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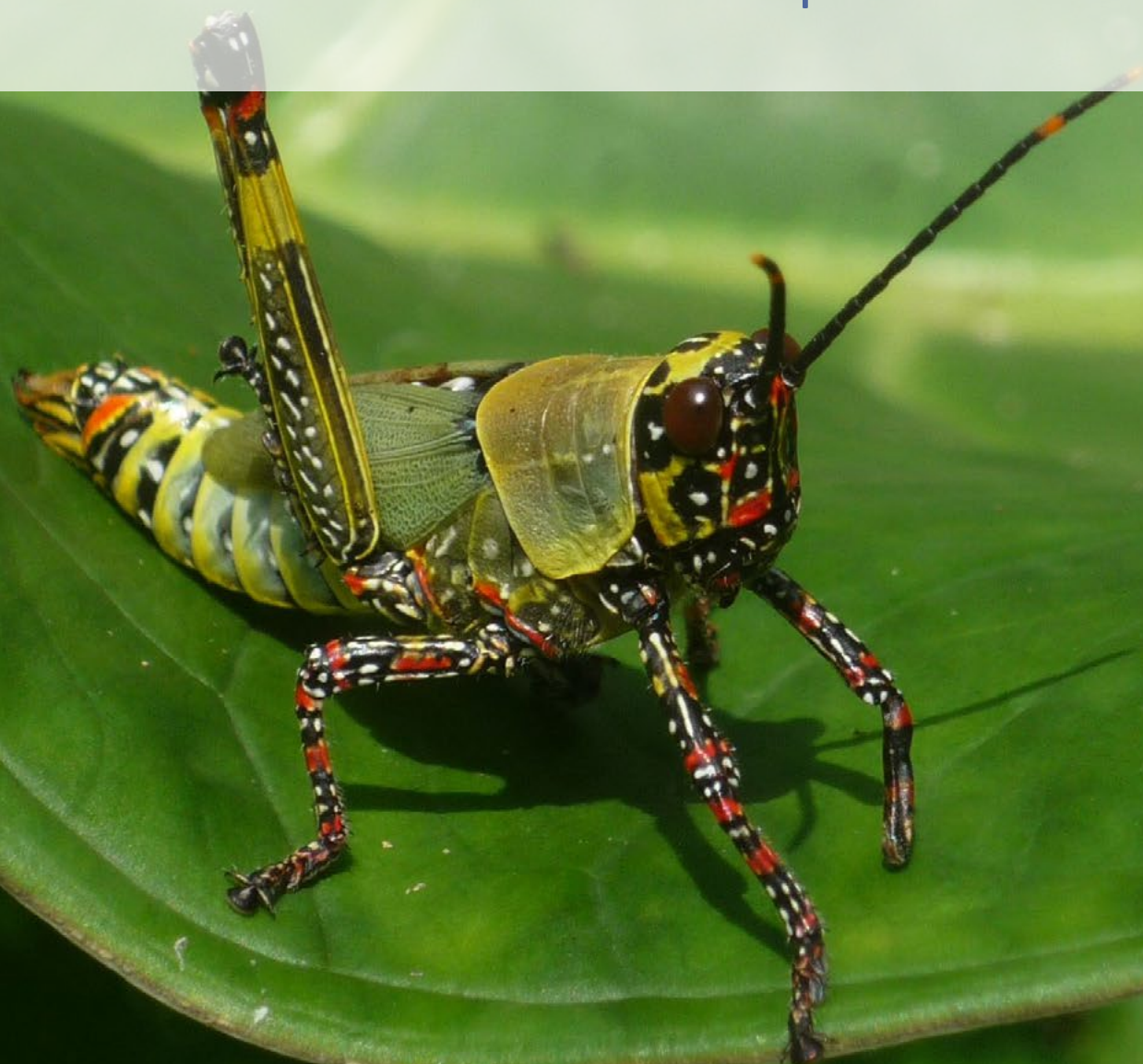
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ZEFNEWS

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LEAD ARTICLE

INSECTS MEET AN INCREASING DEMAND FOR ALTERNATIVE ANIMAL PROTEINS



Scholars project an exponential rise in future demand for animal protein. This demand is currently met by the constant expansion of intensive livestock production. But this development is environmentally unsustainable because livestock production already accounts for the largest share of agricultural land use, either for grazing or producing feed crops. An environmentally sustainable alternative to intensive livestock production needs to be found to ensure a more food-secure world in future.

