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On 7 April 2015 the African Centre for Biosafety officially changed its name to the African Centre for Biodiversity (ACB). This name change was agreed by consultation within the ACB to reflect the expanded scope of our work over the past few years. All ACB publications prior to this date will remain under our old name of African Centre for Biosafety and should continue to be referenced as such.

We remain committed to dismantling inequalities in the food and agriculture systems in Africa and our belief in peoples’ right to healthy and culturally appropriate food, produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems.

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ABOUT THIS PAPER

This paper synthesises the key findings of several of ACB’s recent publications focused on soil health in African countries. It focuses on the implications of a Green Revolution approach to agriculture on the continent, outlines continental and regional frameworks that support this approach, as well as the social and ecological consequences of its implementation. It also expands on the merits of an agro-ecological approach and provides several recommendations, based on ACB’s extensive fieldwork in Malawi, Mozambique, Tanzania, Zambia and Zimbabwe over the past three years, together with the sharing and feedback provided by small-scale farmers and their representative organisations.

EXECUTIVE SUMMARY

Healthy soil is a primary basis for life. It is essential for food production, regulates water cycles, recycles plant and animal matter, and regulates biological and chemical cycles (ACB 2014). It requires feeding, particularly if it loses or is mined of its nutrients (ACB 2015c). Increasing demographic pressure and shifting patterns of land tenure (from communal, land-based systems to privatised models) in Africa increasingly limit the amount of arable land available to small-scale farmers, forcing them to cultivate more intensely or to expand into marginal lands (ACB 2016b forthcoming). Of the estimated 8% of land that is considered arable on the continent, about 65% is degraded (ACB 2014). This affects the ability of small-scale producers to feed their families and sustain livelihoods. (ACB 2016b forthcoming). A changing climate is placing further strain on agricultural systems and soil fertility will play a crucial role in bolstering the adaptive capacity of Africa’s farming communities (ACB 2016b forthcoming).

In the dominant Green Revolution narrative about Africa, poor soils are linked to poor yields, which are linked to problems of hunger and poverty. The proposed solution is to increase farmers’ access to and the use of synthetic fertilisers and improved hybrid seed. Theoretically this will increase yields and allow small-scale farmers to earn more—and this will eventually reduce poverty because these farmers will move to commercial production and become self-sustaining in a globalised world (ACB 2015c). Synthetic fertilisers thus are positioned as one of the necessary ‘radical and innovative interventions’ that will increase agricultural productivity in Africa (ACB 2015b). This mono-focus on yields is shaped and driven by influential international organisations and donor funders, such as the United States Agency for International Development (USAID), the Alliance for a Green Revolution in Africa (AGRA) and its associated African Fertilizer Agribusiness Partnership (AFAP), the G8’s New Alliance for Food Security and Nutrition (NAFSN), as well as several multinational corporations, including fertiliser giant Yara and Monsanto (ACB 2015b). Their influence has shaped several continental and regional policy frameworks in Africa that not only direct public and donor funds towards commercialising agriculture, but that also fail to address the context-specific challenges facing small-scale farmers (ACB 2016b forthcoming).

Member States of the African Union signed the Maputo Declaration in 2003, committing to allocating at least 10% of their national budgets to agriculture, and adhering to the 2004 Comprehensive Africa Agriculture Development Programme (CAADP), which set a target of 6% annual agricultural sector growth (ACB 2016b forthcoming). CAADP is based on an economic growth model with extensive private-sector involvement and a focus on increasing access to and the use of synthetic inputs (ACB 2016b forthcoming). The 2006 Abuja Declaration calls on countries to increase their average fertiliser use to 50 kilogram (kg)/hectare (ha) (ACB 2015c) if necessary through ‘smart’ subsidy programmes (ACB 2016b forthcoming). This thinking is carried through to regional frameworks and interventions, such as the Southern African Development Community’s (SADC) Regional Indicative Strategic Development Plan (ACB 2016b forthcoming) and the Regional Agriculture Inputs Programme of the Common Market for Eastern and Southern Africa (COMESA) (ACB 2016a). This theory is increasingly echoed in national agricultural plans, which are adapted
to align with CAADP investment plans (ACB 2016b forthcoming).

Many public-private partnerships also operate to facilitate access by multinational fertiliser companies to new markets, particularly in agricultural growth corridors—a concept launched by fertiliser giant Yara in 2008 (ACB 2015d) with AGRA providing institutional support (ACB 2015a). These corridors favour the interests of the multinational private sector and domestic elites, while only an estimated 2–10% of small-scale farmers receive any benefit (ACB 2015b). Other public-private partnerships include the G8’s NAFSN, which is also supported by USAID’s Feed the Future Initiative (ACB 2015d) and AGRA, which by the end of 2013 had given 55% of its grants to initiatives that increased fertiliser supply in 12 countries (ACB 2014).

Despite this concerted and extremely interlinked advancement of the agenda for synthetic fertiliser adoption in Africa, there has been neither a significant increase in food security nor a reduction in rural poverty levels (ACB 2016b forthcoming). The problem then is posited as a lack of demand by farmers because they cannot afford fertilisers. The proposed solution is to offer credit facilities to small-scale farmers and implement large-scale Farm Input Subsidy Programmes (FISPs), to provide farmers with the inputs at reduced costs (ACB 2016b forthcoming). Although these FISPs are all implemented over a long period of time and at great cost (between US$ 100–160 million a year) (ACB 2016b forthcoming), they have not alleviated food insecurity or rural poverty to any significant extent (ACB 2016b forthcoming), nor have they created a demand for synthetic inputs on a commercial scale (ACB 2016b forthcoming). What they have done is expose small-scale farmers to synthetic fertiliser and encourage its utilisation in countries such as Tanzania and Malawi (ACB 2015d), to the point where Malawian farmers believe that farming is ‘impossible’ without synthetic fertilisers (ACB 2014b).

The increase in production has come at the cost of a crippling dependency that forces small-scale farmers onto a technological treadmill governed by external actors and controlled by a remote global market (ACB 2015b). Benefits seem to accrue to political parties (that have ‘bought’ favour); better-off farmers; politicians able to divert fertiliser; beneficiaries who leak fertiliser onto secondary markets for private gain (ACB 2014b) and input suppliers who win procurement bids but who are not responsible for the administration or distribution costs of the subsidy schemes (ACB 2015d).

