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"The agroecological approach to global food security: potentials, bottlenecks, necessary measures"

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Background to Biowatch South Africa

Biowatch South Africa (Biowatch) was established as an environmental justice organisation in 1999. We work with smallholder farmers – a majority of whom are women, other civil society organisations and decision-makers towards ensuring that people have control over their food, agricultural processes and resources, and other natural resources, within a biodiverse, agroecological and sustainable system.

Our research, advocacy and policy interventions are grounded in the experiences of these smallholder rural and peri-urban communities. Our work with smallholder farmers began in 2003 in the Umkhanyakude and Zululand District Municipalities in northern KwaZulu-Natal. We have worked for many years in 7 communities, but since 2020 have been spreading our agroecology training and support to other areas in the province of KwaZulu-Natal.

Biowatch is one of 15 partners in the regional Seed and Knowledge Initiative (SKI), active in Malawi, Zambia, Zimbabwe and South Africa.

See http://www.biowatch.org.za/ and https://www.seedandknowledge.org/

Introduction

The farmers Biowatch supports implement a number of inter-linked agroecological practices which combine indigenous knowledge of farming, seed and food with their own experimentation and new ecological science shared through farmer-to-farmer exchange and practitioners passing on learning from supportive research and regional exchanges.

These combined practices raise productivity, mostly with the resources farmers already have and very little additional cost. This is done in ways that increase crop and nutritional diversity, improve soil fertility over time, and help farmers cope with both too much and too little water. Typically, farmers have access to less than 2ha of land, and are still able to feed their families and have surplus for sharing with vulnerable neighbours and income generation.

These agroecology practices include:

1) Building soil fertility through various forms of composting and biofertilisers, fertility beds, planting basins, compost teas, intercropping with nitrogen fixing crops and green manures.
2) Water and soil conservation measures including swales (earth bunds) and soak pits that capture rain, ensuring soil is mulched or covered with vegetation, taking advantage of run-off flows through relative location of farm elements and re-use of grey water.
3) Pest management through building soil and plant health, repelling pests with strong smelling plants and teas, diverse intercropping, encouraging a balanced ecosystem that includes predators, herbal sprays in cases of bad infestations and not using any chemical sprays.
4) Saving and bulking seeds of traditional and indigenous African crops; seed exchanges and knowledge sharing; producing seed in dedicated seed plots; and saving of seed for at least two seasons in household seed banks networked with other farmers in their community and other project sites. Seed, and the traditional knowledge related to seed, is a key focus for Biowatch, which sees seed sovereignty as a necessary pre-condition for food security.
5) Integration of diverse livestock as food, for much needed manures contributing to soil fertility, and as cultural and economic wealth.
6) Connection to the wider landscape and the biodiversity in it through place specific indigenous knowledge supporting spiritual practices linked to sacred natural sites; harvesting of a variety of wild plants, insects and animals including for food, medicinal remedies and craft materials; and seasonal ecological signals predicting weather and other natural phenomena.

See also 'Agroecology is Best Practice': https://biowatch.org.za/download/agroecology-is-best-practice/

Please also see 'Stories of Resilience built through agroecology' which provides insight into the multiple dimensions (across gender, food security, livelihoods and diversity) in which agroecology benefits rural communities and builds resilience – in this case to the intersecting crises of the COVID pandemic, drought followed by extreme flooding, and civil unrest, which Biowatch-supported farmers faced from 2020 to mid-2022: https://biowatch.org.za/download/stories-of-resilience/

Biowatch's work with smallholders is, however, a fraction of the practice, science and the movement that agroecology encompasses.

The current global industrialised food system is deeply iniquitous and destructive: it contributes to around 34% of climate emissions; is polluting land, water and bodies; contributes to the extensive decimation of ecosystems and related biodiversity; and marginalises food producers and workers while hunger and a variety of forms of malnutrition persist. A paradigm shift is needed to reclaim food systems as public commons for the well-being of people and planet, based on the centrality of human rights. Agroecology offers a transformative approach to achieving this shift that can help address all these multiple crises concurrently.