A significant amount of annual global food production is wasted, both pre- and post-harvest. Vegetables and fruits account for almost half of that waste. Food waste has been traditionally used in compost and feed production. However, traditional conversion systems are time-consuming and inefficient. Bioconversion — the process of converting food waste into insect larval biomass and organic residues — can be an alternative to these present practices. Bioconversion reduces the amount of organic material using biological processing agents such as microorganisms or enzymes that transform organic material into usable products or energy sources, thus providing greater spatial potential for landfills and waste containers.

Edible insects require up to six times less feed than livestock for the production of the same amount of high quality protein. They provide oils, vitamins and minerals

but emit less greenhouse gases and ammonia than livestock. This opens up a potentially powerful source of food for direct human consumption or for protein in livestock feed meal mixtures.

ZEF research on the black soldier flies

ZEF researchers are currently engaged in exploring the use of black soldier flies (*Hermetia illucens*) for feed production and as a potential candidate for the bioconversion of organic waste and have come up with the following preliminary results and conclusions: Black soldier flies efficiently convert various organic wastes into high-profile protein through decomposition. The flies have a global distribution, including most tropical and subtropical regions, and can tolerate extreme temperatures.



Black soldier flies have been successfully used for waste management. They can also make use of various nutrients abundant in waste streams. In particular, Black soldier fly larvae can reduce a significant amount of food, animal, and sewage waste. The insects are not pests and actually deter the common houseflies that are normally linked to waste, low hygiene and poor health standards. When compared to livestock, the flies have some distinct advantages: They are cold-blooded and they can convert feed into edible products much more efficiently. They emit considerably less ammonia and greenhouse gases than conventional livestock, and, of course, they occupy less space.

Moreover, Black soldier flies have the ability to inactivate and reduce harmful microbial contaminants in waste streams by modifying the microflora of the waste. The flies also show some potential in reducing heavy-metal traces by incorporating and concentrating nutrients from waste samples into livestock feed. This reduces the pollution potential by 50 to 60 percent or more. After bioconversion, the remaining waste can be used as a bio-fertilizer.

Insect meal is a nutritional product prepared by drying and pulverizing insects. The meal promotes food assimilation and growth in animals because it is rich in protein, oils, essential minerals and vitamins. It can substitute the costly fishmeal, soymeal, and grains that are routinely added to livestock feed in order to promote food assimilation and growth in animals. Insects like Black soldier flies are good alternatives because of their ability to efficiently transform waste into high protein products. Clearly, edible insects provide a promising future source for animal protein. Yet, there remain many challenges to their use. The sustainable harvest of these insects is one. Producing numbers that can meet rising global demand is another. So far, most edible insects have been collected from nature. But their potential future use as feed meal will require large-scale production. In addition, legislation on their production and use needs to be developed to address sustainability and food safety.

See a longer version of this article:

Shumo, M. 2016. Black Soldier Fly: A Bio Tool for Converting Food Waste into Livestock Feed. *Solutions* 7(4): 36-39. <http://bit.ly/black-soldier-fly>

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EDITORIAL: MINI LIVESTOCKS - INSECTS AS PROTEIN SOURCE

There will soon be nine billion people on this planet. Feeding them alone will be a huge challenge for humanity, but providing them with the crucially needed animal protein is a daunting task, especially considering the fragility of our ecosystems. This challenge cannot be addressed using a 'business as usual' approach, which would imply utilizing more arable land for the production of animal

feed, or further depleting marine fish stocks worldwide. Thus feasible and sustainable alternatives need to be developed. An innovative and highly promising concept is to use mass produced insects as a novel protein source for animal and fish feed. Some insect species have a high oil and fat content. They are easily mass-produced, and they can even convert organic



Christian Borgemeister is Director of ZEF's Department for Ecology and Natural Resources Management

waste, including human and animal waste, into valuable biomass. These 'mini livestock' require significantly less space than their larger, conventional 'relatives' and also produce considerably less methane and other greenhouse gases. The consumption of insects (entomophagy) has been part of traditional diets across all continents. Food stands in night-time downtown Bangkok, a traditional restaurant in Mexico City or a market in northern Benin reveal how popular edible insects are in many parts of the world. Yet in North America and Europe, insects constitute niche products at best. Moreover, following the mad cow disease scandal, the use of animal protein in feed is still prohibited in the EU except for fish meal. Consider the irony: It is illegal for a European chicken to eat a 'worm' when it comes from a bag of feed. Yet it is perfectly fine for it to eat fish meal - certainly not a natural food source for our poultry. Removing these and other obstacles will help to provide our growing world population, especially in the Global South, with the much needed animal protein without further destroying our environment.