Acceptance of the Green Revolution ideology has led to a series of decisions and actions that ignore the particular cultural, environmental and economic context of African small-scale farmers (ACB 2015c). The only viable future for African agriculture is an agro-ecologically based approach that uses indigenous and context-specific knowledge, takes into account social relations, relies on locally available materials as inputs and encourages a participative, inclusive approach to production (ACB 2016b forthcoming). Agro-ecology is not a new concept to small-scale farmers; rather, it builds on the traditional soil and water management techniques that African farmers have used for centuries (ACB 2016b forthcoming). ACB supports cooperative, collective farmer enterprises, based on shared technologies and knowledge that is generated through participatory processes, which acknowledge and honour the traditional role of farmers (ACB 2015d; 2016b forthcoming).
INTRODUCTION

A farmer’s ability to grow food depends to a large degree on having access to fertile soil. Soil filters and regulates water cycles, recycles decaying plant and animal matter, and regulates biological and chemical cycles (ACB 2014). It is also the medium we use to grow food for ourselves and for our animals (ACB 2014). Plants need 16 elements to grow properly. They acquire some from the air and from water, but they need nitrogen (N), phosphorus (P), potassium (K), calcium, magnesium and sulphur from the soil (ACB 2014). It is not the presence of a compound in the soil, but rather its concentration and the interlinkages with other chemical compounds, including at the level of macro and micro flora and fauna (ranging down to bacteria and fungi) that determine soil health (ACB 2016a). Plants struggle to reach their potential when they cannot access enough of these elements from the soil.

Just 8% of the African continent has soil that is conducive to productive agriculture—and an estimated 65% of that soil is said to be degraded (ACB 2014). Our soils have been depleted by about 660 kg/N, 75 kg/P and 450 kg/K per hectare, over about 200 million hectares of cropland. This equals about US$ 4 billion worth of soil nutrients lost each year (ACB 2015c). Many factors contribute to the degradation of soil including wind and water erosion and deforestation and monoculture farming (especially of maize and cash crops) (ACB 2015c). Increasing demographic pressure has also reduced the amount of available arable land and small-scale farmers have started cultivating in unsuitable areas or intensifying production on existing farmlands, which mines the nutrients from the soil. Farmers thus are increasingly unable to practice traditional soil management techniques, such as using fallowing periods or ‘slash and burn’ practices to feed the soil (ACB 2015c). A changing climate, which will shift rainfall patterns and increase the frequency and intensity of extreme weather events, will compound these existing problems (ACB 2015c).

The degraded state of the soil is a serious problem for Africa’s farmers, particularly those who rely on subsistence and small-scale farming to feed their families and generate a cash income (ACB 2016b forthcoming). The dominant meta-narrative on African agricultural systems identifies poor soil health as the limiting factor to reducing hunger and poverty. It also identifies the solution as increasing access by farmers to synthetic fertilisers, and the use of these inputs together with improved hybrid seed. Synthetic fertilisers thus assume a starring role in the Green Revolution for Africa, positioned as one of the necessary ‘radical and innovative interventions’ that will increase agricultural productivity in Africa (ACB 2015b).

This paper explores the framework of the Green Revolution approach to soil interventions in Africa and its adverse social and ecological consequences. It outlines recommendations for transitioning from such a system to building resilient soil health and ecosystems that small-scale farmers need in order to feed their families and communities, particularly in the face of a changing climate.

FRAMEWORKS FOR GREEN REVOLUTION SOIL INTERVENTIONS

The Green Revolution push in Africa is a comprehensive, interlinked approach that has shaped the development of several continental and regional commitments to agriculture. Major foreign interests play a significant role in shaping the future of agriculture in Africa, including USAID, AGRA and its associated AFAP, and NAFSN (ACB 2015d). These actors work to proffer Africa’s food chains to private—in most cases multinational—corporations and encourage a reorientation of the continent’s food systems. They lobby for regulatory and legislative reform that benefits their interests, investing in research and development that aligns with the Green Revolution agenda, moving farmers towards inclusion in global commodity chains (ACB 2016b forthcoming).
A report in 2015 by The International Panel of Experts on Sustainable Food Systems notes that “these intertwined and entrenched interests represent an increasingly powerful roadblock to reform” and have “an ability to either block or absorb any emerging alternative” (ACB 2016b forthcoming).

**Continental-wide frameworks**

In 2003, African Union members signed the Maputo Declaration, which committed them to allocating at least 10% of their national budgets to agriculture (ACB 2016b forthcoming). CAADP was launched in 2004 to coordinate the implementation process of the Declaration. The programme identified agriculture-led growth as key to reaching the Millennium Development Goal of reducing poverty (ACB 2015c). It set out several objectives, including growing the sector at an average 6% each year, with a focus on increasing the adoption of ‘improved’ technologies (ACB 2015c).

CAADP has been shaped by its interactions with major donor countries that combine development and philanthropic aid with advancement of the interests of their own private sectors (ACB 2015a). It looks to economic growth as its primary target, using quantitative indicators that do not provide information about nutritional levels, hunger, poverty or social development; it is a top-down technical solution that is imposed on complex social-agricultural systems (ACB 2016b forthcoming). In 2006 members of the African Union signed another declaration, the Abuja Declaration, which calls for countries to increase their average fertiliser use to 50 kg/ha (ACB 2015c) using, if necessary, ‘smart’ subsidy programmes (ACB 2016b forthcoming). While the Declaration demonstrates some focus on the use of organic farming, conservation agriculture and grain-legume intercropping to build up soil health, its dominant focus is on synthetic fertiliser and ways in which to create awareness of, boost the demand for, facilitate access to, and assist with the purchase of such fertiliser.

**Regional harmonised frameworks**

Donor organisations, such as USAID and AGRA, push for coordinated policies and regulations at the regional level—for example, the harmonisation of seed laws and fertiliser regulations (ACB 2015a). USAID and AGRA, with their focus on facilitating private-sector entry into value chains, note that it is the lack of regional standards that hinders private-sector involvement in the fertiliser value chain (ACB 2015a). AGRA recommends that governments remove non-tariff barriers through regional economic groups and provide tax relief for those involved in importing and distributing fertiliser in the region (ACB 2015a).