In this regard agroecology practitioners in South Africa have identified 3 core elements that are essential to agroecology: environmental sustainability, social justice and redress, and economic fairness and participation. These align with the 13 agroecological principles that the High Level Panel of Experts on Food and Nutrition (HLPE), to the UN Committee on World Food Security, which were distilled from scientific and social movement literature and aligned to the FAO's 10 Elements of Agroecology adopted by member states in 2019.[1] These 13 principles guide The

[1] HLPE. 2019. Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.

Agroecology Coalition, formed during the UN Food Systems Summit, to "accelerate the transformation of food systems through agroecology guided by the 13 principles of agroecology". Germany is a member of this "coalition of the willing", which commits to facilitating co-creation and exchange of knowledge, promoting increased investment in agroecology, and seeking political engagement and increased commitment to the agroecological transformation.[2]

The 13 principles are highlighted to emphasise that agroecology is not just about more sustainable production practices. Agroecology necessarily includes dimensions of social justice, participation and co-creation to attain a food system that delivers on the right to healthy and nutritious food for all and where the multi-dimensionality of food in our communities, cultures and ecologies can be restored.

Response to questions

A1.
What opportunities for increased yields, or risks of reduced yields, do you see in the short or long term through the use of agroecological cultivation methods?

Undocumented discussions with farmers we support indicate that those who have been farming traditionally, but without synthetic inputs, make rapid progress in increasing their yields when learning improved agroecological methods. However, farmers that have been using synthetic fertilisers and pesticides and then transition to agroecology can experience some difficulties while transitioning, such as managing pest outbreaks, while their soil fertility and ecological balance builds in their farming system. Bioinputs, which cultivate and restore native microorganisms, can help enormously to speed this process up. However, the aging women farmers with whom we work have found it difficult to sustain making these due to the physical labour required and this an area where entrepreneurial support could be effective.

The question of yields often arises in relation to the narrative that agroecology can't feed the growing population and will keep farmers trapped in poverty. A growing body of research and case studies from civil society are debunking this myth.[3]

South Africa is a case in point, where commercial industrial agriculture claims to supply 90% of the food South Africans consume and our per capita production is 120% of dietary energy needs. Despite this, South Africa has a hunger crisis and high levels of nutrition related NCDs. Before the COVID-19 pandemic, 20% of South Africans had inadequate or severely inadequate access to food.[4] With rising food prices and a deepened unemployment crisis, by March 2021 35% of households were still

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[2] See https://agroecology-coalition.org/wp-content/uploads/2023/08/AC_BROCHURE_ENGLISH.pdf

[3] See for example:
Adhikari, P., et al. (2018). System of crop intensification for more productive, resource-conserving, climate-resilient, and sustainable agriculture: experience with diverse crops in varying agroecologies. *International Journal of Agricultural Sustainability*, *16*(1), 1–28. https://doi.org/10.1080/14735903.2017.1402504
Chappell, M. J., et al (2018). *Agroecology as a Pathway towards Sustainable Food Systems*. MISEREOR IHR Hilfswerk. https://www.misereor.org/fileadmin//user_upload/misereor_org/Publications/englisch/synthesis-report-agroecology.pdf

[4] StatsSA. 2019. Towards measuring the Extent of Food Security in South Africa: An Examination of Hunger and Food Inadequacy. Pretoria: Statistics South Africa.

failing to purchase adequate food and 17% of households experienced consistent hunger.[5] At the same time, agriculture grew economically by 13.4% in 2020 and 8.3% in 2021[6] with maize supplies in southern Africa at 10-year high following a bumper 2020-21 production season.[7] The preoccupation with productivity is commercial, and doesn't address the structural issues and the access to and affordability of food.

A2.
What opportunities and risks do you see regarding land take caused by increased use of agroecological approaches?

It is not agroecology which has been responsible for land grabs in South Africa; but intensive agricultural monocultures (such as for timber, sugar, soya etc) and other extractive industries, which are displacing communities from their land and polluting and using scarce water reserves. Many of these crops are also for export without local beneficiation.