NUTRIHAF: NUTRITION-SENSITIVE AGRICULTURE IN ETHIOPIAN BIOSPHERE HOTSPOTS

Governments and development agencies are promoting the production of staple foods to combat hunger and to provide export crops to generate income. Nevertheless, it is not only calories or cash that count, but also nutritional values. Fruits and vegetables are significant for a healthy and balanced diet. Agricultural policies and practices should therefore become more 'nutrition-sensitive'.

The biosphere reserve in the Yayu Region of Ethiopia is a biodiversity hotspot. More than 90 percent of the population are smallholder farmers. The major cash crop is coffee,

which is grown under trees in the forest. The NutriHAF Africa project, in which ZEF is a research partner, investigates the possibility of integrating vegetables into this farming system to increase nutrition security, intensifying agriculture and thus reducing pressure on natural habitats.

The suitability of crops for multi-storey cropping systems depends on shade-tolerance and the risk of wild animal damage. New crops should also not 'disturb' coffee plants, so management needs to be adapted to avoid negative impacts on coffee production. Nutritious crops will affect gender-relations: Horticulture production could result in a better income for women, as well as an increase in their workload. Both factors may affect the nutrition of their families. Women prefer their home gardens for horticulture over forest plots. The negative image of leafy vegetables as 'weeds' or 'poor man's food' and consumer habits may also be a challenge. It is thus important to find out how nutritious crops can be promoted and how markets for fresh, processed and preserved vegetables can be developed.

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NOVEL RESTORATION STRATEGY OF GOLD MINING AREAS IN COLOMBIA

Gold mining is considered an axis of development in Colombia. Yet, there is a common perception that the expansion of gold mining has environmental and health impacts, leads to competition over land and water, as well as to the loss of livelihood for farmers.

Alluvial gold mining generates a vast amount of deposits. Gravel and sand completely cover the natural soil and destroy riparian ecosystems. In Colombia, about 79,000 ha of land area are affected by gravel deposits, especially in the Antioquia Department.

Degraded land can be reclaimed for agroforestry purposes. Since 2000, a gold mining company has been reclaiming deposits in two municipalities of Antioquia by supporting settlers through the establishment of farmland with integrated trees and shrubs. Cassava and plantain are combined with lemon and orange trees and livestock in these agroforestry systems. This complements reforestation efforts. More than 600 ha have already been reclaimed this way.

This ZEF research project provides a comprehensive understanding of transition processes from nutrient-poor and acidic deposition sites towards productive agroforestry-based systems. It explores the spatial variability of substrate properties and their changes over time and assess the influence of these properties on biomass production and the nutritional status of the vegetation. Another study component looks into farmers' perceptions and strategies to cultivate various qualities of the land.

Gold mining in Colombia



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Women selling vegetables in Yayu market place, Ethiopia.

RELATIVE DEPRIVATION AND OCCUPATIONAL CHOICES OF RURAL YOUTH IN AFRICA

Seventy percent of the youth in sub-Saharan Africa work in agriculture. A sizeable reduction in youth involvement in farming will have a detrimental impact on agricultural outputs. Besides considering factors such as the availability of land, conditions on the labor market and lack of opportunities, youth decide on their occupation on the basis of their relative deprivation. Relative deprivation is the individual assessment of one's situation (or life satisfaction) in comparison with the peer group. This research tries to understand how relative deprivation works exactly and what effects it has. Economically, relative deprivation measures the gap between the individual's income and the income of all richer individuals around. It can also be measured on the basis of households compared with other households.

Youth do not find agriculture uninteresting. But when thinking about whether to stay or to leave, they consider their relative economic position as well as their wealth

disadvantages. This explains partly why middle-class youth are more likely to choose livelihoods outside agriculture than their counterparts from the poorest and richest households. Development policies that aim at the redistribution of rural resources could even worsen youth out-migration if they result in an increase in local inequalities. Agriculture may become the work place of the left-behind, especially male youth, because better-off households invest in education and non-farming activities while the most deprived groups could be locked in agriculture. This, in turn, also damages agricultural productivity.