Africa’s commitment to the Maputo Declaration, reaffirmed in 2014, forms the basis for the Regional Indicative Strategic Development Plan of the SADC. The Plan aims to support a structural transformation of the region’s agriculture-dependent economies, by prioritising access to and the use of improved, synthetic inputs (ACB 2016b forthcoming). It recommends facilitating public-private partnerships that enhance the production and distribution of improved seed and fertilisers; drafting strategies and mechanisms that promote increasing adoption rates; and facilitating the harmonisation of regulatory and policy frameworks (ACB 2016b forthcoming). Regional programmes also promote uptake of the Green Revolution approach, such as the COMESA-funded Regional Agriculture Inputs Programme with its focus on financial services and insurance, the regional harmonisation of seed laws and policies, and the development of agro-dealers and agents in four COMESA countries (ACB 2016a).
Character and Logic of Green Revolution Soil Interventions

Legal and policy

Many African governments have already restructured, or are in the process of restructuring, their legal and policy landscapes to facilitate access to and promote the use of synthetic fertilisers (ACB 2015b). Nearly 40 African countries have signed the CAADP Compact, 25 have drafted investment plans and 13 are in the process of doing so, while another 11, including South Africa, are working towards signing the Compact (ACB 2016b forthcoming). These plans are set within a typically Green Revolution-oriented policy framework that focuses on productivity, input and output markets, building public and private institutional capacity and increasing small-scale farmer access to productive resources (ACB 2015b). National agricultural plans tend to be aligned with these aims, as in the case of Mozambique, Zambia and Zimbabwe (ACB 2015a; 2015b).

Policy frameworks also are oriented towards encouraging private-sector investments, to the detriment of public investment in long-term public goods. This is apparent in Tanzania’s diversion of public resources to support the establishment of public-private partnerships and the input subsidy scheme (ACB 2015d) and in Zambia where less than 15% of annual agricultural expenditure goes to research, compared with the 40–70% that is spent on subsidies (ACB 2014). Some actors, such as the IFDC, influence policy at a multitude of levels.

International Fertilizer Development Center (IFDC)

The IFDC has worked in Africa since 1987 and is a significant player in the push to increase access to and the use of synthetic fertilisers on the continent. It receives funds from AGRA and all the world’s major fertiliser industry bodies, aims to strengthen agro-dealer and input networks that work closely with AGRA and USAID, and its influence stretches beyond the agricultural sector. In Mozambique it has recommended that the government amend its regulatory role in the financial industry, to provide a cushion for lending institutions that operate in the relatively high-risk agricultural sector. It works to promote the harmonisation of fertiliser policies and regulations in east and southern Africa. It also funds research into increasing fertiliser use and has provided US$ 20 million to fund the West African Fertiliser Project, from 2012 to 2017.

Source: ACB 2014; 2015a.

Agricultural policy frameworks in Africa need to take into account the plurality and diversity of the changing contexts, challenges and cultures in which farmers operate. The process of drafting policy and regulations therefore must be a participative, iterative and transparent process to ensure that those whose lives will be affected most are included in creating the policies that govern their livelihoods (ACB 2016b forthcoming). The International Panel of Experts on Sustainable Food Systems recommends that processes of this nature must also provide opportunities for revision, based on feedback from those whom they affect (ACB 2016b forthcoming).
Table 1: Green Revolution funding in Africa

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<td>AFAP in: Mozambique</td>
<td>Led initiative to launch and provides the secretariat for the National Platform for the Promotion of Fertiliser Use in Mozambique. Provides financial and technical support to the Instituto Superior Politecnico de Manica, a soil laboratory to improve fertiliser testing capabilities.</td>
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<tr>
<td>NAFSN in: Nigeria</td>
<td>Builds up institutional capacity for fertiliser regulation.</td>
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<tr>
<td>AGRA in: Zambia</td>
<td>Provided funding to the Zambian Agricultural Research Institute, the University of Zambia and the Seed Control and Certification Institute. Established in 2013 the Zambia Soil Health Consortium, which forms part of the Soil Health Consortia for Eastern and Southern Africa and the African Soil Health Consortia. Provided funds to the national agricultural research institute, the IFDC and the Manica Economic Development Agency. Provides institutional support to Beira Agricultural Growth Corridor (BAGC).</td>
</tr>
<tr>
<td>USAID in: SADC countries</td>
<td>Supports the Southern African Trade Hub, which focuses on regulatory matters, modernisation, food production and trade facilitation, among other aspects. The hub supported and co-financed the South African National Seed Association. Build capacity in local research institutions under a food security research project.</td>
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Source: ACB 2015a; 2015b; 2015c; 2015d.

Institutional

Various existing and new institutional structures are in place to facilitate the uptake of fertiliser in African countries. The funding of institutional arrangements has a significant influence on an institution’s agenda and focus areas. Table 1 provides a brief snapshot of some Green Revolution funding and its potential influence on the institutional agenda.

Infrastructure

There is also a call on governments to upgrade infrastructure, including building or upgrading roads, port handling facilities and warehousing infrastructure (ACB 2015a). Some of these investments obviously benefit farmers, but only if they are in the right place and serve farmers’ needs, as opposed to facilitating entry into the value chain by lowering transaction costs for corporate multinational companies, particularly through the agricultural growth corridors.

For example, the Zambian government has spent more than US$ 5 billion in recent years to rehabilitate the national road network and promote regional transport corridors (ACB 2015b).

Public-private partnerships

Agricultural growth corridors

Yara launched the concept of agricultural growth corridors at the United Nations General Assembly in 2008. The concept was pitched as an innovative way to use public-private partnerships to build infrastructure, improve access to financing and credit, provide inputs and improved storage, and facilitate access to markets (ACB 2015c). The two primary corridors are the BAGC through Mozambique to the strategic port of Beira and the Southern Agricultural Corridor of Tanzania (SAGCOT).
Agricultural growth corridors

Both corridors have 20-year investment plans and combine large-scale commercial agricultural projects aimed at export markets, with some interventions to commercialise small-scale agricultural production. Interventions tend to focus on enhancing access to improved seed and synthetic fertilisers, credit, irrigation and markets, and to favour the interests of multinational companies and domestic elites; only an estimated 2–10% of small-scale farmers benefit.

The United Kingdom consultancy company, Prorustica, and its agricultural and infrastructure development arms, AgDevCo and InfraCo, manage both corridors (ACB 2015d).