Agroecology enables farmers to be productive on small parcels of land (through the practices of inter-cropping, stacking crops in space, continuous crop rotation, etc.). Not all land is cultivated, especially since many agroecological producers value and are deeply connected to natural areas in their vicinity.

A3.
What opportunities and risks do you see regarding biodiversity as a result of increased use of agroecological approaches?

Appreciation for and inclusion of nature is inherent in agroecology practice and approaches. The natural environment is an intrinsic part of agroecological landscapes, especially where agroecology practice is rooted in traditional knowledge and African spiritual practice. Biodiversity is utilised in traditional culture, providing numerous medicines, crafted products and foods. In particular, wild fruits, herbs, insects and animals are a regular inclusion in local diets. Many of these are an important source of added nutrition, especially during droughts due to their hardiness.

Practices actively encourage biodiversity within the farm to create balanced ecosystems for nutrient cycling and pest management, including the diversity of beneficial microorganisms. This is an antithesis to the large-scale monocultures of industrial agriculture which obliterate the natural biodiversity through their presence and through the toxic agricultural chemicals that are used.

Agroecology conserves and values local agricultural diversity, and the associated indigenous knowledge and skills that sustain local crops and animals in their diverse contexts worldwide.

Biodiversity is the foundation of our food security.

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[5] van der Berg, S et al. 2021. Food Insecurity in South Africa: Evidence from NIDS-CRAM Wave 5. Coronavirus Rapid Mobile Survey 2020.

[6] https://www.bfap.co.za/perspectives-on-agricultures-gdp-performance-in-q4-2021/

[7] https://reliefweb.int/report/zambia/southern-africa-regional-maize-supply-and-market-outlook-august-31-2021

A4.
What opportunities and risks do you see regarding the production of greenhouse emissions, as well as resilience to climate impacts, as a result of increased use of agroecological approaches?

The increasingly industrialised global food system that produces and distributes food from farm-to-plate-to-landfill is responsible for one-third (31–34%) of all anthropogenic greenhouse gas (GHG) emissions.[8] The largest share of 25% comes from agriculture – this includes 11% from land use change (such as deforestation to make way for crops or livestock grazing), and 14% from the production of the inputs used, and on-farm emissions including from energy use, livestock, tilling and fertiliser off-gassing. Other sources along the value-chain include food processing and packaging (2.9%), transport (1.6%), food retailing (1.3%), consumption (0.9%) and food waste across all parts (2.3%).

Although a transition to a food system based on agroecology will still produce some emissions, many of the emissions in the current food system will be avoided or greatly reduced, and there will be greater resilience in the food system.

Agroecology builds climate resilience in the food system through:

- Nourishing communities with fresh, highly nutritious, and poison-free food that is locally produced and affordable.

- Focusing on local and regional markets and exchange, which avoids the need for energy hungry transport, packaging, processing and refrigeration. Production for more local consumption also means that food can be more easily processed with locally available, smaller scale, affordable and appropriate technologies.

- Production practices that support the living processes between organic matter, microbes and plants to improve the health, structure and nutrition available in soils. These living soils avoid compaction that creates water run-off and erosion and are better able to hold water and soil carbon.

- Practices that conserve water by increasing infiltration and holding water for longer, including creating water retention structures, increasing plant diversity and cover, mulching, and preparing soils that are deeply fertile and full of living organisms. This helps to absorb and reduce the force of flood waters, but also provides moisture for crops and soil life which can then survive through longer periods without rain.

- Emphasising reciprocity and participatory approaches, building from local knowledge and linking with scientific innovations that strengthen community relationships and ability to respond to challenges with locally relevant solutions.

- Connecting producers, consumers and their local environment. Locally produced and indigenous foods are more likely to be locally adapted, and therefore resilient, appropriate and supportive of the ecology and culture of that place, leading to resilience to climate change and other stressors such as increased disease or pests.

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[8] Crippa, M. et al. 2021. Food systems are responsible for a third of global anthropogenic GHG emissions, *Nature Food* 2, pp. 198–209.