Governments need to invest in generating employment for youth, in entrepreneurial training schemes and agribusinesses. Forward and backward linkages between agriculture and non-agricultural professions need to be improved. Deprived households require special consideration in this regard.



Focus group discussions with youth

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GHANA'S DEVELOPING PETROLEUM SECTOR – EXAMINING TWO SIDES OF THE SAME COIN

Development efforts reached a turning point when oil and gas offshores were discovered on Ghana's west coast in 2007. In the words of President Mahama, petroleum is the 'game changer' for Ghana, which has faced several power crises in the past. Energy self-sufficiency is helping Ghana to become an upper middle income country.

Taking lessons from the global debate on the 'resource curse', the government introduced the Petroleum Revenue Management Act in 2011. Scholars and practitioners praise this legislation as unique because it includes the establishment of two funds in order to alleviate shortfalls in revenues and to provide future generations with proceeds following the depletion of the oil reserves. Priority Areas have been identified for the coordination of development efforts and the transparency of the distribution of revenues. In addition, a Public Interest Accountability Committee was formed to monitor government compliance with the Petroleum Act.

Legal precautions, however, could not fully prevent the new industries from having negative impacts on the local communities near the offshore oil rigs. The construction of the Ghana Gas Pipeline involved dispossessing around 1,800 farmers and land owners in 72 communities of the Western Region.

A survey revealed critical views on the national success story. More than 150 respondents reported that the authorities had taken their crops, which were ready to harvest, without prior consent. In a number of cases,

farmers were absent when their crops were evaluated for compensation. They found their crops destroyed when they returned to their farms and missed the harvest which they needed to feed their families. One third of the farmers criticized the fact that the volume and age of their crops were only roughly estimated and not computed via remote sensing techniques. One third of the dispossessed farmers still await compensation payments.

Research findings provide a more differentiated and multi-scalar perspective on how public authorities are handling the governance of petroleum resources. Even though Ghana has been successful in evading the 'resource curse' at the national scale, it is doubtful whether oil has also changed the game in favor of the local communities which live around the gas fields and are part of the extraction project. So far, they have not gained benefits but have borne certain costs as a result of the project.

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"Danger! High pressure - natural gas pipeline" - Farmers can't access their fields anymore

FOOD GRAIN POLICIES IN INDIA



Grain shop in Jodhpur Market, Rajasthan/India

From what was once a famine-prone country, India has now become a large exporter and stockholder, with stable domestic prices and several nutrition programs. However, 15 percent of the Indian population is still undernourished.

The current implementation of the National Food Security Act is experiencing many challenges while a switch to a cash-based system is being vociferously discussed. The Act provides, inter alia, a legal right to food at subsidized prices for 67 percent of India's population. It is based on the pre-existing Public Distribution System, which delivers subsidized wheat and rice to poor households across the country.

Strong impact of policy measures on market outcomes

Production, consumption, procurement, stocks and trade in India are strongly affected by policy measures. Among other conclusions, research found that the support prices have a strong impact on wheat and rice production, whereas rice consumption is mostly driven by the distribution of the subsidized grains. Protectionist trade policies mean that the export of grain is so distorted that its volumes hardly correlate with prices.

In-kind or cash-targeting issues

Based on household consumption data, this research revealed some serious targeting errors in the Public Distribution System. Many poor households were excluded from the system and migrant workers and female-led households were often not well covered. On the other hand, consumption of subsidized grains decreases substantially as the income of a household increases. This negative self-selection brings savings to the system, which would be lost under an alternative cash-transfer scheme. Leakage rates, that is to say, subsidized grains not reaching the poor, are in general very low for the poorest households and regions.

Assessing reform options – difficult choice between fiscal costs and market prices

Since 2006, there has been a clear upward trend in inflation-adjusted fiscal costs as a consequence of the growing procurement, storage and distribution of wheat and rice. Research findings indicate that the implementation of the National Food Security Act will put even higher pressure on fiscal costs and public stocks. These high fiscal costs and public stocks could be mitigated at the cost of higher and more volatile market prices. This research showed that a cash-based regime generates lower fiscal costs while total stocks remain sufficient due to the increase in private stocks. However, higher market prices and volatility under this system may have a negative impact on producers and consumers, as well as on political stability.

