POLICY BRIEF

SUSTAINABLE MECHANIZATION-BASED SOLUTIONS FOR CLIMATE SMART AGRICULTURE IN ASIA AND THE PACIFIC

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

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Tracking number: ESCAP / 4-PB / 30

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Summary

Agriculture is among the sectors most vulnerable to climate change. In the Asia-Pacific region, this sector is facing a number of key constraints such as a large proportion of small or fragmented land holdings, use of outdated or inefficient technologies and practices, high dependence on rainfed agriculture, low farm productivity and incomes, low investment capacity of farmers, and environmental challenges including ecosystem and land degradation. These constraints are significantly worsening the vulnerability of agriculture to climate impacts in the region. At the same time, agriculture is an important contributor to climate change.

Sustainable mechanization can play a key role in addressing many of the challenges posed by climate change for agriculture in the region. Some of the machinery-based solutions include precision agriculture; mechanized crop residue management to reduce greenhouse gas emissions and air pollution from biomass burning; conservation agriculture; and digital and smart mechanization technologies.

In order to reap these potential benefits of mechanization for climate-smart agriculture, it is recommended member States prioritize needs of vulnerable groups such as smallholder farmers and women farm workers, strengthen the policy environment, and leverage South-South and triangular cooperation.

I. Climate change and agriculture in the Asia-Pacific region

1. The Food Systems Summit convened by the Secretary-General of the United Nations in 2021 recognized the vital role of agriculture and food systems in achieving the 2030 Agenda for Sustainable Development in this Decade of Action. It reiterated that all the seventeen Sustainable Development Goals rely to some degree on healthier, more sustainable and equitable food systems. At the same time, agriculture is among the sectors most vulnerable to climate change. The range of possible climate impacts, inter alia, include losses from rise in frequency and intensity of extreme weather events like droughts and floods, decline in soil health, deterioration in crop yields and quality, variation in type and incidence of pest and disease attack, changes in distribution of agroecological zones, increased spatial and temporal uncertainty regarding precipitation, and changes in availability of water resources for irrigation.

2. The agricultural sector in the Asia-Pacific region is suffering from a number of key constraints, especially in developing and least developed countries. These constraints include, among others, (a) a large proportion of small or fragmented land holdings with 85 per cent of the farms below 10 hectares worldwide found in Asia[1] (b) use of outdated or inefficient technologies and practices (c) high dependence on rainfed agriculture (d) low farm productivity and incomes (e) low investment capacity of farmers, and (f) environmental challenges including high levels of land degradation with an average rate of 24-28 per cent in many parts of Asia as compared to 20 per cent globally.[2] These constraints are significantly worsening the vulnerability of agriculture to climate impacts in the region. Just since 2021, Afghanistan experienced its second drought in four years which affected 80 per cent of the country and resulted in a decline in harvest, while in Pakistan, even before the massive floods seen in 2022, drought conditions and deficient rainfall in several provinces adversely affected crop and livestock production and contributed to increase in food prices. In Cox's Bazar in Bangladesh, significant damage was witnessed from soil erosion, landslides, floods and storm.[3]

3. It is noteworthy that in rural areas of the Asia-Pacific region, women play a large role in the economic sphere as farmers, wage earners and entrepreneurs, and climate change has a disproportionate impact on them. For instance, the agricultural sector engages more than 64 per cent of employed women in the Lao People's Democratic Republic, while the corresponding percentage for Nepal and Bangladesh is 60 and 50 per cent respectively. This further increases the vulnerability of rural women to impacts such as changes in weather patterns which affect agricultural production and yield.[4]

4. Apart from being highly vulnerable to its impacts, agriculture is also an important contributor to climate change. The agrifood sector broadly, also encompassing forestry and fisheries, is responsible for a third of the anthropogenic emissions of greenhouse gases[5] including through activities such as rice production, soil tillage, crop residue burning and livestock production.

