management of the Hydro power plants in southern highlands in Dar es Salaam on Tuesday, Mr Stephen Kirama, the University of Dar es Salaam lecturer and consultant said there was an increase of the processing and value addition to some selected products like sunflower, timber and coffee due to extension of electricity services in rural areas.

"Besides, increases in production and revenue, communities in these areas are

poverty," he said.

The small hydropower projects are Lupali, Isoliwaha, Lugarawa, Mawengi, Wino, Matembwe and Ilondo located in Njombe Region, Ludewa District and Songea District.

The hydropower projects provides modern low cost energy services to households, business enterprise like milling machines, garages, juice extracting (juta and juice), poultry (incubator), tailoring business and normal

projects are also supplying for the public institutions like schools, hospitals, health centres and public offices within the village governments. Students in both boarding and day enjoy extra studies during evening due to power availability.

"The maternal and child health services have also improved not only during delivery in which they are no longer using fuel lamps but also accessibility of vaccination has

are either non profits oriented or cost recovering, Mr Kirama called upon the government to subsidize and provide VAT exemptions as an incentive to keep them operating with an end goal to provide high quality services.

Also, it is high time that the National Environment Management Council (NEMC) to suspend the planned environmental fees to be paid annually for use of water in

In addition to the media attention, several members of the center have been invited by other non-governmental organizations dealing with energy issues to work on collaborative research work in the energy sector. For example, the Iringa Medium Hydropower Plant, located at Mwenga Coffee Estate, currently generating more than 15.5 GW of electricity and with 14 project villages, has requested the center's assistance in research work, in particular, finding some interested master's and Ph.D. candidates to conduct research on the sustainability of the project.

'For the first time in the history of EfD Tanzania, the research findings of key studies were disseminated to the level of the civil society organizations as well as the community-based organizations that are closely working with the grassroots', says Dr Kirama.

'There has also been a significant policy impact when the above research was disseminated to the grassroots', adds Dr Lokina. 'The reception when the research findings were publicized was immense'.

The new approach has also been applied to research studies on renewable energy and the oil and natural gas sector. One of them is a baseline survey and capacity needs assessment for strengthening the role of civil society organizations in delivering sustainable energy solutions in Tanzania, conducted by Dr Aloyce Hepelwa and Dr Stephen Kirama in collaboration with the World Wildlife Fund (WWF) Country Office in Tanzania. Another is an evidence-based research and policy review of the oil and natural gas sector in Tanzania. The purpose is to identify gaps, challenges and opportunities relevant to civil society organizations and key areas for civil society organization intervention. The research findings have been published widely in local newspapers. Currently the findings are being used to prepare policy briefs for more dissemination.

'It is evident that the involvement of organizations at the community level is crucial in making the research findings important, reaching the people, and enhancing very positively the concept of environment for development, especially at the grassroots. It also makes the center visible to more stakeholders', says Dr Lokina.

Researchers involved

Aloyce Hepelwa, Stephen Kirama, Razack Lokina, Salvatory Macha, John Mduma, Adolf Mkenda, Wilhelm Ngasamiaku, and Onesmo Selejio.

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Focus group discussion during the research work conducted in the Southern highlands of Tanzania on small hydropower plants.

Pollution tax will save lives and spur green growth

APEC Blue vs. Beijing Smog. Two new concepts – 'APEC Blue' and 'Beijing Smog' – were coined in Chinese social media in November 2014 when Beijing hosted the APEC (Asia-Pacific Economic Cooperation) summit. To improve the air quality during the summit, the government closed factories, mandated days off from work and imposed restrictions on car traffic. Subsequently the sky turned an unusual blue (for Beijing), but at an enormous cost. Photo: Jun Yang/EfD China

Half a million premature deaths a year due to air pollution. More carbon emissions than any other country. Excessive energy use per unit of GDP. China suffers many problems due to monopoly and price regulation in the energy sector, according to a policy research report from EfD China. In response, marketization reform, deregulation and pollution taxes, including carbon taxes, are highly recommended by the researchers.

Policy research by EfD China researchers reveals that monopoly and price regulation of the Chinese energy sector lead to serious consequences such as lethal cancer and respiratory diseases, the world's highest dependence on dirty energy sources, a shortage of energy supply, and global warming.

The studies by Prof Jintao Xu, Dr Min Wang and Dr Zhuo Huang, EfD China/Environmental Economics Program in China (EEPC), Peking University, were conducted between July 2013 and March 2014 and cover the last 30 years. The findings are published in a report that was presented to representatives from industry, government and the media at a workshop organized by Prof Xu on April 16, 2014. When published online in July 2014, the report was cited by many newspapers. At the end of July, the EfD researchers were invited to present their findings as keynote speakers at the China Energy Forum 2014, where industry and high-ranking officials gathered.

