Climate-Resilient Agriculture:

what small-scale producers need to adapt to climate change



In Bangladesh, keeping livestock offers small-scale farmers another source of food and money in times of need.

Introduction

Climate-resilient agriculture: agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for future generations.

During the 21st century, global food production will face unprecedented pressure from climate change. This presents an especially difficult challenge to developing countries and their ability to end poverty through more and better investment in agricultural development. Agriculture¹ is the economic sector that is most vulnerable to climate change and it is directly responsible for about 25% of the world's total greenhouse gas emissions.² Livestock production and crop yields are projected to fall, especially in the expanding sub-tropics.³ Conversely, these are areas with the greatest incidence of hunger and where agricultural transformation has the greatest potential to end poverty.⁴

Urgent action is therefore needed to support farmers in developing countries to further develop, adapt, increase their knowledge of and scale-up innovation that will enable them to become more resilient. Small-scale farmers, who currently manage 60% of the world's agricultural land and produce 50% of its food,⁵ should play a central role in this process. However, their

involvement depends on the extent to which they have a say in the global decisions and large investments over the next five years.

These are challenges faced in particular by the Global Alliance for Climate Smart Agriculture (GACSA), the UN Framework Convention on Climate Change (UNFCCC)⁶ as it forms a new global climate deal, and the Green Climate Fund, and in implementing the Sustainable Development Goals (SDGs). Christian Aid calls on these global processes and institutions to learn from decades of farming experience across the globe and ensure that the 21st century approach to agriculture is inclusive of the majority of farmers and focused on resilience and ecological rehabilitation, and not on top-down agroindustrial approaches. This means a change from inputintensive to knowledge-intensive agriculture.

False solutions

One solution, promoted by a significant proportion of official donor agencies, high profile philanthropists, multinational corporations, and the agricultural research they fund, encourages developing countries to focus on increasing agricultural productivity. This would be funded significantly by including soil carbon in mechanisms developed to trade other carbon emissions, such as power generation, and deployed through an expansion of large-scale commercial agriculture at the expense of small-scale farmers and their livelihoods. This top-down approach largely excludes small-scale farmers from determining their own solutions and pays only token attention to their concerns on economic, socio-cultural and environmental sustainability.

It relies instead on increased use of potentially toxic synthetic chemical inputs, together with the new biotechnologies designed to complement them, as the main answer to increased climate vulnerability. With global food production already sufficient for 10 billion people (about 1 billion more than the global population is predicted to reach in 2050),⁷ this approach also ignores the potential for improved global food security through better storage of crops after they are harvested in developing countries, and reducing food waste and overconsumption in developed countries. It is this 'solution', which resembles the approach that generated the problem in the first place, that concerns a growing number of farmers, their associations, and the organisations and research that support their priorities.



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Inclusive solutions

Such a narrow focus results in increasing both climate change and climate vulnerability. Instead, agriculture needs to balance long-term resilience with productivity and efficiency to deliver sustained improvements in food security, health and poverty reduction. This encourages systems that understand the fundamental importance of healthy ecosystems (through sustainable management of land, soil, water and agrobiodiversity) for effective agricultural resilience. It also recognises that small-scale farmers, both women and men, produce most of the food consumed in developing countries and manage most of the land used for food production. They should fully participate in the development of knowledge, actions and policies to support climate-resilient agriculture.⁸

Christian Aid and its diverse group of partners (including local civil society organisations, producer associations, cooperatives and micro-finance institutions) have worked alongside farmers and pastoralists across Asia, Africa, Latin America and the Caribbean to develop their rural livelihoods through a wide range of sustainable agricultural approaches. Various publications, including Christian Aid's report *Healthy Harvests: the benefits of sustainable agriculture in Africa and Asia*,⁹ have described the results. From this wide experience, some of the key priorities for a climate-resilient future for agriculture can be defined.

Climate-resilient agriculture



A small-scale farmer in India shows her community's vulnerability map, developed as part of a planning process to help them adapt to the changing climate.