BAGC
- **Partners:** Mozambique government, AGRA, the World Bank, Tongaat Hulett and Yara.
- **Aim:** Whole-sale commercialisation of agriculture based on the large-scale Brazilian model from the 1970s.
- **Financing:** The estimated amount needed is about US$ 1.74 billion. To date, donor companies include AGRA, USAID, the United Kingdom’s Department for International Development (DfID), Yara, the IFDC and DuPont.
- **Activities:** AgDevCo operates the BAGC’s revolving fund, which is backed by DfID, Norway and the Netherlands, and it grants loans in exchange for a share in the enterprise. It currently has 14 investments in Mozambique with values ranging up to US$ 1.5 million.

SACGOT
- **Partners:** Tanzanian government, AGCO (machinery supplier), Bayer CropScience, Monsanto, Nestle, Olam (international grain trader), SABMiller, Unilever and Yara.
- **Aim:** To place 350 000 hectares under cultivation, create 420 000 jobs and increase farming revenues by US$ 1.2 billion by 2030.
- **Financing:** The Tanzanian government is expected to provide up to US$ 650 million in funding over the first 20 years—it is not clear where this money will come from or if it will be at the expense of other public sector expenditure.
- **Activities:** Yara is building a US$ 20 million fertiliser terminal at the port at Dar es Salaam; AGRA provides direct support for the corridor’s institutional arrangements and has funded projects to the value of US$ 4 million between 2007 and 2012.

Source: ACB 2015a; 2015b; 2015d.

G8 New Alliance for Food Security and Nutrition (NAFSN)

Yara also played a significant role in the launch in 2012 of this multilateral partnership between African governments, the G8 countries and 19 private organisations (ACB 2015d). It brings a corporate agenda to the CAADP implementation process and the Grow Africa partnership, for which Yara also played a key founding role (ACB 2014). The platform is a joint programme of the World Economic Forum, the African Union Commission and the New Economic Partnership for Africa’s Development (NEPAD) (ACB 2014). As of 2015, ten African countries have entered into partnerships under NAFSN (ACB 2015d). Participating countries need to make certain commitments, such as creating fertiliser policies (ACB 2014). Mozambique has committed to reducing tariffs and developing a national fertiliser strategy and regulatory framework (ACB 2015a); Tanzania has agreed to review its legislation on fertilisers (ACB 2015d).

USAID’s 2010 Feed the Future Initiative operates in 12 African countries and provides support to NAFSN and Grow Africa (ACB 2015d). AGRA manages the NAFSN Scaling Seeds and Technologies Partnership in Mozambique, and also operates in Tanzania, Malawi, Ghana and Senegal (ACB 2015a). Monsanto is involved in NAFSN and works in SAGCOT to strengthen
Soil fertility: Agro-ecology and not the green revolution for Africa

agro-dealer networks and distribute its maize varieties (ACB 2015d).

The Alliance for a Green Revolution in Africa (AGRA)
AGRA’s Soil Health Program was launched in 2008 with start-up funds of nearly US$ 200 million, mostly from the Gates Foundation (ACB 2014). AGRA promotes Integrated Soil Fertility Management (ISFM) and Conservation Agriculture (CA), but with the inclusion of synthetic inputs to restore soil fertility (ACB 2014). It also trains extension staff and lead farmers on this approach (ACB 2014) and provides direct support to the establishment of agro-dealer networks: a grant of US$ 1.51 million to the IFDC, to construct a network in Mozambique (ACB 2015a), and more than US$ 7 million for the same purpose in Zambia (ACB 2015b). AGRA focuses on developing private agro-dealer networks, as opposed to empowering government agricultural extension officers as transfer agents of technical knowledge and resources (ACB 2015b). By the end of 2013, the Soil Health Program had invested about US$ 68 million, of which nearly US$ 38 million was spent on increasing fertiliser supply in 12 of AGRA’s focus countries (ACB 2014). In Tanzania AGRA has focused almost exclusively on investments in SAGCOT (ACB 2015d). AGRA’s biggest grant to date was the US$ 25 million grant to establish AFAP (ACB 2015c).

While enormous amounts of public, donor and development funding is directed towards initiatives such as those outlined above, the benefits do not appear to accrue to the intended beneficiaries—small-scale farmers, their households and communities—and none of the initiatives speak directly to building soil fertility. In addition, there has been no significant increase in food security or the reduction of rural poverty. Even Malawi’s much promoted Green Revolution success in 2005/06 did not prevent the food crisis that

African Fertiliser Agribusiness Partnership

- **Description:** AFAP, established in 2011, is a collaborative partnership between NEPAD, the African Development Bank, the IFDC and the Agricultural Markets Development Trust.
- **Aims:** To increase synthetic fertiliser use by 100% and the number of users by 15%. This seems to indicate that activities will be targeted at a particular group of farmers.
- **Funding:** An initial US$ 25 million from AGRA and a significant level of donor and development funding, including from USAID, DfID, and the Food and Agriculture Organisation (FAO) which is part of the United Nations.
- **Focus areas:** The ‘breadbasket’ countries of Ghana, Mozambique and Tanzania, with additional work in Cote d’Ivoire, Ethiopia, Malawi, Nigeria and South Africa.
- **Products:** AFAP extends credit guarantees and grants to actors in the fertiliser value chain, working through agribusiness partnerships and contracts with private players in the value chain.
- **Activities:** AFAP actively supports the regional harmonisation of fertiliser policies and regulations in COMESA and the Economic Community of West African States (ECOWAS). By the end of 2013 AFAP had invested US$ 5.2 million with seven fertiliser companies and it had signed 35 agribusiness partnership contracts: 16 for guaranteed credit facilities and 19 for matching grants, primarily for building warehousing infrastructure. The organisation is most active in Mozambique, which is also home to the largest known reserve of apatite ore in the region, (apatite ore is key for fertiliser production), and considerable deposits of natural gas. In Tanzania it has a contract with Minjingu Fertiliser Company, which owns a concession with deposits of about 10 million tons of rock phosphates.
- **Influence:** AFAP has signed a Memorandum of Understanding (MOU) and a grant agreement with NEPAD, to entrench fertiliser issues into national agriculture plans, and provides NEPAD with technical assistance and support. AFAP is an implementing partner for six of AGRA’s soil health programmes and for USAID’s West Africa Fertilizer Program (ACB 2015c; 2015d).
occurred at the end of 2012; a government report noted then that rural poverty levels had actually increased since the introduction of the FISP (ACB 2016b forthcoming). And in Zambia, farmers remain as mired in poverty as they were prior to the introduction of subsidies on hybrid maize seed and synthetic fertilisers (ACB 2015b).