'The Chinese energy sector mainly consists of coal, oil, gas, and electricity producers', says Dr Min Wang. 'Private firms are not allowed to enter the oil, gas and electricity sectors. The electricity grids sector is monopolized by two state-owned enterprises. In the oil sector, four state-owned enterprises have exclusive rights to explore and extract oil resources. Three of these four companies, plus three or four other state-owned enterprises, have the exclusive right to import oil. Private firms can refine oil, but they have to buy it from the state enterprises, and also compete with state-owned refiners'.

The first problem identified by the EfD researchers is shortage of energy supply. The administrative monopoly in the energy sector is an inheritance from the planned economy. Due to the monopoly of the state-owned energy enterprises, the state has to regulate and depress energy prices for two reasons: to balance the welfare of consumers against the profits of those state-owned enterprises, and to spur economic growth. As a consequence, energy prices are heavily depressed. Such a price distortion induces excessive demand as well as inadequate supply of the energy products, leading to the persistent energy shortage in the last three decades (except during the short periods of economic recession in 1998-2002 and 2013-2014). In one region, many producers simply stopped producing electricity in 2011, using excuses like 'our generator has to be repaired'.

The second problem is high dependence on dirty energy

sources. 70 percent of China's total energy consumption comes from coal. While carbon trading has been implemented in some regions, there is still no carbon tax in China. Despite the damages that coal and oil cause to society, they are still cheap to use because this cost to society is not incorporated in the energy price. This in turn induces people to use too much energy. The EfD research findings show that the amount of energy used per unit of GDP is almost four times higher in China than in many European countries. Clean energy sources such as solar and hydropower account for only 9 percent of Chinese energy consumption, while gas accounts for 5 percent and nuclear for 1 percent.

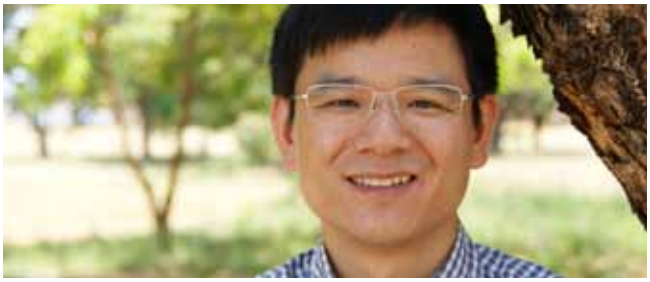
The third problem is the resulting air pollution. China is the world's biggest emitter of many air pollutants, such as carbon dioxide and sulfur dioxide. In addition to global warming, the burning of coal and oil also leads to emissions of unhealthy, fine particles, for example, the particulate matter known as PM2.5, which has a diameter of 2.5 micrometers or less. According to the most conservative figures from China's Ministry of Health, as many as 300 000 to 500 000 people die every year in China due to cancer and respiratory diseases caused by air pollution.

'We highly recommend that the government implement a uniform tax on coal and oil consumption. The next step is a tax on emissions that targets big firms such as electricity and steel producers', says Dr Min Wang.

'In theory, a market allowing trade in carbon permits is equivalent to a tax', continues Dr Wang. 'However, in reality, especially in developing countries, a pollution tax is a much better choice than a permit trading system because the former can provide revenue incentives for the local government to seriously implement the policy'.

Industry, government and the media participated in the first workshop held to present the report in April 2014. Among the ten people invited to a discussion in front of the audience were the research director of a state-owned grid company and a government representative in charge of the energy sector.

Dr Min Wang, Research Fellow of EfD China, Environmental Economics Program in China (EEPC), Peking University.



Field trip to a coal mine. Three researchers from EfD China, Jintao Xu, Ping Qin and Min Wang, visited a coal mine in the north of Anhui province, together with Zhongmin Wang, from Resources for the Future, and Chu Wei, research colleague from Renmin University of China. The researchers wanted to understand how the coal industry continued operating when the economy was in a recession, and also see how the coal mine uses coal to produce electricity and how they recycle the coal waste.

'Ideology is the most difficult part', adds Dr Wang. Many interest groups want to keep the existing system and use excuses such as 'energy is national security' or a 'national strategy' to defend their monopoly power. 'The views from researchers and industry are totally different from those of the government. For example, the academic and industry people talk more about how the market is efficient and the solution is to let the market work. The people from government talk about how the market is chaos and the entry of private firms would lower the quality of energy products and hurt the welfare of the people. We show with policy research findings that, if China is to achieve energy supply security, it is necessary to deregulate the energy sector and introduce a marketization reform', he concludes.

Researchers involved

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Rural people must deal with threats to drinking water

Luis Felipe, President of the community based organization for water provision in Cuajiniquil de la Cruz, Guanacaste, Costa Rica.