Reversing degradation

Increasing agricultural productivity and resilience are critically dependent on transforming the environmental sustainability of agriculture from individual farm to catchment and landscape scale. During the past 40 years, the so-called green revolution approach has:

Degraded land – 38% of the world's cropland is now degraded,¹⁰ costing an estimated US\$40bn annually, worldwide (this excludes the hidden costs of increased fertiliser use, loss of biodiversity and loss of unique landscapes).¹¹ By 2002, some 188 million hectares of

India's cultivable land had become degraded by salinity, erosion and other factors largely as a result of the overuse of chemicals, creating a loss to national annual GDP of 1.1% but a loss of 6.4% to the 'GDP of the poor', ie, the natural systems, such as forests and rivers, that poor communities rely upon for survival.¹² Globally, 34 million hectares (about 11%) of the irrigated agricultural area has been affected by some degree of salinity.

Exhausted freshwater supplies – farming uses 70% of all freshwater consumed.¹³ In India, irrigation has multiplied water use by five times since 1970, resulting in more than 25% of aquifers being depleted faster than the annual monsoon replenishes them.¹⁴ In more water-stressed regions, such as the Middle East, aquifer depletion is even more acute as surface water resources decline due to long-term drought and dam construction.¹⁵

Contaminated land, atmospheric and water resources – use of nitrogen fertilisers, in particular, have increased greenhouse gas emissions (especially nitrous oxide, about 6% of total emissions¹⁶) and contaminated the environment to such an extent that research on planetary boundaries¹⁷ confirms the need to cut their use by 75% globally to avoid catastrophes that include large-scale ocean anoxic (oxygen-depleting) events.¹⁸

Poisoned farmers – use of pesticides kills 355,000 people every year (two-thirds of them in developing countries), and leaves health-damaging levels of pesticide residues in food.¹⁹

Reduced the number of essential pollinators – certain categories, such the neonicotinoids that make up about one-third of all insecticides used, have been shown to contribute to the widespread decline of pollinating insect species essential for more than a third of global crop production and most of the vitamin and mineralrich foods necessary to prevent nutritional deficiency.²⁰

Depleted agro-biodiversity – there has been a loss of 90% of the genetic diversity in the planet's 20 main crops²¹ and 75% of crop diversity generally. In addition to this, 30% of livestock breeds are at risk of extinction and six are lost every month.²² This hidden catastrophe erodes the basis of small-scale farmers' ability to build resilience through drawing on the rich diversity built up over centuries of selective breeding.

The green revolution has also simultaneously driven increased inefficiency into food production. For example, energy productivity of Bangladesh's agriculture declined from an output/input ratio of 3.9/1 in 1990 to 3.0/1 in 2005: showing that more energy is needed to produce a crop now than in the early 1990s. In China, the ratio has declined from 2/1 in 1978 to 1.5/1 in 2004, increasing fossil energy use by three times.²³ Both inefficiency and greenhouse gas emissions have increased together. Addressing this legacy means embedding agricultural resilience in ways that are complementary to environmental sustainability at all levels. Mitigation actions would focus on reducing overuse of greenhouse gas-intensive practices, such as the use of mineral nitrogen fertilisers and fertiliser subsidies, which deplete national agricultural budgets that could be used for more cost-effective, resiliencebuilding activities.

Adaptation needs to take a strategic landscape approach (ie, it needs to look across large, connected geographic areas to more fully recognise natural resource conditions and trends, and natural and human influences) to integrated catchment planning (ie, planning across whole river catchments), managing sustainable water resources and restoring lands degraded by over-reliance on chemical agriculture. Substantial, urgent and effective upscaling of resilience-proven technologies (that show resilience, productivity and profitability performance that is higher than conventional chemical agriculture),²⁴ such as agro-ecological methods, conservation agriculture, agroforestry, integrated pest management, and system of rice intensification (SRI), is needed.²⁵ There also needs to be an appropriate method of certification for resilient, eco-friendly farming practices so that environment- and climate-related subsidies and adaptation funding can be targeted effectively at farmand catchment-scale resilience-building practices.