- Using and building local natural resources that are free and accessible to producers, which promotes self-sufficiency and helps save money for use in times of crises, instead of creating debt. It avoids using chemical pesticides and fertilisers, which damage soils, pollute the environment (especially scarce water resources), and release greenhouse gases during their energy intensive manufacture and off-gassing in the field.

- Building on local and traditional knowledge and inheritance, including locally adapted but genetically

- Using diverse seeds and breeds of animals that are more resilient to climatic variations and disease.

- Valuing natural ecosystems as part of food and livelihood systems. These are conserved and provide landscape-level resilience to extreme weather and other climatic shocks.

Please see more detail on the climate impacts of the food system and true versus false solutions towards a Just Transition of the food system here: https://biowatch.org.za/download/factsheet-climate-change-and-food/ and here: https://biowatch.org.za/wp-content/uploads/2023/10/FactS-01-ENG-Towards-a-just-transition.pdf

A5.
What opportunities and risks do you see regarding the health of farmers and consumers as a result of increased use of agroecological approaches?

The shift to agroecological production will reduce the risk from hazardous chemicals to farmers and consumers. Agroecology also contributes to improved health, through greater dietary diversity provided in diverse inter-cropped agroecological systems, and access to fresh food from more localised food systems.

We note the struggles of South African farm workers and rural communities, many of whom have been poisoned by agrochemicals, and their demands to ban 67 highly hazardous pesticides still used in South Africa but banned in Europe.[9]

A6.
What opportunities and risks do you see regarding the impacts on employment, particularly of women, as a result of the increased use of agroecological approaches?

The fact that agroecology can generally produce diverse crops on smaller parcels of land without costly inputs makes it particularly appealing for rural women, who often have less access to land and finance while often shouldering the responsibility of feeding their families. Agroecology enables women to become economically dependent through surplus incomes, with very little capital input. Please see 'Stories of Resilience built through agroecology' for some examples of this.

In South Africa, agroecology enterprises are mostly organised as projects or cooperatives. Some of these have grown markets linked to urban communities or input supply, enabling their members to

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[9] See for example: https://www.dailymaverick.co.za/article/2019-08-30-women-farmworkers-demand-an-end-to-use-of-harmful-pesticides/ and the section on pesticide exposure in Chapter 6. Occupational health and safety in Devereux, S. (2020). Violations of farm workers' labour rights in post-apartheid South Africa. *Development Southern Africa*, *37*(3), 382–404. https://doi.org/10.1080/0376835X.2019.1609909

be consistently “employed” in the project. It is this work of building local food systems based on agroecology that needs support.

A7.
What development-cooperation measures do you believe would be particularly effective in supporting agroecological approaches in the partner countries of German development cooperation?

Development cooperation must stop supporting the industrial approach to agriculture from policies that limit the space for agroecology to thrive, as well as funding the spread of monocultures grown with corporate seed and toxic inputs. The recent announcement (June 2023) that the BMZ would stop funding AGRA is welcomed in this regard. We welcome support to African civil society in holding multinationals to account, especially regarding double standards in environmental and health impacts applied in Africa compared to in developed countries.

Funds can be redirected to putting in place the infrastructure and especially growing the knowledge to support transitions to agroecological food systems, based on the priorities of local movements.

Priorities include:

i) training for farmers, extension officers and government officials. This should include farmer-to-farmer learning approaches.
ii) support for wider accessibility and production of appropriate agroecological inputs and small-scale equipment.
iii) support for local processing and markets (including infrastructure, off-grid technologies and systems) to replace existing global value chains.
iv) context-specific research in partnership and supporting local producers on locally appropriate seeds, crops and growing practices.
v) Continued support for non-government and farmer organisations that have been supporting the transition to agroecology through advocacy and training. The support from German NGOs including Brot für die Welt, the Rosa Luxemburg Foundation and Heinrich Böll Foundation has been greatly appreciated by Biowatch.

Support will be necessary over a number of years for this transition, before agroecological production and market systems are well-established and become self-sustaining.