Household chores, Cuajiniquil de la Cruz, Guanacaste, Costa Rica.

People in Central America's rural areas will face a 20 percent decline of drinking water availability by 2050, estimates show. EfD researchers are now collecting information from 8 000 households in Nicaragua, Guatemala and Costa Rica. The primary aim is to map capabilities and obstacles for communities to adapt, and to provide community leaders tools and skills to respond to drier scenarios. EfD findings also support governmental adaptation policies.

'In the end, it is not the governments who adapt. It is the people. In their communities, in their houses, they need to adapt and solve the water scarcity problems that they will face in the coming decades.

Róger Madrigal, Senior Research Fellow, EfD Central America, CATIE

This is why we want to focus primarily on building local capacities to adapt drinking water systems to the predicted drier scenarios', says Róger Madrigal, senior Research Fellow at EfD Central America. He is principal investigator of the research project 'Water for human consumption, communities and climate change: expected impacts and adaptation in Central America'.

Throughout Central America, there are 24 000 community-based drinking water organizations. These organizations are the most important providers of drinking water in the rural areas of the region. In most cases, they self-organize to provide drinking water and have little if any relationship with the government of the respective country. Most of these organizations have financial and managerial problems that affect their capacity to deliver safe water regularly.

'Besides all these problems, rural people now also face the threat of climate change. It is the local community leaders that are ultimately responsible for taking decisions to adapt to drier scenarios', explains Dr Madrigal. 'As researchers, we are therefore committed to building capacity at the local level. We organize participatory meetings, workshops and small capacity building courses to raise awareness, provide information and share knowledge in an accessible way'.

The EfD researchers focus on 200 communities including 8 000 households, situated in the driest areas of Nicaragua, Guatemala and Costa Rica. The project, funded by the International Development Research Centre (IDRC) based in Canada, started in 2013 and

Benito Guadamuz, President of the community based organization for water provision in Piedra Verde, Guanacaste, Costa Rica.

aims to provide input to design adaption strategies at the governmental and community level. It also provides information to governmental bodies, international donors and NGOs about the needs of local people.

The initial estimations from the project's climate modeling component show that drinking water availability might decrease 20 percent by 2050. To map communities' and households' capacity to adapt and respond to drier scenarios, the researchers are collecting information about many different social, economic and organizational indicators. They identify factors that can facilitate or restrict implementation of future adaptation measures, such as infrastructure improvements, new wells and water metering.

Their findings so far show that many communities lack sufficient technical knowledge and management skills, and struggle with financial and organizational problems to effectively implement these critical investments. Further, in many cases, financial and technical support from governments and other external actors are necessary conditions to implement adaptation strategies.

'Most communities and households need to adapt their drinking water systems to cope with drier scenarios. But most of them also need external assistance. Governments need research based information about how to best support them, for example, by financing infrastructure investments and developing human capabilities', says Róger Madrigal.

Finally, findings reveal that, when a community has a reliable piped water system, it is much less costly to adapt to water scarcity at the community level than at the individual household level. Estimates from Nicaragua and Guatemala show that, in a community with an unreliable water system, a household's cost for buying water from additional sources, such as bottled water or drinking water from trucks, is 15 US dollars per month. In communities with highly reliable pipe systems, households spend only two dollars per month in additional sources to fulfill their drinking water needs.

Researchers involved

Róger Madrigal, Francisco Alpízar, Paul Ferraro, Pablo Imbach, Eugenia León, Chelsia Moraes

In English the project is called Water for human consumption, communities and climate change: expected impacts and adaptation in Central America. See also efdinitiative.org/central-america/projects/l/ac3-project-water-human-consumption-communities-and-climate-change-expected/2910

In Spanish it is called Proyecto Agua, Comunidades y Cambio Climático, and abbreviated AC3. See also aguaycomunidades.org

Behavior change will improve air and public health

Participants in the stove replacement study look at different stoves to decide which one to buy.

Air pollution caused by wood-burning in homes for cooking and heating purposes is one of the most important environmental problems in Chile, affecting thousands of families and causing early mortality. EfD Chile researchers study families' and producers' economic behavior, and advise the government to incorporate effective economic incentives to design better pollution control policies.

Incomplete combustion of wood creates pollution from particulate matter. This has a huge impact on health, creating respiratory and cardiovascular problems. In winter months, more than 25 cities in southern Chile have concentrations of particulate matter that are double or triple the national and international health standards.

The government develops major pollution control plans, including measures to reduce the use of wood and to promote the replacement of old stoves by providing subsidies to buy cleaner and more efficient stoves. EfD Chile, or the Research Nucleus on Environmental and Natural Resource Economics (NENRE), hosted by University of Concepción, Chile, has been involved in this process by contributing to the design of a subsidy system that can be scaled up to all families in the most cost-effective manner.