Responding to farmer priorities

Secondly, the agenda of agricultural research and advisory organisations, mainly in the public sector, needs to be transformed into a process that understands and addresses small-scale farmer priorities. Integrating farmers and their representative organisations into the management and agendasetting mechanisms of all agricultural research and advisory institutions would gain their involvement and leadership in the research process and ensure meaningful consultation on public policy priorities. This would include a substantial transition from isolated research station and researcher-led methods to on-farm, participatory and farmer-led research methods.

There needs to be equal access for women and men to land and agricultural support services. Given that women make up 43% of the workforce and manage up to 90% of staple crop production,²⁶ effectively responding to farmer priorities requires a gender transformation. Globally, only 15% of agricultural field advisers are women and only 5% of female farmers receive technical advice.²⁷ Women's land tenure rights can be equally disproportionate - for example, although only 7% of agricultural land in Niger is owned by women, in many countries women make up a more significant proportion of landowners, such as 49% in Uganda.²⁸ This highlights a persistent double failure; both in failing to promote more equal land ownership and in failing to provide quality advisory services tailored to women who often own land and perform the majority of agricultural management roles. Both of these deficiencies need to be comprehensively addressed if climate resilience that works for the majority of farmers is to be achieved.

In review after review, Christian Aid has found a disparity between the advice farmers are given (mainly the promotion of expensive chemical inputs) and the advice farmers report that they want.²⁹ Almost always top of the farmers' list is guidance on improving soil management practices, such as conservation agriculture, soil and moisture conservation

methods and regular soil testing services. These soil management strategies enhance crop yields, use sustainable fertility sources, such as natural nitrogenfixation (where root-dwelling bacteria use atmospheric nitrogen to provide plant nutrients), composts and manures (which increase soil organic matter thereby helping to mitigate greenhouse gas emissions), and tailored micro-dosing of mineral supplements when required. Improving soil structure and its ability to retain moisture through these approaches increases both productivity and resilience to cyclones, floods and drought (improved soil is less likely to be washed away and more likely to retain water) better than chemical agricultural methods.³⁰



Farmers in Kenya discuss increasing their use of drought-resilient sorghum, after receiving better seasonal forecasts that help them to plan ahead.

Increasing farmers' access to climate information services that combine weather forecasts with relevant agricultural information supports informed, timely decision-making, which in turn increases productivity, reduces costs and improves their ability to prepare for and cope with adverse weather.³¹ Harnessing the expanding opportunities presented by information and communication technologies, especially mobile phones, in both transmitting advice (such as market prices, weather forecasts and soil test results) and connecting farmers and farmer institutions to each other can maximise resilience planning and cooperation. It allows farmers to share their experiences and knowledge with each other, as well as facilitating communication between farmers and their research and advisory services.

Supporting crop and livestock breeding strategies that increase rather than deplete agricultural biodiversity would make as diverse a genetic resource as possible available to farmers, as would encouraging the development of new climate-resilient breeds and varieties through safe, responsible, cost-effective use of biotechnology. This includes legally enshrining the rights of farmers, many of whom depend on informal seed systems to save, exchange and multiply seed, and safeguarding their intellectual property rights with respect to the agricultural biodiversity they have played such an important part in generating. It would also protect the farmers against uncompensated exploitation by corporate biotechnology interests.

Land tenure security

No enterprise logically makes investments that are unlikely to deliver the anticipated benefits. Smallscale farmers are no different – without long-term land tenure security, they cannot look beyond the next growing season to make investments, such as planting trees and terracing to reduce soil erosion, that are needed to build resilience to climate change.³² The land tenure rights of small-scale farmers, tenant farmers and pastoralists need to be strengthened and protected from encroachment, appropriation and other forms of land-grabbing by state and private sector interests. Nearly 55 million hectares of land have been subject to land deals,³³ but their impact on resilience goes beyond these, sending an unmistakable message to small-scale farmers about the instability of their land rights.