Regardless of the choice between in-kind and cash policy instruments, on-going corruption needs to be reduced. The scale of corruption has an impact on the outcomes of National Food Security Act.

Marta Kozicka started working as a senior researcher for the PARI project after finishing her doctoral research on policies for food security in India.

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Viewpoint

INTERVIEW WITH ZEF-SENIOR RESEARCHER NICOLAS GERBER

POLICY-RELEVANT RESEARCH FOR A FOOD-SECURE WORLD

You have been working in the FOODSECURE project on different countries. Were there similar constraints at work?

The project has a very global perspective with respect to its modeling components and a good coverage of the world in terms of in-depth case studies based on more empirical analyses. The 'library' of case studies under the FOODSECURE project is truly impressive and covers many different topics: from the analysis of national agricultural trade regimes to the impacts of culture and political systems on local food and nutrition security. Here at ZEF, we have concentrated on a smaller number of countries, with a strong focus on Ethiopia and India. From the global analysis we can definitely see that there are very different constraints at work. One example is the relationship between agricultural innovation or investments in agricultural research and innovation and the impact that this has on the agricultural system in terms of productivity.

So productivity is still an issue in poorer countries. And, of course, these are also countries where people face hunger and malnutrition. What needs to be done to solve this problem?

That is a difficult question. There are very basic drivers, such as education and conflicts. Education is something that you can invest in, of course. But we see serious constraints on improving education in poor countries. I could imagine that education will be taken care of as development progresses. Conflicts are volatile and difficult to foresee. We can see right now in Ethiopia that the situation that people are facing in some regions is not what we had imagined when the project started. I mention Ethiopia because some of the findings that we gained from the research that started four or five years ago would lead to

potentially different findings under current conflict conditions. Or we would maybe not even be undertaking that sort of research considering the security situation in parts of the country.

You were also involved in developing tools for applying research findings, such as the FOODSECURE Navigator. What is this exactly and how does it work?

The Navigator is basically the tool which encompasses every research result that has been produced under the project, be it a toolbox, that is to say, a modeling tool or empirical tool, be it a database or be it just research results. The Navigator will help policy makers facing a food security crisis to navigate that crisis by applying the relevant tools, using data or results from our project. The web-based Navigator is a very well organized library of tools and results with different entry points and with a menu that is very easy to access. It is a pyramid leading from very short entry points to the final products, such as policy briefs, peer-reviewed articles and so on. So the architecture of the Navigator is in place and it already contains very good products. The Navigator goes online in 2017.

You worked with a huge consortium. What was ZEF's particular expertise and contribution?

ZEF was active in two streams of work. One was linked to food commodity markets, food price volatility and its impact on food and nutrition security. In that context, the linkage to national policies was investigated in a number of ways, for instance by answering the following questions: How do international food prices transfer to national and local prices, and how do countries control prices, or not? What are their specific policies to ensure the food security of their people (e.g. food reserves, export bans, etc.), and what are the costs and effectiveness? The other stream of research focused on the drivers and impacts of agricultural innovation at the macro level and at the micro level. In both cases, we had case studies on specific country issues as well as a global analysis.

How does the interplay work between science and policy-making?

This kind of dialogue has been ongoing in the FOODSECURE project. This is the main European Commission-funded project on global food and nutrition security. So there are high stakes to deliver something that is of direct interest to the Commission. The communication channels with the European Commission were open all the time. We had a great coordination team at Wageningen Economic Research in the Netherlands, who were visiting Brussels regularly. The European Commission was the focus stakeholder in our inception meeting in Brussels in 2012 and



ZEF director Joachim von Braun in Dialog with Stakeholders and Commissioners from the European Commission at FOODSECURE's final conference.

Facts & news

was also the focus audience for our final conference in October 2016. Both meetings gave policy-makers a lot of room to voice their opinions and requests so that these can be integrated and reflected in the research agenda and in the results being presented. It also helps that we have very prominent researchers in the project who have close interactions with the policy-makers either nationally or at the European level. Trust and communication have been there all the time because these people also meet outside of the project.

Research objectives that were fixed five years ago could become outdated in a very dynamic policy environment such as the European Union. New publications are appearing, new research questions are being developed, etcetera. How to deal with this?