In addition, we ask that the learnings and recommendations from 2 African civil society processes are taken into account:

- A report emerging from an autonomous assessment by African peasant and civil society organisations providing a critical analysis of the process and content of the 2021 UN Food Systems Summit (UNFSS) and the Dakar 2 ‘Feed Africa Summit’ in 2023: https://www.csm4cfs.org/wp-content/uploads/2023/10/CSIPMAutonomousReport_EN-fin.pdf
- African civil society declaration on the AU-EU partnership: https://afsafrica.org/african-civil-society-declaration-on-the-african-union-eu-partnership/

A8.
To what extent can optimisation of the agricultural methods already in use contribute to sustainably ensuring sufficient food for the population of the world?

Optimisation of existing methods of production lean towards use of digital data collection and services to farmers that can recommend more precise use of industrial inputs. While this may have some economic and environmental benefits, such as reducing the volume of inputs and application at times where they will be better utilised, this approach doesn't really engage with the main problems in the food system. Farmers are still reliant on toxic inputs and specialised equipment requiring significant investment that exacerbate debt; and are further de-skilled, becoming totally locked-in and reliant on corporations telling them how and what to farm, and often also determining markets and prices. There is also a large hidden cost in the form of the energy and water requirements to run the data centres that are required for processing all this real-time information from on-farm sensors.

A9.
In what way do the agroecology approach and approaches based on conventional, industrial-style agricultural production complement each other? Do they necessarily have to be seen as contradictory? Where can synergies occur?

A fundamental transformation is needed in the way that we produce and distribute food. While we accept that this may require a period of transition, it is difficult to see how these two systems can be compatible as they are structured by different intentions. Agroecology centres people in the food system, enabling their agency for improved health, livelihoods and resilience in tune with healthy functioning ecosystems. The industrial food system puts both producers and consumers on the receiving end of products, services and systems designed to profit ever more powerful multinational corporations, while the cost of negative impacts – ranging from diseases related to poor nutrition to vanishing biodiversity and climate change - are externalised to society and the public purse.

A more in-depth discussion of these divergent ways of seeing and structuring the food system can be found in Pimbert, M.P. *Transforming food and agriculture: Competing visions and major controversies*, *Mondes en développement*, vol. 199-200, no. 3-4, 2022, pp. 361-384. https://doi.org/10.3917/med.199.0365

A10.
What need for research do you see to strengthen agroecological approaches?

As evidenced by the recent and growing science relating to microorganisms in natural ecosystems, soils and the human body, there is much we don't yet know about the natural world. Deeper understanding of the inter-relationships in ecosystems will no doubt be critical to coping with changing climates and other factors to inform agroecological innovation in the future.

However, most important is that the people on the ground in the food system such as farmers are centred in research: that they identify the research questions that they need answered, and that this research is resourced and supported. It is also important that research teams are multi-disciplined and constituted to respond to intersectionality and other ways of seeing and being in the world.

More research is needed to make visible the costs of the industrialised food system. There is too much hype around this system feeding the world and not enough research and analysis in terms of the truth of this hype or the industrialised system's high cost to life on earth.

A11.
In the use of new plant breeding methods, do you view the opportunities or the risks as greater with regard to follow-on use of seeds for cultivation?

Seed is at the heart of agroecological systems of the farmers Biowatch works with. A Farmers' Right[10] to save, exchange and sell seed within farmer-led seed systems impacts many of the choices farmers can make and is therefore fundamental to sustained food security. Farmer-led seed systems enable farmers to use their own traditional and farmer varieties; choose which varieties are best suited to a variety of purposes; access diverse seed and crops to support diverse agroecological systems that are more resilient to stressors; to produce food without being dependent on external inputs (bought or subsidised) and to be responsive to timing and weather including second plantings if an initial crop fails.