Improving this land tenure security specifically implies legally protected recognition of the common-property land tenure systems used by many small-scale farmers and pastoralists. It also means progressively reducing small-scale farmer reliance on rented land and accelerating the conversion of tenant, share-cropping and other inequitable forms of land rental to local ownership.³⁴

Building resilience does not stop at the farm gate. It must ensure, through climate-resilient land use planning and regulation, that individual farmers, especially large-scale farmers, avoid degradation and increase environmental sustainability in ways that improve catchment and landscape-scale resilience. This includes regulation to minimise soil erosion and drainage practices that increase downstream flood risks; eliminating agro-chemical use that concentrates toxic residues in water resources and damages the health of communities further downstream and coastal fisheries;³⁵ and enhancing protection for catchment forests, wetlands and other ecosystems that improve resilience to climate change. These natural resources have been shown to be particularly cost-effective in protecting the land and people from extreme weather when compared to expensive, engineered solutions.³⁶

Increasing voice and market linkages

Small-scale farmers and their organisations are one of the largest private sector groups globally, but

rarely receive the attention this status might suggest. Typically they are faced with a choice between highly efficient and competitive but low-value local markets, and highly inefficient, monopolistic external markets with high barriers to entry (such as logistical and regulatory barriers designed to enable large companies to maximise their market share). Support and structural change is needed so that farmers receive better and more stable prices that reflect the quality of their produce, enabling them to invest in building the resilience of their farming systems. They can then become either more commercially oriented or better able to use agriculture as the basis for other small- and medium-enterprises, such as local food processing and retailing, which will promote thriving, economically diversified rural economies.

Part of this involves reducing energy poverty through better access to small- and medium-scale renewable energy technologies that provide low-emission and affordable power for both household and rural enterprise development.



Market day in Nicaragua. Increasing access to local markets and processing products to add to their value offers small-scale farmers a more secure way to earn an income.

Building membership and management skills of farmers' marketing organisations can improve their ability to negotiate better prices and effectively represent their members at all levels, from local authority to national and international policy arenas. Expanding and strengthening rural infrastructure (roads, local renewable energy-based supply, mobile phone systems, cyclone shelters, etc) is needed so that the impacts of climate change do not lead to isolated communities but maintain small-scale farmers' access to markets, information and safe refuge in the event of climate shocks. A specific focus on increased storage will enable farmers to be better able to cope with the increased variation in production expected from one growing season to the next as a result of climate change and climate volatility.³⁷ This includes increased on-farm capacity to reduce post-harvest losses and enable strategic improvements to local food security and marketing through more and better local food storage and processing.

Integrating agriculture with other resilience priorities

Above all, there is a need to see the climate challenge to agriculture as more than just a narrow food productivity or greenhouse gas mitigation issue. The way land is managed affects everything, from the way biodiversity does or does not survive climate change to the increase in flood risks in towns and cities downstream from areas that are used largely to produce food. It affects the availability of freshwater for drinking and whether that water is healthy or contaminated with nitrates and pesticide residues. And it generates a substantial proportion of global greenhouse gases. To deliver increased resilience, it is essential to cut across the siloed interests of agricultural research, corporate input supply (fertilisers, machinery, agrichemicals), biotechnology and large-scale agriculture in order to work with small-scale farmers and pastoralists and the landscapes they live in.

Recommendations

It is important that the global decisions and investments in agriculture made in 2015 and beyond should have the priorities of small-scale farmers at heart, ensuring that the ecological integrity of land is prioritised to ensure long-term benefits and deliver secure land tenure to the most vulnerable farmers and farming communities.

The GACSA should realign its work through engaging with small-scale farming communities and their associations rather than the interests of agro-industry and large-scale commercial agriculture, echoing the declaration made at the 9th Community-Based Adaptation Conference in Nairobi to 'incorporate the principles of inclusiveness, community leadership and environmental sustainability into all of their plans for adaptation and development.'³⁸

The UNFCCC must ensure that the new global climate deal to be agreed in Paris at the end of 2015 gives priority to adaptation and sustainable development, with adequate climate finance being accessible to vulnerable farming communities through appropriate mechanisms to enable them to increase their climate resilience and environmental sustainability.

Soil carbon should not be included in the carbon market, as it promotes false solutions for agriculture and undermines the integrity of the climate finance regime. Mitigation should focus on reducing overuse and eliminating subsidies on greenhouse gas intensive inputs, such as mineral nitrogen fertiliser, as well as waste and inefficiency in the agricultural value chain.