II. Sustainable mechanization-based solutions for climate smart agriculture

5. Sustainable mechanization can play a key role in addressing many of the challenges posed by climate change for agriculture in the region. It can help in increasing agricultural productivity and incomes, reducing the drudgery of agricultural work, combating land degradation and enhancing resilience. Appropriate machinery is also critical to enhance the efficiency and timeliness of agricultural operations in order to cope with extreme weather events and climate-related shocks. A few examples of mechanization-based solutions which can promote climate-smart agriculture are enumerated below:

(a) *Precision agriculture:* Precision agriculture enables more efficient decision-making by producers based on availability of site-specific information. It can help achieve higher productivity by identifying variations in soil characteristics and moisture content, facilitating improved assessment of pest and disease attack, and enabling necessary remedial action. It helps farmers in building resilience to climate impacts by promoting more efficient use of water, fertilizers and pesticides, and helps attain cost savings on both material and labour inputs, while reducing the negative fallout of agricultural operations on the health of farmers and the environment. Machinery and technologies like drip irrigation equipment and variable rate application systems are essential to support precision agriculture;

(b) *Mechanized crop residue management:* Burning of straw residue by farmers after harvesting in order to prepare the field for the next crop is a common concern in many countries of the region.[6] Apart from accelerated greenhouse gas emissions and air pollution, straw burning causes loss of soil carbon and micronutrients in the long term while adversely affecting soil temperature, pH, moisture, organic matter as well as agricultural production and farmers' income. Agricultural machinery can provide solutions to sustainably manage crop residue and to utilize it for purposes such as fertilizer, fodder, base material for mushroom growing, and clean energy production. For instance, balers enable straw residue to be collected, compressed and prepared for transportation with reduced requirement of human labour, thus discouraging burning;

(c) *Conservation agriculture:* Based on the core principles defined by the Food and Agriculture Organization of the United Nations, namely minimum soil disturbance, permanent soil cover (including sustainable crop residue management referred to above), and diversification of plant species, conservation agriculture can reduce erosion, protect soil health and productivity and reduce carbon emissions, enabling the transition to sustainable and low-carbon agricultural production. By lowering dependence on chemical inputs and reducing the labour requirement for production through minimum tillage practices, it can build the resilience of the farming community including for resource-poor smallholder farmers, women and elderly workers who are most vulnerable to climate shocks. Agricultural machinery such as no-till seeders, which allow seeding in crop residue conditions, is conducive to the successful application of conservation agriculture;

(d) *Digital and smart mechanization technologies:* The advent of smart technologies, 'intelligent' equipment and digitally-enabled solutions holds significant promise to boost climate resilience in agriculture and reduce greenhouse gas emissions. The application of the Internet of things, sensors, locations systems, robotics and artificial intelligence, big data solutions, and mobile applications to agricultural machinery can make operations more efficient, optimize agricultural and human inputs, and increase the quality and quantity of agricultural products. For example, smart mechanization can help in saving chemical inputs and address labour shortages, while helping reduce food loss and waste which is an important contributor to climate change.[7] It can concurrently attract young people to enter the agricultural sector and establish profitable businesses.

III. Initiatives undertaken by ESCAP-CSAM

6. The Centre for Sustainable Agricultural Mechanization (CSAM) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is working to promote sustainable agricultural mechanization in the region in support of the 2030 Agenda. Its work is particularly aligned with relevant targets under Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), Goal 15 (Life on Land) and Goal 17 (Partnerships for the Goals). Some of the targeted initiatives undertaken by the Centre in support of climate smart mechanization in the region include:

(a) *Technical capacity building:* CSAM has strengthened capacities of member States on the theme of climate-smart mechanization for dryland agriculture with a particular focus on the arid and semi-arid areas of Central Asia, and three workshops have been organized since 2020. In addition, the Centre has co-organized three regional workshops on mechanization-based solutions for conservation agriculture in collaboration with partners in Cambodia. Another key area for capacity building has been the application of digital and smart agricultural mechanization solutions for smallholder farmers;