N2 Africa
The ‘N2Africa Putting nitrogen fixation to work for small-scale farmers in Africa’ project, commonly known as N2Africa, was initially funded by the Gates Foundation in 2009. The project focuses on legumes with nitrogen-fixing abilities (i.e. legumes that take the nitrogen they need from the air and pass it into the soil through fallen leaves and decaying plants) (ACB 2016c unpublished).

N2Africa works across three agro-ecological zones: the highlands of East and Central Africa, the Southern Africa plateau, and the West Africa Guinea savannah (ACB 2016c unpublished). In 2014 the Gates Foundation announced a further grant of US$ 25.3 million for the second phase of the project, which will expand into Ethiopia, Tanzania and Uganda (ACB 2016c unpublished) and continue until 2019.

The project operates in partnership with international and African organisations and by 2015 it had signed 22 MOUs with partners, including private input suppliers, buyers and development partners, and agreed 59 partnerships, including research agreements (ACB 2016c unpublished). It works through AGRA-funded initiatives in many countries, as well as AFAP (ACB 2016c unpublished). It promotes the use of improved seed and fertilisers, pushes for the harmonisation of regional regulatory frameworks, and lowers the risk of private-sector entry into the agricultural market by using donor money to create demand (ACB 2016c unpublished).

MAJOR SYNTHETIC FERTILISER CORPORATIONS OPERATING IN AFRICA

The major users of fertiliser in sub-Saharan Africa are South Africa, Nigeria, Kenya, Ethiopia and Malawi, with production concentrated in Zimbabwe (one of the largest producers in sub-Saharan Africa) (ACB 2016a), Senegal, Nigeria and Mauritius (ACB 2014). No more than four firms operate in each country and in most cases there is only one (ACB 2014). Several large fertiliser companies—Yara, Notre Chemical Industries of Nigeria, South African Omnia and the OCP Group SA from Morocco—have significant operations in Africa (ACB 2014). These and other smaller companies are highlighted in Table 2.

FISPS ENCOURAGE FERTILISER CONSUMPTION AND FARMER DEPENDENCE

Fifteen FISPs have been initiated in Africa since 2000; ten of these are large-scale programmes, some are universal (Namibia, Nigeria) and others are targeted (Malawi, United Republic of Tanzania, Zambia, Zimbabwe) (ACB 2016b forthcoming). Their primary objective is to increase yields and boost food security, with occasional aligned goals that aim to reduce rural poverty, lower food prices or develop input supply markets (ACB 2016b forthcoming). The programmes are implemented over a three- and ten-year period, cost between US$ 100–160 million a year, and are funded largely by national governments (ACB 2016b forthcoming). By 2010, ten African countries had spent about US$ 1 billion on FISPs, close on 30% of their agricultural budgets (ACB 2016b forthcoming).
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Although FISPs have been enthusiastically promoted by organisations such as the World Bank, following the significant yield increases on implementation of the subsidy programme in Malawi in 2005, they have not alleviated food insecurity or rural poverty to any significant extent (ACB 2016b forthcoming), nor have they created a demand for synthetic fertiliser or improved seed on the commercial scale (ACB 2016b forthcoming). What they have done is encourage fertiliser utilisation; for example, in Tanzania average usage has risen from 5.5 kg/ha prior to introduction of the subsidy scheme to 8.7 kg/ha in 2009 (ACB 2015d). This utilisation has occurred to such an extent in Malawi that farmers there, who are using shockingly high levels of synthetic fertiliser, argue that farming is ‘impossible’ without synthetic fertilisers (ACB 2014b). While some yields have increased (in Malawi, Tanzania and Zambia) there are doubts about whether this is due to the subsidisation of inputs, or expansion onto fallow or virgin lands, or to crop replacement driven by the desire to access the subsidy (ACB 2016b forthcoming).

Any increase in production has come at the cost of a crippling dependency that forces small-scale farmers onto a technological treadmill: declining soil quality must be countered with a greater application of subsidised fertiliser, which leads to a further decline in soil quality, and so on (ACB 2015b). Zimbabwean farmers have identified a number of concerns regarding the dominance of hybrid maize, including the loss of agricultural

Table 2: Snapshot of fertiliser companies operating in Africa

<table>
<thead>
<tr>
<th>Company</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yara</td>
<td>The world’s largest producer of ammonia, nitrates and complex NPK fertiliser, and one of the biggest fertiliser companies by revenue. It is instrumental in shifting policy and regulations to facilitate the increased uptake of synthetic fertilisers.</td>
</tr>
<tr>
<td>OCP Group (Morocco)</td>
<td>The world’s largest exporter of phosphate, accounting for about 21% of the global phosphorus-based fertiliser market. Plans to invest US$ 17 billion to increase its market share to 40% by 2020. Built four plants in Morocco and Gabon in 2014, intending to supply 30% of the African market.</td>
</tr>
<tr>
<td>Omnia (South Africa)</td>
<td>Operates in nine African countries and has interests in mining, explosives and chemicals. The Public Investment Corporation holds 14% of Omnia, which was blacklisted by Zambia’s FISP because of bid rigging and cartel behaviour.</td>
</tr>
<tr>
<td>Louis Dreyfus</td>
<td>One of the largest distributors with operations in Nigeria, Kenya, Tanzania and Zambia.</td>
</tr>
<tr>
<td>Smaller local companies:</td>
<td>Zimbabwe Phosphate Industries/Zimbabwe Fertiliser Company/Sable Chemical Industries/Windmill/ Africa Fertiliser Tanzania Ltd./China Pesticides Ltd./DRTC Trading Group Ltd./Minjingu Mine &amp; Fertiliser Ltd, Tanzania Fertiliser Company Ltd.</td>
</tr>
</tbody>
</table>

Source: ACB 2014; 2015c; 2016a.
biodiversity and dietary diversity, lower yields obtained over time, and the associated costs of production (ACB 2016a).