The SDGs should deliver long-term sustainable food, land tenure and job security to women and men by promoting sustainable small-scale farming approaches. A key factor will be to address the acute gender disparity evident at all levels, from recruitment of research and advisory staff to ensuring inclusive, equal participation of female farmers in land ownership and agricultural advisory systems.

Small-scale farmers require access to essential climate services, such as weekly and seasonal forecasts and long-term climate scenarios, which will require a transformational change in both the capacity of national meteorology agencies and intermediary organisations, such as agricultural advisory services. This should be a priority for the Green Climate Fund, and will require increased support for the Global Framework for Climate Services and regional and national hydrometeorology capacity.

Endnotes

1. 'Agriculture' is used in the wider sense, including all aspects of terrestrial food production using crops, trees and livestock. 'Small-scale farmers' is used as shorthand to refer to farmers, pastoralists and forest dwellers relying on their land to feed their families as well as to earn an income.

2. 25% includes agricultural emissions and those related to agriculture's impact on forest and land emissions; this rises to more than 40% if all parts of the food production value chain, from input manufacture to food retailing, are included. See Agriculture at a Crossroads, International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) 2009, apps.unep.org/ publications/pmtdocuments/-Agriculture%20at%20a%20 crossroads%20-%20Synthesis%20 report-2009Agriculture_at_ Crossroads_Synthesis_Report.pdf

3. See *Climate Change* 2014: Impacts, Adaptation and Vulnerability, IPCC Working Group 2 2014, ipcc-wg2.gov/AR5/

4. J Gallup et al, *Economic Growth and the Income of the Poor*, Harvard Institute for Economic Development, Discussion Paper No. 36, 1997.

5. This rises to 80% in Africa and many developing countries.

6. un.org/climatechange/summit/ wp-content/uploads/sites/2/ 2014/05/AGRICULTURE-PR.pdf

7. About 1 billion more than the projected global population for 2050, after which a slow decline is anticipated. See E Holt Gimenez, *We Already Grow Enough Food for 10 Billion People*, Food First/ Institute for Food and Development Policy, 2012.

8. For an understanding of what Christian Aid means by resilience, see *Resilient Livelihoods Framework*, 2012, dl.dropboxusercontent. com/u/94841753/Road%20 to%20resilience%20resources/ Resilience%20framework%20 technical%20guidelines.pdf Also Folke et al, *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*, Scientific Background Paper on Resilience for The World Summit on Sustainable Development on behalf of The Environmental Advisory Council to the Swedish Government, 2002.

9. Health Harvests: the benefits of sustainable agriculture in Africa and Asia, Christian Aid, 2011, christianaid.org.uk/images/Healthy-Harvests-Report.pdf

10. See note 2.

11. Land degradation assessment, FAO 2010, fao.org/nr/land/ degradation/en/

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13. See note 2.

14. Central Ground Water Board, Dynamic Ground Water Resources of India, Ministry of Water Resources, Government of India, 2009.

15. Katalyn Voss et al, Groundwater Depletion in the Middle East from GRACE (Tigris-Euphrates), Water Resources Research, 2013.

16. S Park et al, *Trends and Seasonal Cycles in Nitrous Oxide since 1940*, Nature Geoscience 5, 261–265, 2012, nature.com/ngeo/ journal/v5/n4/full/ngeo1421.html

17. Rockstrom et al (2009, revised 2015), *A Safe Operating Space for Humanity*, Nature 461, 472-475, 24 September 2009, nature.com/ news/specials/planetaryboundaries/ index.html

18. There are already 400 regionalscale anoxic areas where the marine ecosystem has been as been turned into 'dead zones' by fertiliser run-off. N Rabalais et al, *Dynamics and Distribution of Natural and Human-Caused Hypoxia*, Biogeosciences 7, 585–619, 2010.

19. WHO/UNEP Health and Environment Linkages Initiative (HELI), who.int/heli/risks/toxics/ chemicals/en/

20. JP Van der Sluijs et al, *Conclusions of the Worldwide Integrated Assessment on the Risks of Neonicotinoids and Fipronil to Biodiversity and Ecosystem Functioning*, Environmental Sciences and Pollution Research, 2014, tfsp.info/ wp-content/uploads/2014/06/8_ ESPR_11356_2014_3229_

OnlinePDF.pdf

21. Strengthening Biocultural Innovation Systems for Food Security in the face of Climate Change, Planning Workshop Report, IIED and Centre for Chinese Agricultural Policy, 2012.