'We have conducted theoretical and empirical research, applied surveys and even implemented a pilot program with real subsidies given to families to replace their old stoves. We have provided advice to the Ministry of Environment about how to correctly demonstrate the benefits of pollution control plans and how to incorporate social issues and participation of different stakeholders in the policy implementation process', says Dr Hugo Salgado, EfD Chile Research Fellow and Associate Professor at University of Talca, Chile.

EfD Chile researchers have found that families are willing to spend more money for cleaner technology and improved air quality, but not enough to trigger real change. Families need a partial subsidy to take action and use drier wood and cleaner stoves. The findings also show that companies respond to the incentive of subsidies. Sellers of equipment quickly computed which model of stoves would result in the greatest profit, and offered a discount to families to buy this model. The researchers' advice to policy makers is to set rules in terms of maximum amount of pollution of stoves that can be sold in local markets. Recently, such a new regulation that set standards for wood stoves has been implemented.

'We also need education campaigns such that families understand the importance of using dry wood and how to operate their stoves to minimize the effects on air pollution. Some simple changes of behavior can have a big impact on air quality', says Dr Salgado.

The Ministry of Environment has calculated that benefits can be up to five times the cost of implementing the measures proposed in pollution control plans. Besides public health effects, families can benefit from saving money on wood expenses when they use better technology and higher quality wood. Researchers at EfD Chile are currently advising the ministry about how to correctly value different benefits, for example, the effects on agriculture productivity, infrastructure, buildings and visual values, and how to incorporate these in the socioeconomic analysis of new regulations.

'One of the most important benefits is avoiding the future cost of doing nothing today. As cities grow, the demand for energy increases and the air pollution problem gets worse. Currently, cities have started to prohibit the use of wood on critical days. However, this restriction more seriously affects low income families that do not have alternative sources of clean energy for heating their houses. To find an alternative to the wood-burning prohibition, and in that way protect poor families, we need to start acting today to reduce pollution problems by developing clean and affordable technology and fuels', says Hugo Salgado.

EfD Chile/NENRE researchers have been able to publish a number of scientific papers that contribute to the literature on the design and implementation of air pollution control programs. And, they now have a better understanding of one of the most important environmental problems in Chile, caused by the behavior of thousands of families.

'Sandra Briceño was the first student who worked on this subject in our program. We are proud that she is now the chief of the Environmental Economics Department at the Ministry of Environment, in charge of the design of these pollution control programs', says Hugo Salgado.

Researchers involved

Carlos Chávez, Walter Gómez, Hugo Salgado and Felipe Vásquez.

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Hugo Salgado

'Air pollution is a problem where environmental economics analysis can have a huge impact', says Hugo Salgado, EfD Chile Research Fellow and Professor at University of Talca, Chile.


LOCAL

Mayor capacidad calórica y menos emisiones contaminantes entre sus características

Estufa italiana es una alternativa de recambio

50%

The EfD model

Climate change and scarcity of natural resources affect all aspects of society from the local to the global level. When facing the biggest challenges of our time, the role of research is to provide reliable, evidence-based knowledge for wise decisions. Our response as environmental economists is to analyze and design policies to manage climate change and to use natural resources in an efficient and sustainable way for the benefit of people today and future generations.

For twenty-five years, we have built environmental economics capacity globally, through the Environmental Economics Program, managed by the Environmental Economics Unit at the Department of Economics, University of Gothenburg.

This capacity building program includes a full PhD program in Global Change and Climate Economics and a number of Specialization Courses in Environmental and Climate Economics. We offer stipends financed by the Swedish International Development Cooperation Agency (Sida) to PhD students from low and middle income countries. The establishment of the EfD Centers over the past decade has been a collaboration among alumni, colleagues and partners in Central America, Chile, China, Ethiopia, India, Kenya, South Africa, Sweden, Tanzania and the US. We are proud that the EfD Initiative is run jointly with high-quality universities and research institutes in low and middle income countries, as well as with Resources for the Future in the US, the world's leading academic think-tank in environmental and natural resource economics. Sida provides core funding for the EfD Initiative. Other donors supporting EfD research include the World Bank, the Swedish Research Council Formas, and Canada-based International Development Research Centre (IDRC).

Our mission is to contribute to poverty alleviation and sustainable development through increased use of environmental economics capacity, tools and instruments in policy design and policy-making processes pertaining to management of ecosystems, natural resources and climate change impacts.

Our vision is a green economy with sustainable economic growth founded on efficient management of ecosystems, natural resources and climate change.

Find out more at www.efdinitiative.org

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