This is definitely a big challenge. You can see that when you recall our very first meeting with the European Commission to present our project in 2012. We said these are the themes that we are going to work on. And people were coming to us saying: 'This is the policy question that I would really like you to look into'. And these policy questions have changed completely. What the Commissioners asked us to find out four or five years ago is no longer their prime interest right now. Of course, we can't change the research results. But we can tune them and present them in a way that links up with current policy questions. For the final conference, we have asked policy makers to give a statement at the beginning of our different sessions. These statements directed the way researchers present and discuss their results.

The Interview was conducted by Irit Eguavoen.

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Capacity Building: Workshop on Resource Investments

ZEF and the Ghanaian-German Center for Development Research organized a joint workshop on "Civilizing Resource Investments and Extractive Industries" on September 20-23, 2016. Read more: bit.ly/ZEF-resources

ZEF-led study on bioenergy published in Elsevier receives Elsevier's Atlas Award



Outcome of the ZEF project on certification of bioenergy, published in an Elsevier article on "As Bioenergy Booms, Certification Schemes Must Consider Food Security", was awarded Elsevier's Atlas Award in

April 2016. The awarded article was one of 12 articles selected yearly out of 35,000. The Award Ceremony took place in Bonn on June 30, 2016. Read more: bit.ly/ZEF-Elsevier

STRIVE: New project on Bioeconomy launched at ZEF

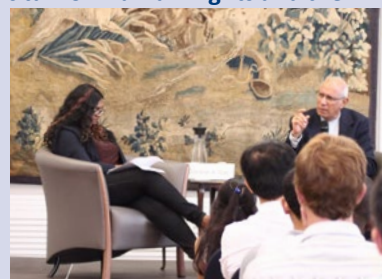
The project STRIVE (Sustainable TRade and InnoVation transfer in the bioEconomy: from national strategies to global sustainable development goals) combines research expertise from economics, political science, and environmental geography to improve the knowledge base for the design of sustainable bioeconomy policies and investments. The 3-year project will be funded by the German Federal Ministry of Education and Research (BMBF). Read more: bit.ly/ZEF-STRIVE

Award winner @ZEF: Josef G. Knoll European Science Award

ZEF-alumnus Abu Hayat Md. Saiful Islam won the Josef G. Knoll European Science Award 2016 for his dissertation on "Impact of technological innovation on the poor: integrated aquaculture-agriculture in Bangladesh". The award is granted by the Stiftung fiat panis. Read more: bit.ly/ZEF-award

Right Livelihood College: public talk on Human Rights and the Empowerment for Change

Right Livelihood Awardees Anwar Fazal and Glorene A. Das spoke about their lifelong struggle for human rights in Bonn on September 5. They shared their experiences and talked about the strategies they have successfully used to empower marginalized groups, as well as their motivation and private backgrounds. Read more: bit.ly/RLC-Human-2016



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DOCTORAL THESES @ ZEF

CHALLENGES TO LOCAL POPULATIONS AND ENVIRONMENTAL PROTECTION IN THE FACE OF IRON ORE MINING IN BRAZIL

The accumulation of land and other natural resources has continuously been pushed to ever new frontiers, especially in the Global South. This process is accelerated by an increasing demand for industrial raw materials, water and hydropower, as well as for arable land to support the production of foods and bio fuels. The rather weakly regulated ‘developing countries’ allow easier resource extraction and higher profits than the highly regulated Global North.

While the environmental and social externalities of large investments in resource extraction tend to be ignored by political decision-makers, they have been criticized by academics and contested by activists for a long time. Local and international campaigns have raised public awareness in the Global North and political advocacy has led to consumer pressure and the introduction of international standards. In addition, national legislative powers have reacted in order to prevent the most devastating consequences of resource extraction.

Brazil’s mining and extractive business

This is also the case in Brazil’s extractive industries and mining sector. After decades of local opposition and political advocacy, state laws were introduced in order to restrain the environmental and social devastation due to mining. Written regulations, apart from providing a high symbolic value, could have furnished the foundation for the effective protection of citizens’ and environmental rights. But the regulations were often revoked, bypassed or ignored following legal and administrative processes. Thus, citizens’ and environmental rights are undermined in practice.