Farmer varieties, including indigenous and traditional crops, are beneficial because they are locally adapted and resilient, continuing to provide yields in the variable and harsh conditions that smallholders typically face[11] compared to the optimal conditions required by commercial seed. Many are also more resilient to pests than commercial varieties; more so when used in diverse agroecological systems. See https://biowatch.org.za/download/farmer-led-seed-systems/

Farmer varieties have been developed over time to respond to a range of concurrent social, cultural, economic and production needs. The diverse traits that smallholders may consider include taste and appearance when cooked; ease of processing and cooking; ability to satisfy more than one purpose, such as food, fodder and soil enrichment; resilience to drought or variable weather; adaptability to particular soils; resistance to pests and disease in the field and in storage; and cultural uses.

Biowatch encourages and supports farmers to maintain household/family seed banks especially of staple grains and legumes, and traditional African crops. Each seed saver links to others in their community, as well as with agroecological farmers in other areas through traditional cultural practices and seed rituals, as well as Biowatch facilitated seed fairs and farmer exchanges. This creates a web of reciprocal relations through which farmers can access seed as well as restock varieties should bad weather or pest conditions impact their local production. In our experience, in situ conservation of genetic resources with networked household seed banks have been more sustainable than communal seed banks, which often collapse when external funds to maintain the building and systems are withdrawn. See https://biowatch.org.za/download/fact-sheet-household-seed-banks/ and https://www.seedandknowledge.org/reconnecting-for-resilience-a-case-study-of-farmers-seed-exchange-networks-in-southern-africa/. [The experience of partners in SKI indicates that where there is strong local ownership, communal seed banks are viable.[12]]

The traditional practice of exchanging propagating material is necessary and intrinsic to the continued resilience of farming systems. Farm-saved seeds contribute to 80% of the food grown in Africa. Despite the importance of farmer-led seed systems to livelihoods and food security in the region, and their contribution to our common heritage of crop genetic diversity, these are

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[10] As outlined in the 2018 United Nations (UN) Declaration on the Rights of Peasants and Other People Working in Rural Areas.

[11] In South Africa most smallholders were removed from fertile agricultural land under Apartheid and displaced to marginal areas with poor soils and where they are reliant on rain-fed agriculture.

[12] Andersen, Regine & Vásquez, Viviana & Wynberg, Rachel. (2022). Improving Seed and Food Security in Malawi. The Role of Community Seed Banks. 10.13140/RG.2.2.27709.95205.

increasingly under threat in Africa. Countries are under pressure to adopt and implement plant variety protection under the International Union for Protection of New Varieties of Plants (UPOV) 1991 Convention that favours breeders' rights and limits farmer seed exchange. In opposition to Farmers' Rights, vested interests are lobbying for harmonisation of seed trade laws in the Regional Economic Communities on the continent and using funding (for example, AGRA) to curtail farmer seeds systems in favour of corporate seed and inputs. For detail see AFSA (2017). Resisting corporate takeover of African seed systems and building farmer managed seed systems for food sovereignty in Africa: https://afsafrica.org/wp-content/uploads/2018/09/seed-policy-eng-online-single-pages.pdf

We therefore note with interest the 19 March 2024 vote by European Parliament's Agriculture Committee (AGRI)[13] to allow farmers to exchange and sell limited quantities of plant reproductive materials to facilitate the conservation of agricultural diversity and adaptation to climate change. We request support from European Union countries to ensure that farmers in the global south can also continue to save, exchange and sell their farmer and landrace varieties. However, for smallholders in southern Africa, this exchange should not be limited to "heritage" varieties as seed with PBRs enter farmer seed systems inadvertently and by contamination, especially for crops where farmer varieties are not easily distinguishable, due to the fluidity of traditional seed exchange systems, and farmers should not be criminalised as a consequence.

Biowatch and our partners in the Seed and Knowledge Initiative emphasise the importance of farmer varieties of seeds in agroecological systems, and **exclude seeds produced through first generation and new processes of genetic modification (GM)**. Most commercial hybrids are also excluded because of the Plant Breeders' Rights over these, the inability to save them for replanting the following seasons, as well as their associated production requirements.