22. What is Happening to Agro-Biodiversity?, FAO 2004, fao.org/ docrep/007/y5609e/y5609e02.htm

23. Pelletier et al, *Energy Intensity* of *Agriculture and Food Systems*, Annual Review of Environment and Resources, 36:223–46, 2011, plantbiopath.rutgers.edu/faculty/ robson/AGECOLOCT28-4.pdf

24. A growing body of evidence has shown the enhanced resilience, productivity and profitability performance of sustainable and agro-ecological practices when compared to conventional, chemical agriculture, including: a) J Pretty et al, Resource Conserving Agriculture Increases Yields, Environmental Science and Technology 15, 40(4), 1114-9, 2006, julespretty.com/ wp-content/uploads/2013/09/7.-Pretty-et-al-EST-2006-Vol-40-4-pp-1114-19.pdf b) Organic Agriculture and Food Security in Africa, UNEP and UNCTAD 2008, unctad.org/en/docs/ditcted200715_ en.pdf c) Conservation Agriculture Research Study, Malawi, Concern Universal 2011 d) N Uphoff, The System of Rice Intensification: using alternative cultural practices to increase rice production and profitability from existing yield potentials, International Rice Commission Newsletter, 55, FAO 2007 e) Increasing Crop Production Sustainably - the Perspective of Biological Processes, FAO 2009, fao.org/docrep/012/i1235e/ i1235e00.pdf For their enhanced profitability and resilience, see N Nemes Comparative Analysis of Organic and Non-Organic Farming Systems: A Critical Assessment of Farm Profitability, FAO 2009, fao. org/3/a-ak355e.pdf and note 21.

25. The System of Rice Intensification (SRI) is a methodology based on planting young seedlings, planting single seedlings, and applying minimal irrigation water to keep the soil just at or below saturation. It also emphasises agro-ecological methods, eg, composts rather than chemical fertiliser. See irri.org/ news/hot-topics/system-of-riceintensification-sri **26.** *Gender and Agriculture*, FAO 2008.

27. Fact Sheet on Extension Services, GFRAS/FAO/Farming First/IFPRI 2012, farmingfirst. org/wordpress/wp-content/ uploads/2012/06/Global-Forumfor-Rural-Advisory-Services_Fact-Sheet-on-Extension-Services.pdf

28. Cheryl Doss et al, *Gender Inequalities in Ownership and Control of Land in Africa: myths versus reality*, IFPRI Discussion Paper 01308, 2014, ifpri.org/ publication/gender-inequalitiesownership-and-control-land-africa

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30. E Holt-Gimenez, *Measuring Farmers' Agroecological Resistance after Hurricane Mitch in Nicaragua: a case study in participatory, sustainable land management impact monitoring,* Agriculture, Ecosystems and Environment 93, 87–105, 2002, bio-nica.info/biblioteca/ holtgimenez2002agroecolgynic.pdf

31. See note 26.

32. Agricultural Growth and Poverty Reduction, DFID, 2004.

33. See Land Matrix Online Database on Land Deals, landmatrix.org/en/ (This figure includes concluded and intended, but not failed, land deals.)

34. Including common property, cooperative and equitable individual land title forms of land tenure management.

35. N Rabalais et al, *Dynamics and Distribution of Natural and Human-caused Hypoxia*, Biogeosciences 7, 585–619, 2010, biogeosciences. net/7/585/2010/bg-7-585-2010.pdf

36. Resilience to Extreme Weather, Royal Society 2015, royalsociety. org/policy/projects/resilienceextreme-weather/

37. This has led to the World Bank to state: 'the world seems to have forgotten the importance of post-harvest food losses in the African grain sector'- see *Missing Food – Post-Harvest Losses in Sub-Saharan Africa*, World Bank 2011, siteresources. worldbank.org/INTARD/Resources/ MissingFoods10_web.pdf

38. pubs.iied.org/G03919.html

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