Critiques of the programmes range from their design, poor targeting and distribution mechanisms, to their exorbitant costs (particularly in Malawi, at 6.3% (2013) and in Zambia, at 13.6% (2011) of national budgets) (ACB 2016b forthcoming). Benefits seem to accrue to political parties (that have ‘bought’ favour), better-off farmers, politicians able to divert fertiliser, and beneficiaries who leak fertiliser onto secondary markets for private gain (ACB 2014b). Primary beneficiaries tend to be the input suppliers who win procurement contracts—including multinational seed and fertiliser companies—but who are not responsible for the administration or distribution costs of the subsidy schemes (ACB 2015d).

This information leads to the unavoidable conclusion that African governments are being tasked with creating the demand for synthetic fertiliser (primarily through expensive subsidy input programmes), providing the infrastructure to enable private business to access the market at low risk, and then rewarding private business through tax relief measures (ACB 2015a). Accordingly, public funds are being used to establish a private market that is not accountable to the state (ACB 2014b).

SOCIAL AND ECOLOGICAL IMPACTS OF GREEN REVOLUTION INTERVENTIONS

Deteriorating dietary diversity

Green Revolution ideology focuses on increasing yields—and thus calories. It does not focus on enhancing nutritional quality or building resilient farming systems. In Africa, its primary focus on maize and, to a lesser extent, rice (by providing seed and fertiliser through subsidy and donor programmes) is linked to a decrease in agrobiodiversity and thus dietary diversity, which people need to stay healthy (ACB 2014b). Farmers also need to grow a variety of crops to maintain a resilient and diverse seed system, particularly because of climate change (ACB 2015b). In Malawi up to 45% more land is being planted under improved maize; thus less land is being planted under traditional varieties of maize and other crops. This contradicts Malawi’s own agricultural policy that calls for increased crop diversification (ACB 2016b forthcoming).

In Lesotho, even though it would be cheaper, more appropriate and more profitable to plant sorghum and wheat, the country continues to spend scarce resources on subsidising maize cultivation (ACB 2016b forthcoming). This almost mono-focus on maize entrenches the need for the inexorable use of fertiliser because maize, as with cowpea, has the largest nutrient removal footprint of all food crops (ACB 2015a).

A culture of dependency

African small-scale farmers have become increasingly dependent on subsidised inputs that are, for the most part, produced elsewhere in the world, using capital-intensive production processes and expertise (ACB 2015b). In Botswana, the number of subsistence farmers in the country has increased significantly since implementation of its subsidy scheme; in Zambia, small-scale farmers lost up to 30% of their incomes when the scheme was temporarily stopped, with the World Bank noting that the attempt to test and encourage adoption of new technologies had effectively become an income transfer scheme that lowered production costs; and in Zimbabwe and Lesotho critics of the programmes note the crippling dependency of farmers on subsidised inputs, with the World Bank noting that subsidies in Lesotho seem to be converting farmers into “welfare recipients … mere passive receivers of technical advice, beneficiaries of public sector subsidized inputs and price takers in local markets” (ACB 2016b forthcoming).

Creating dependencies of this nature is dangerous—many rural households could relapse into extreme poverty if or when these subsidies are reduced or removed (ACB 2015b forthcoming).
In addition, because all subsistence farmers are producing the same crop, within the same market footprint, at the same time, the resultant glut in the local market drives down prices just at the time that farmers need to sell (ACB 2016b forthcoming). ACB’s work in Malawi indicates that even the yield gains made by Malawian small-scale farmers (on average 519 kg/ha more than local maize varieties) were not enough to cover the financial costs of the inputs or offset the ecological impacts (ACB 2014b). There is an evident net transfer away from farming households to agribusiness in Malawi when small-scale farmers adopt Green Revolution technologies (ACB 2014b). Farmers become trapped on the technological treadmill and will increasingly pay more for their inputs, given the significant increase in input prices in recent years. Compounding this situation, ACB’s fieldwork in Malawi and Zimbabwe reveals that most farmers do not have the financial resources to return to less expensive forms of production (ACB 2014b; 2016a).

Creating differentiated rural social structures

The Green Revolution aims ultimately to create a class of commercial producers linked to active markets and able to access finance. It is inevitable that support is targeted towards those who already have some access to land and labour, and are able to access government or donor support services (ACB 2016b forthcoming). Even input subsidy programmes, meant to help vulnerable groups (for example, the poorest, women- and child-headed households, those living with disabilities or chronic illness), are tending to shift towards more commercial farmers; this is true in Zambia, Malawi and Tanzania (ACB 2016b forthcoming). The result is that particular groups benefit, while the poorest and most vulnerable are further relegated to the margins of economic life. In this way, the Green Revolution actively contributes to creating class differentiation (ACB 2015d). The Green Revolution model also tends to orient farmers towards competitive behaviour in order to secure their livelihoods. The District Agricultural Extension Officer in Zimbabwe’s Murewa District, Mr Makuvire, notes that farming households that used to work collaboratively to cultivate large areas of small grains now focus on the market and have “become more and more selfish in the pursuit of profits” (ACB 2016a).

If African agriculture modernises in this way it will displace those farmers who are unable to compete. Households that historically have been reliant on land-based livelihoods will be left with little choice but to migrate to cities, to bolster the already growing numbers of urban poor, or will be compelled to accept low-paid and insecure labouring jobs on commercial farms (ACB 2015d). The assumption that it is still possible for Africa to industrialise and to follow the typical development path, in a globalised world in which it occupies a subordinate position in terms of accumulation (ACB 2015d), is a dangerous notion.

Ecological impacts and implications

Within the Green Revolution narrative, soil is relegated to the role of a medium for plant growth, as opposed to being viewed as a symbiotic partner in production. This notion is mirrored in institutional and research frameworks that focus on the constraints the plant will face, rather than any methods that will improve soil health (ACB 2016a). The argument that soils lack crucial nutrients or are unbalanced is rarely based on context-specific evidence; this implies that a blanket solution of synthetic fertiliser application is not scientific and appears to be more about creating fertiliser markets (ACB 2015b). A good example of how this thinking can lead to long-term ecological damage is the promotion of blanket applications of nitrogen-based fertiliser, which has severe implications for soil, ecosystems and human health, at the same time as boosting plant growth (ACB 2016a).
The effects of excess nitrogen

- About 50% of nitrogen from synthetic fertilisers accumulates in the broader environment.
- In water: excess nitrogen can lead to too much plant growth and decay, loss of oxygen and plant and animal life, and an increase in acid levels.
- In the soil: reactive nitrogen can leach into water as a nitrate or oxidise to become N2O, and excess nitrogen removes soil carbon and speeds up the growth of microorganisms that feed on vital humus, and also removes nutrients from the plant itself.
- In the atmosphere: reactive nitrogen has nearly 300 times the warming effect of carbon dioxide (a greenhouse gas) over 100 years.
- Mismanagement of fertilisers can worsen soil acidity, which, combined with high rainfall patterns, can initiate reactions that progressively acidify and leach through the soil profile.