We do not support the use of GM seed and crops for many reasons, including the following:

GM crop technologies further the industrialisation of agriculture. Rather than reducing reliance on damaging and unaffordable industrial inputs, they lock farmers into their use, which deepens dependency and debt. For example, some "conservation agriculture" projects in South Africa have disingenuously promoted herbicides and their linked GM crops to reduce tillage as an environmental benefit to smallholders that were not using herbicides.

The biotechnology industry has promoted the idea of the 'co-existence' of GM and non-GM agriculture. However, this is practically not possible especially in smallholder systems. GM and hybrid seed has been promoted and distributed by subsidy programmes both by government extension workers and agribusiness agents; often without labelling and training on the need for non-GM refugia. Due to extremely small land parcels that smallholders have, it is often extremely difficult to prevent drift of pollen and also associated agrochemicals between neighbouring farmers. Smallholder farmers who do not want to grow and eat GM crops, must be vigilant to prevent contamination of their seed through cross-pollination (especially of the staple maize in which pollen can travel more than a kilometre), from stock feed and cultural seed exchange practices[14]. The

[13] https://www.europarl.europa.eu/legislative-train/carriage/revision-of-legislation-on-seeds-plant-and-forest-reproductive-material/report?sid=7901

[14] Iversen M, Grønsberg IM, van den Berg J, Fischer K, Aheto DW, et al. (2014) Detection of Transgenes in Local Maize Varieties of Small-Scale Farmers in Eastern Cape, South Africa. PLoS ONE 9(12): e116147. doi:10.1371/journal.pone.0116147

farmers with whom Biowatch work employ several strategies including early field preparation and planting, and inclusion of tall trap crops and boundary plantings to avoid contamination. Nevertheless, random testing of a small sample of farmer varieties of maize seed in 2017 found contamination by GM RoundUp Ready and Bt Cry1A proteins.

In addition, the introduction of these technologies and associated chemical inputs is contributing to a process of "deskilling" farmers[15]; reducing their agency and the knowledge needed to respond to social and environmental changes at a time when climate change makes this more necessary.

Herbicide tolerant (HT) GM crops are designed to be used with herbicide, correspondingly increasing herbicide consumption.[16, 17] We note the increasing evidence of harm to health and the environment from glyphosate[18], which the agrichemical industry has promoted as having low toxicity to the environment and living organisms. As the efficacy of glyphosate has diminished following the introduction of RoundUp Ready GM crops, South Africa has followed the USA in authorising GM crops for cultivation and/or use with stacked traits resistant to additional herbicides such as dicamba, glufosinate and 2,4-D setting us up for an ever more toxic chemical treadmill.

Bt crops can affect non-target organisms, with knock-on impacts for local biodiversity. Also, while BT crops are touted for reducing pesticide use, there are numerous examples where, after a period of efficacy, target organisms develop resistance, and secondary pests increase. The maize stem borer started developing resistance to Bt maize in South Africa within ten years.[19] Research in the Makhathini Flats, KwaZulu Natal (where Bt Cotton was introduced to smallholders as part of the early promotion of GM crops in Africa) found that while pesticide application to control the targeted boll-worm fell after the introduction of Bt cotton, these were increased application of pesticides to control secondary insects such as Jassids, which substantially increased after the introduction of Bt cotton.[20]

Although controversial, there are numerous concerns relating to the impact of GM crops on the health of humans and other organisms.[21] One of these is the impact of horizontal gene transfer of transgene fragments (producing Bt toxins, antibiotic resistance etc) into bacteria in the gut and in soil, which is grossly understudied given the growing body of knowledge on the importance of microbial communities in human and soil health.

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[15] Maya Marshak, Fern Wickson, Amaranta Herrero & Rachel Wynberg (2021): Losing practices, relationships and agency: ecological deskilling as a consequence of the uptake of modern seed varieties among South African Smallholders, Agroecology and Sustainable Food Systems, DOI: 10.1080/21683565.2021.1888841

[16] Benbrook C. Impacts of genetically engineered crops on pesticide use in the US – The first sixteen years. *Environmental Sciences Europe.* 2012;24. doi:10.1186/2190-4715-24-24.