One of Brazil’s largest iron ore mines in the countryside of Minas Gerais started extraction in 2014 after years of local protest and legal contestation. My field research has focused on the administrative and legal processes which dominated the negotiations in the mining conflict. Preliminary results confirm the arguments of the existing literature and further point to various processes that seem to undermine constitutionally enshrined environmental and social rights.

Iron ore mining in Minas Gerais



ZEF research in Minas Gerais

Binding legal regulations gave way to self-regulation in Minas Gerais. Regulations were bypassed in the name of efficiency and the need to speed up investments. Following the procedural trends, the content of some regulations was not clearly defined and thus became the object of negotiations between investors and the regulating state agencies. The negotiators changed frequently due to a high staff turnover in environmental agencies and mining companies. This made it difficult to monitor the implementation of negotiated outcomes. Moreover, in some cases individuals switched jobs from regulating agencies to companies and changed sides at the negotiation table. Thus, positions could become quite blurred.

The research revealed that not all parties enjoyed equal access to the law or had the same level of legal literacy. Local people who were negatively affected and contested the environmental and social cost of iron ore extraction were ignored by political decision-makers, even when they succeeded in collecting modest resources to translate their protest into practices of administrative or legal contestation. They did not enjoy the same degree of institutional openness to their claims as the mining company.

About the author



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“Mr. Governor, we have the largest enterprise of the State, but we don’t have security!”



THE MILITARY AS A POPULAR DEVELOPMENT ACTOR AND “SAVIOR” OF PAKISTAN

The backside of a rickshaw commemorates Pakistani soldiers who died in the 1965 war showing how pro-military sentiment is still omnipresent.



Photo by Katja Mielke

Pakistan has been under direct martial rule for 33 years – almost half the time of its independence as a state. Before that, though not directly in power, the military was an active player in the country’s administration, with varying degrees of intrusion.

Literature on Pakistan and the challenges that confront its polity tend to blame the military. This blame game relates to the failure of the leadership to devise sound economic policies or develop appropriate institutions, for example independent electoral, judicial and bureaucratic structures. It also illustrates that the military is widely accepted as a hegemon. Most academic literature focuses on explaining how this hegemony is maintained and conducted.

The unique popularity of Pakistan’s military

While Pakistan is not the only country where the military exercises hegemonic control, it is unique in the strong public support the military enjoys. All coups by the military (1958, 1977 and 1999) met little to no opposition from civil society. While polls show that the Pakistani public neither wants military takeover nor a military-led direct rule, the military’s popularity has never been stronger. The military seems to be the current go-to solution – whether for establishing Military Courts to prosecute suspected terrorists, dealing with the mediation of political unrest, conducting en masse anti-corruption drives or handling the rehabilitation of internally displaced persons. Public opinion ordains the military as the “savior” of Pakistan.

Concurrently, the military’s habitus is characterized by a self-confidence based on no corruption and its quality as a means of upward social mobility in terms of career

and educational aspirations. In short, it reflects all attributes that the current government falls short of in the public’s perception: politicians are perceived as corrupt, compelled by self-interest as opposed to national interest. They have failed to provide viable avenues of economic growth and development.

During my field research, military officers defined the defense of the country as the only responsibility of the military. Yet while ‘development’ is consigned to the civil realm, the understanding of defense in Pakistan emerges as a seamless web. ‘Defense’ includes all socio-economic aspects pertaining to the running of the country. This includes traditionally civilian domains such as road construction, as well as establishing schools and universities for civilians.

The purpose of this study is to explain how the Pakistan military has established indirect hegemony and how its auxiliary capabilities have contributed to its legitimacy and sustained mass popularity. The analysis focuses in particular on civil infrastructural and educational development projects implemented by the military.

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Why did you choose Cali as your research site?

Cali is the third-most populated city in Colombia and the pole of development in the Pacific region. The city experienced a sudden expansion towards the Cauca River due to the construction of a dike that allowed the district to gain land once belonging to the floodplain. This new land, in the first place intended for agricultural use only, ended up being mainly used for housing, both legal and illegal. By 2015, more than 800,000 people were living in the floodplain area. A breach in the dike during the rainy season would not only inundate the populated lowlands of eastern Cali, but also the main water and wastewater treatment plants that lie just across the river.