(b) *Pilot projects on sustainable crop residue management:* CSAM in collaboration with ESCAP's Environment and Development Division is implementing a 'Regional Initiative on Mechanization Solutions for Integrated Management of Straw Residue in Asia and the Pacific' to identify, test and promote an integrated model of straw management using agricultural machinery which discourages farmers from burning the residue. Since the launch of the project in 2018, positive results have been attained from the initial pilot countries (China and Viet Nam) for use of straw residue as fodder, fertilizer and base material. The regional initiative has successfully secured additional donor funding and new pilots have been established in Cambodia, Indonesia and Nepal;

(c) *Network building:* CSAM has promoted climate-smart mechanization through building and strengthening stakeholder networks in the region. These include (a) the 'Asian and Pacific Network for Testing of Agricultural Machinery' which aims to promote harmonization of testing standards of agricultural machinery amongst participating countries in order to enhance the quality, performance, occupational safety and environmental dimensions of the machinery, and (b) the 'Regional Council of Agricultural Machinery Associations in Asia and the Pacific' which seeks to strengthen the capacity of national agricultural machinery associations, facilitate the exchange of knowledge and information, and enhance collaboration and closer business connections among national associations and their members for sustainable and climate-smart mechanization. The two networks currently include 19 and 15 participating countries respectively.

Recommendations

7. As pointed out in ESCAP's 'Asia and the Pacific SDG Progress Report 2022', the coronavirus disease pandemic and climate change have accentuated the development challenges facing the region and slowed the progress towards the Sustainable Development Goals. At the current pace, the report highlights the region would achieve the Goals only by 2065.[8] In respect of the agricultural sector, this finding underscores the need to accelerate the move towards sustainable and climate-smart agricultural development, in which sustainable mechanization must play a critical role. Three recommendations are outlined below for pertinent stakeholders in the region:

(a) *Prioritize needs of vulnerable groups:* Member States should undertake targeted efforts to address the needs of smallholder farmers, migrant farm labourers, women and elderly workers towards adoption of agricultural machinery that can enhance their resilience. Apart from development and demonstration of machinery that is suitable for these groups and for crops grown by smallholders, custom hiring or renting of such machinery should be promoted to allow resource-poor farmers to access them. Moreover, emphasis should be laid on ensuring that vulnerable groups are equipped to take full advantage of digital and smart technologies;

(b) *Strengthen policy environment:* An enabling policy environment is necessary to guide sustainable and climate-smart agricultural mechanization. Development of dedicated national policies or strategies to promote mechanization in the agricultural sector through a participatory process engaging all relevant government entities, academia, development partners, private sector, civil society and farmers themselves should be taken up where needed;

(c) *Leverage South-South and triangular cooperation:* Partnerships and cooperation amongst different countries as well as stakeholders are vital to address the complexity and scale of climate-related challenges facing the agricultural sector in the Asia-Pacific region. Coordination mechanisms should be established to build upon the expertise and resources of individual stakeholders while promoting opportunities for knowledge exchange and sharing of best practices on climate-smart mechanization.

References

1 See FAO, The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide (2016).

2 See United Nations, https://unstats.un.org/sdgs/report/2019/goal-15/ (accessed on 7 October 2022).

3 Global Network Against Food Crises, 2022 Global Report on Food Crises: Joint Analysis for Better Decisions (2022), p. 23.

4 ESCAP, Asia and the Pacific SDG Progress Report 2022 (2022), p. 42.

5 FAO, The State of Food and Agriculture: Making Agrifood Systems More Resilient to Shocks and Stresses (2021), p. v.

6 See ESCAP (2020), ESCAP/CED/2020/INF/4.

7 See FAO, www.fao.org/climate-change/our-work/areasofwork-old/food-loss-and-waste/en/ (accessed on 7 October 2022).

8 ESCAP, Asia and the Pacific SDG Progress Report 2022 (2022), p. xii.

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