[17] In South Africa, Glyphosate use rose from 12 million litres in 2006 to 20 million litres in 2011, and imports increased by 177%. See African Centre for Biosafety. 2012. *Glyphosate in SA: Risky pesticide at large and unregulated in our soil and water*.

[18] See for example Rivas-Garcia, T.; Espinosa-Calderón, A.; Hernández-Vázquez, B.; Schwentesius-Rindermann, R. Overview of Environmental and Health Effects Related to Glyphosate Usage. *Sustainability* 2022, *14*, 6868. https://doi.org/10.3390/su14116868

[19] Kruger, M., Van Rensburg, J.R.J., and Van Den Berg, J. 2011. Resistance to Bt Maize in Busseola fusca (Lepidoptera: Noctuidae) from Vaalharts, South Africa. *Environmental Entomology*, Volume 40, Issue 2, 1 April 2011, Pages 477–483, https://doi.org/10.1603/EN09220.

[20] Witt, H., Patel, R., & Schnurr, M. (2006). Can the Poor Help GM Crops? Technology, representation & cotton in the Makhathini flats, South Africa. *Review of African Political Economy*, *33*(109), 497–513. https://doi.org/10.1080/03056240601000945

[21] For an extensive list of references and discussion relating to health impacts of GMOs see Fagan, J., Antoniou, M., and Robinson, C. 2014. *GMO Myths and Truths*, Second edition, Version 1.0. London: Earth Open Source.

Southern Africa has the highest average maize consumption per person. In the 2010 -13 period this averaged 267 g/person/day; more than double the African average of 120 g/p/day and much more than the world average of 48 g/p/day. In South Africa, the poor are eating diets which are mostly maize - that is alarmingly more than 90% GM maize - due to the unaffordability of nutritious food.

For an overview of the history and concerns related to the introduction of GM crops in South Africa please see: https://acbio.org.za/wp-content/uploads/2022/04/gmos-south-africa-23-years-failures-biodiversity-loss-and-escalating-hunger.pdf

The new breeding technologies (second-generation GM technologies) have many of the same issues as first-generation GM technologies in that these continue to intensify industrial production and corporate control of the food system, without addressing the structural issues that are contributing to the intersecting crises of hunger, biodiversity loss and climate change.

There is growing documentation that these new breeding technologies (including cisgenesis and intragenesis; RNA-mediated DNA methylation, agroinfiltration, grafting, reverse breeding, and genome editing techniques (CRISPR and gene drives, TALENS and oligonucleotide-directed mutagenesis) still produce many unintended genetic errors through both continued reliance on tissue culture and GM transformation of cells by *Agrobacterium tumefaciens* infection, as well as from the new processes of gene editing or insertion. These can create concerning unintended changes to the plant genome and composition, with the potential to alter behaviours and performance; for higher susceptibility to disease; altered invasiveness/fitness; and altered composition of signalling molecules, nutrients, toxins and allergens.[22]

Of particular concern are gene drives where selected or engineered traits are “driven” through a particular population or species by altering the probability that these genes will be inherited as subsequent generations of the organism reproduce. The use of this technology to alter or create infertility in entire species of wild populations is of grave concern ethically and for biodiversity and ecosystem functioning.

Biowatch strongly supports the application of the Precautionary Principle and are relieved at the decision of our South African Minister of Agriculture Ms Thoko Didiza, who in terms of section 19 of the Genetically Modified Organisms (GMO) Act of 1997, upheld an October 2021 decision of the Executive Council (EC) which assesses GM applications, that the risk assessment framework existing for GMOs will also apply to new breeding techniques (NBTs).

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[22] See for example African Centre for Biodiversity 2017 reports on “Biosafety Risks of Genome Editing in Plant Breeding’ and ‘Biosafety Considerations of Novel Plant Breeding Techniques’: https://acbio.org.za/gm-biosafety/two-simplified-briefings-introducing-new-gm-technologies-and-biosafety-risks/ and Robinson, C. (2022) Gene editing myths and reality. The Greens EFA: https://extranet.greens-efa.eu/public/media/file/9065/6768