Source: ACB 2015c; 2016a.

SUSTAINABLE AGRO-ECOLOGICAL ALTERNATIVES

A report produced in 2015 by the International Panel of Experts on Sustainable Food Systems notes that sustainability must be the benchmark for any reform of food systems and that global, regional and local-level practices must be assessed within this framework (ACB 2016b forthcoming). The report indicates that field-level practices contribute 15% of the human-made greenhouse gas emissions attributable to food systems which, at the global level, account for 33% of total emissions (ACB 2016b forthcoming). The focus on using synthetic fertilisers to boost yields ignores other interconnected elements, such as the need for sustainable water, food, and social and economic systems (ACB 2016b forthcoming). In other words, it is not a sustainable option, particularly given that farmers become reliant on external inputs sourced and priced on a global market, and it does not solve the problem of degraded soils. Further, it does not help small-scale farmers adapt to a changing climate, unlike the agro-ecological approach that takes these factors into account.

African farmers still practice traditional soil management techniques using mostly manure and water-management methods, but these practices are increasingly falling away (ACB 2014; 2015b). These techniques are broadly grouped as agro-ecological interventions because they use locally available resources in a way that sustains the resource base (ACB 2015b). In addition, traditional systems tend to promote peer-to-peer exchanges of knowledge, which is generated through direct experience and experimentation (ACB 2015b). ACB’s field work in Tanzania and Malawi found that farmers were keen to explore agro-ecological farming techniques, in particular conservation farming, but that they required support to do so (ACB 2014b; 2015d).

Examples of traditional soil management techniques

- Fallow cropping: leaving lands idle for a set period in order to recover.
- Pit storage of manure and composting.
- Boosting organic matter: including soil from ant heaps, animal manure and rotting leaves.
- Intercropping with grain legumes, such as cowpeas and bambara nuts.
- Nitrogen fixing through agroforestry.
- Rotating crops with grain (groundnuts) and tree legumes (faidherbia albida).
- Agroforestry: combining growing trees with crops and raising livestock—tree roots help to bind the soil.

Source: ACB 2016a.

Three of the biggest challenges to maintaining, reviving and adapting agro-ecological practices are: increasing pressure on arable land (ACB 2015d), dwindling resources of animal manure (ACB 2014b), and the labour intensity of the

Source: ACB 2015c; 2016a.
practices. Demographic pressure has led to smaller farm sizes in many countries and the consequent intensification of production in many African countries; this means that farmers are no longer able to observe fallowing periods or practice slash and burn techniques (ACB 2015d).

In addition, the number of households that own significant levels of livestock is decreasing. Causes for this are attributed to: livestock having been lost to disease as a result of dwindling extension dipping services, as in Malawi and Zambia (ACB 2014b; 2015b); the extended civil war in Mozambique (ACB 2015a); households having to sell livestock to access cash (ACB 2014b; 2015d); and the labour intensive nature of maintaining livestock in order to increase the organic content of soil—this work most often falls to women or the elderly (ACB 2015b).

Solutions to the challenges faced by farmers must be sustainable on all three levels: economically, ecologically and socially. They must therefore be localised, participatory and inclusive, as well as aim to help build adaptive capacity and resilience. They must address the causes of the problem and not the symptoms (food insecurity and poverty) (ACB 2016b forthcoming). Transitioning to agro-ecological systems rests on the inclusion of farmers as primary bearers of knowledge, which is able to help craft context-specific interventions (ACB 2016b forthcoming). Agro-ecological practices are based on traditional practices and have been refined over centuries—they belong to farmers who must be treated as knowledge generators and included in any research and development process that affects them (ACB 2016a forthcoming). Anything less is illegitimate, particularly if it is ‘sold’ under the guise of helping African small-scale farmers. Given the nature of traditional soil management practices in Africa, agro-ecology is not a new concept for small-scale farmers, but rather part of everyday practice. However, if, over time, Green Revolution inputs undermine this base, the entire agricultural system could collapse (ACB 2014b).

**RECOMMENDATIONS**

**Maintaining a systems-oriented view**

Africa’s food sovereignty movements should broaden their focus to connect farming households to broader constituencies, to ensure that their voices are carried to national and sub-national bodies responsible for planning and implementation (ACB 2015a). They must also widen their approach to encompass a systems view of localised food systems, and studies and critiques must acknowledge the interlinked nature of food systems with other biological systems, as well as with broader economic and social systems (ACB 2016b forthcoming). There is a need to develop practical alternatives in the present, based on the principles of collective and inclusive democracy, which will support us in the future. This requires that we create space for the material advancement of agro-ecological practices and the materialisation of these principles (ACB 2015d).

**Taking back control**

Small-scale farmers form the majority of the agricultural producer base in African countries. Consequently they must participate actively in the processes that affect them, demand that they are included in the programme design process, and be able to monitor and evaluate outcomes (ACB 2016b forthcoming). They must also be ready to mobilise against the diversion of resources to wealthy elites (ACB 2015a; 2015d). State input subsidy programmes that target individuals should be phased out and replaced with public investment in extension services, farmer-based research and development, and bulk infrastructure (water and roads), all of which offer collective, long-term benefits (ACB 2014b; 2016b). Reviewing other state support programmes focused on soil fertility could provide additional motivation for promoting an alternative to the current regime (ACB 2016a).
Supporting participatory approaches

Farmers and public-sector extension officers need to be supported through the provision of training in agro-ecological techniques (ACB 2015d). This support, together with other efforts to reclaim the power of small-scale farmers, must rest on multidisciplinary partnerships that cut across social, organisational and technical fields (ACB 2015d; 2016b forthcoming). As noted in the 2015 report by the International Panel of Experts on Sustainable Food Systems, the knowledge held by farmers and the general population is “one of the greatest untapped resources in the quest to reform food systems” (ACB 2016b forthcoming). The report advocates for a “multi-directional flow of knowledge between the worlds of science, policy and practices” with each part informing the other (ACB 2016b forthcoming).