Unfortunately, the authorities in Cali have fallen short in terms of risk management and land use planning execution. Almost all their efforts and money are spent on repairing the internal losses of human and material resources. Had this not been the case, the city could have devoted its resources to boosting the Pacific area and the agro-industrial potential of the Cauca Valley region, which alone could be the pantry of Colombia.

What kind of research have you conducted in Cali?

I spoke with relevant stakeholders: agents of regional entities, city hall officials, scientists, illegal settlers, law enforcement officers and water plant operators. I collected secondary data regarding previous floods, risk analysis, city topography, bathymetry of rivers, schematics of drainage networks and water supply systems, inventory and location of housing and priority public facilities. I attended conferences and talks related to the topic. With these impressions and secondary data I aim to set up a dynamic model of the flood extent, and of the response of the drainage network and water supply system. Based on this research I plan to propose a policy that improves the joint action of regional entities regarding flood risk management for different scenarios.

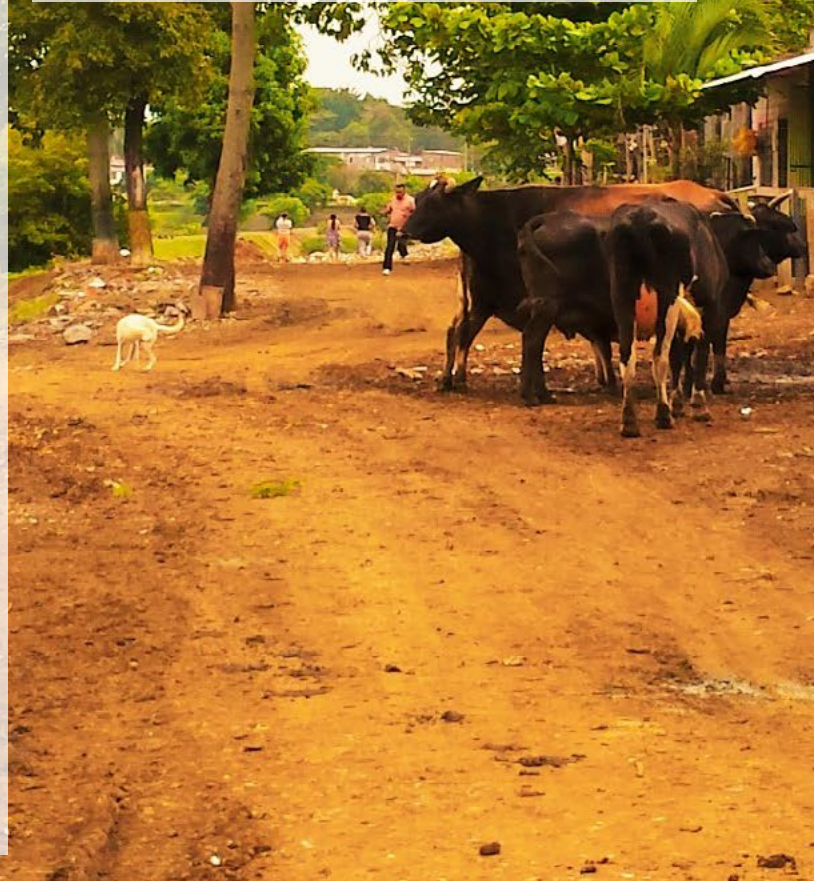
What were the challenges you faced while conducting the research?

It is usually difficult as an independent researcher to get information from entities in Colombia. In most cases, the data is only shared through inter-administrative or international agreements. However, it proved just a matter of time for me to make my way through the different organizations and find people who might be interested in the topic and would give me the information requested. It was

also not easy to visit the illegal settlements at the dike and get in touch with the people there: firstly, for safety and health reasons (i.e. Zika virus, crime and lack of security), and secondly, because once I did get to talk to them, it was a challenge to infer the truth; they are aware that their answers might compromise them and so they tend to lie about their income, activities, reasons why they ended up in the settlements, etc.

How can you contribute to solving the problem?

Risk management in general is improved by raising awareness in different sectors of society. I expect to keep the interest in tackling this issue alive by discussing the risks associated with dike failure in Cali and by emphasizing the strategic importance of the city in the country's development. Technically, I can also contribute to updating previous studies and give a more detailed quantification of the risk. By presenting scenarios to the regional government and academic institutions, I hope that these changes can be taken into account in the near future.



About the author



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