Soil science needs to return to and be utilised at the local level, under the control of farmers. More work needs to be done to determine missing nutrients in a specific ecological context (ACB 2016a) and nutrient mapping would be beneficial, but only if the information gathered is made publicly available to farmers (ACB 2015a). Farmers should be empowered to determine nutrient profiles on their own, or be able to access localised soil testing technologies (ACB 2016a). Knowledge gathering and generation should be pursued, with farmers exercising their indigenous knowledge to craft solutions suitable for them, preferably employing local input sources (ACB 2016a). Soil research should focus on identifying and expanding the means of increasing organic content in the soil, and be oriented, together with soil health programmes, towards regarding soil life as the basis of fertility (ACB 2014b). Countries such as Mozambique provide evidence of participatory extension approaches, and sharing and learning opportunities between farmer associations, with links to technical knowledge in the public sector (ACB 2015a). It is important to identify more of these examples and provide support to those involved.

The Green Revolution is far from complete in Africa and can still be overcome, but the natural resource base (soil health, diversity of seed, indigenous farming knowledge) is gradually being eroded, and social and economic systems are being fractured and restructured—to enable corporate entry into Africa’s seed and food markets. ACB supports cooperative, collective farmer-managed systems, based on collective and shared technologies, and knowledge that has been generated through participatory processes that acknowledge and honour the traditional role of farmers (ACB 2015d; 2016b forthcoming).
Annexure 1

INTERMEDIATE GREEN REVOLUTION STRATEGIES REGARDING SOIL FERTILITY

There are a range of alternative approaches—supported by public and donor funding—to the mainstream, conventional Green Revolution soil fertility methods. These include: ISFM, CA, and grain-legume integration. While all these approaches are inherently sustainable and agro-ecological in nature, they have been hijacked, to a large extent, by Green Revolution practices (ACB 2015b).

Integrated soil fertility management

ISFM practices include: combining the use of mineral fertilisers; utilising inputs such as lime or rock phosphate and organic matter; agroforestry; crop rotation and intercropping; and conservation farming (ACB 2015b). AGRA encourages the adoption of ISFM practices—as a response to declining soil fertility—but argues that the practices in themselves are not enough to replenish lost nutrients and recommends that synthetic fertilisers must also be used (ACB 2015d). It maintains that African farmers find it difficult to adopt ISFM practices because they lack physical and economic access to inputs, have low levels of crop management skills, and struggle to access markets, which makes it difficult for them to justify the additional expense of synthetic fertilisers (ACB 2015d). AGRA designed its Soil Health Program to respond to these challenges (ACB 2015d). The bulk of grants from this programme go towards commercialisation and privatisation (ACB 2015d). For example: in Tanzania, 55% of the funds allocated to ISFM are spent on increasing access to synthetic fertilisers, mostly to support AFAP’s work (ACB 2015d); in Mozambique, US$ 400 000 was spent to train extension workers on ISFM (using synthetic inputs), on research into micro-dosing with synthetic fertilisers, and on grain-legume integration (ACB 2015a). ISFM is a good approach, but its subversion to serve the Green Revolution is disturbing.

Conservation agriculture

CA encompasses a range of farming practices that aim to enhance sustainable fibre and food production by conserving water, soil and energy (ACB 2016a). CA is based on three principles: minimal mechanical soil disturbance, permanent organic soil cover and crop rotation (ACB 2015b). It is closely associated with the notion of climate-smart agriculture, introduced by the FAO in 2009, which emphasises sustainable increases in agricultural productivity and incomes, while building resilience to climate change (ACB 2015b). Advantages to the CA approach include its ability to reduce erosion, improve yields (although not significantly) and gradually improve soil quality (ACB 2015a). In addition, technically, it offers cost savings through reduced or no mechanical tilling (ACB 2015a) but this is relevant only if farmers are already using machinery. Its disadvantages, which account for its slow rate of adoption, include: it can take up to five years for farmers to see an improvement in their soils; using crop residues can take this resource out of the mix for fuel and feed (ACB 2015a); it can be costly to set up (seed for cover crops, herbicides and sprayers); and it requires specialised knowledge and increased labour (ACB 2015b). In Zambia, where the number of small-scale farming households practising CA has diminished from 13% in 2004 to just 5% in 2008, farmers indicated that it is a risky undertaking, because they have to learn new practices and cannot access insurance or the credit necessary for the initial investments (ACB 2015b). Farmers have tended to use some CA practices (e.g. covering some of the soil) but not all of them, due to the need to use biomass for other purposes. This partial utilisation of CA has diminished its potential for positive results (ACB 2015a).

CA is likely to be hijacked by the Green Revolution agenda if synthetic fertilisers, improved seed and pesticides are inserted into the frameworks through which it is supported (ACB 2015a). This is to be expected
if this approach is used to promote genetically modified soya bean and cowpeas over time (ACB 2015a).

**Grain-legume integration**

An approach that has proven attractive to farmers with few livestock, in southern Malawi and parts of Zimbabwe, has been intercropping maize with legumes, such as pigeon pea or cow pea (i.e. green manures) (ACB 2016a). This practice improves soil fertility and maize yields, but has not enjoyed a significant uptake—farmers prefer to use grain legumes (pulses) that can also provide food or a marketable crop, despite offering less in the way of soil replenishment than the green manures (ACB 2016a). While intercropping edible legumes with staple grains (i.e. maize) can lead to improved maize yields due to increased levels of nitrogen in the soil, legumes are generally considered orphan crops and lack public investment (ACB 2016c unpublished). They are also relatively labour-intensive and small-scale farmers, women in particular, frequently cannot afford the additional labour required (ACB 2016c unpublished). While legumes fetch higher prices than maize or rice, finding markets for them can be challenging (ACB 2016c unpublished).

Accordingly, there is a tendency to favour synthetic fertilisers as a quick fix, despite general agreement regarding the need to increase organic content in soils (ACB 2015b).
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