

Economic and Social Commission for Asia and the Pacific
Committee on Environment and Development

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**Solutions to accelerate progress with respect to the
environmental dimensions of the 2030 Agenda for
Sustainable Development**

**Enabling sustainable food systems through
mechanization solutions for production and processing****

Note by the secretariat

Summary

Countries in the Asia-Pacific region face significant challenges to achieving the 2030 Agenda for Sustainable Development. In the context of food systems and overall agricultural development, these challenges include persistent poverty, reduced availability of agricultural labour, demographic changes that result in a larger proportion of women in agriculture as well as an ageing agricultural workforce, inefficient agricultural value chains, degradation of natural resources and the environment, and negative impacts of climate change. Sustainable agricultural mechanization has a multi-faceted role in promoting sustainability across the entire value chain and enabling sustainable food systems. It can thus play a key role in addressing these challenges.

Promoting sustainable agricultural mechanization in the Asia and the Pacific is both promising and challenging. The region has made great progress over the past six decades in transforming the farm power situation from over 90 per cent from animate sources in the 1960s to over 60 per cent from mechanical sources in 2014 in many countries. However, the overall level of agricultural mechanization development in the region is still comparatively low with vast disparity among countries and different districts within the same country. Major gaps also exist among different crops and different stages of production. The recommended programme and policy priorities for addressing these gaps include strengthening national policies and strategies in relation to sustainable agricultural mechanization, focusing on needs of smallholders, promoting innovative institutional mechanisms such as custom hiring, promoting the engagement of the private sector, and enabling regional cooperation to address trans-boundary issues.

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I. Sustainable agricultural mechanization and the 2030 Agenda for Sustainable Development

1. In recent decades, increased use of farm machinery has been an important contributor to the modernization of agriculture. Agricultural mechanization is generally understood to involve the use of powered machinery, implements and tools that substitute human labour and improve the efficiency of production. However, under the circumstances of demographic pressure, accelerated urbanization, climate change, and constraints of land and water resources, there is increasing need for agricultural mechanization to address a broader range of emerging technological, economic, social, environmental and cultural requirements, and offer innovative and economically viable opportunities for growers, consumers, policymakers and other stakeholders in the entire food system.

2. Sustainable agricultural mechanization is generally understood to cover farming and processing technologies at all levels, ranging from basic hand tools to sophisticated and motorized equipment.¹ Sustainable agricultural mechanization has a multi-faceted role in promoting sustainability across the entire value chain and enabling sustainable food systems. For instance, it can help address shortage of labour, ease drudgery, enhance productivity and the timeliness of agricultural activities, promote efficiency in resource use, enable better market access and support measures to mitigate climate related hazards.²

3. A system perspective is essential in relation to sustainable agricultural mechanization, which involves envisioning agricultural mechanization in its broadest sense, from individual machinery or equipment to the entire food system; from a perspective of engineering to the whole agricultural value chain; and from viewing the contribution of agriculture solely to rural communities to that for the environment as well. A system approach also implies interdisciplinary efforts in policy making, research and education, and undertaking of respective responsibilities by all pertinent stakeholders.

4. Countries in the Asia-Pacific region face significant challenges to achieving the 2030 Agenda for Sustainable Development. In the context of food systems and overall agricultural development, these include economic, social and environmental challenges such as persistent poverty, reduced availability of agricultural labour, demographic changes that result in a larger proportion of women in agriculture as well as an ageing agricultural workforce, inefficient agricultural value chains, degradation of natural resources and the environment, and negative impacts of climate change. Sustainable agricultural mechanization can play a key role in addressing these challenges and balancing the economic, social and environmental dimensions of agricultural development.

5. *Economic challenges:* Fifty seven percent of all people suffering from extreme poverty live in Asia and the Pacific,³ and the majority rely predominantly on agriculture for a living. While the region has made significant progress in recent decades in reducing the proportion of the population living below the poverty line, the progress has been uneven across

¹ FAO Website, www.fao.org/sustainable-agricultural-mechanization/overview/what-is-sustainable-mechanization/en/.

² FAO Website, www.fao.org/sustainable-agricultural-mechanization/overview/what-is-sustainable-mechanization/en/.

³ ESCAP (2012), Statistical Yearbook for Asia and the Pacific 2012, P10.

countries. According to the World Bank, agricultural growth in low-income and agrarian economies is at least twice as effective as growth in other sectors in reducing hunger and poverty.⁴ Sustainable agricultural mechanization has been well recognized in terms of reducing the cost of farm operation, maximizing the efficiency of utilization of inputs, and improving agricultural productivity as well as product quality,⁵ thus contributing directly to Sustainable Development Goal 1 (No Poverty), and Sustainable Development Goal 2 (Zero Hunger).

6. Owing to structural transformation in economies, the percentage share of agriculture in the total work force has been decreasing in most countries in the region. Moreover, urbanization is expected to continue at an accelerated pace in Asia and the Pacific driven by rural to urban migration and reclassification of rural areas into urban areas. In 2012, 1.96 billion (46 per cent) people in Asia and the Pacific lived in urban areas. By 2020, the urban population is expected to reach 50 per cent.⁶ This has resulted in (often seasonal) shortage of agricultural labour and rising rural labour cost in many countries. Sustainable agricultural mechanization has been envisioned as a key option to address the shortage of agricultural labour and cope with rising rural labour costs in the future.

7. It has been estimated that up to one third of all food produced for humans is lost or wasted before being consumed.⁷ Moreover, in developing countries, 40 per cent of food loss occurs at the post-harvest and processing stage.⁸ Sustainable agricultural mechanization, in particular, the machinery and facilities for harvesting, drying, processing, and storage can play a significant role in reducing agricultural losses. Less loss means higher production and persons fed per unit area of land. Therefore, sustainable agricultural mechanization can help in increasing the efficiency of value chains and facilitate the achievement of Sustainable Development Goal 12 (Responsible Consumption and Production).

8. *Social challenges:* For many countries in the region, compared to women, men are more likely to (first) migrate out of rural areas and the agriculture sector, contributing to an increasing proportion of female labour in agriculture. Around two thirds of women in South Asia are employed in agriculture, while in East Asia the proportion is around 40 per cent. Meanwhile, the Asia-Pacific region is ageing at an unprecedented pace. The population of elderly persons (65 years and older) has nearly doubled (from 173 million to more than 330 million) from 1990 to 2014; and by 2034, the elderly population is expected to double again and the child population is expected to continue declining in the region.⁹ In this context, sustainable agricultural mechanization reduces drudgery of agriculture, and particularly facilitates the work of women

⁴ World Bank (2008), Agriculture for Development Policy Brief, available at http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/223546-1171488994713/3455847-1192738003272/Brief_AgPovRedctn_web.pdf.

⁵ Goyal, S.K. et. Al. (2014), Agricultural Mechanization for Sustainable Agricultural and Rural Development in Eastern U.P. – A Review, available at www.researchgate.net/publication/263398428_AGRICULTURAL_MECHANIZATION_FOR_SUSTAINABLE_AGRICULTURAL_AND_RURAL_DEVELOPMENT_IN_EASTERN_U_P_-_A_REVIEW.

⁶ ESCAP (2013), Statistical Yearbook for Asia and the Pacific 2013, P11.

⁷ FAO Website, www.fao.org/food-loss-and-food-waste/en/.

⁸ FAO Website, www.fao.org/save-food/resources/keyfindings/en/.

⁹ ESCAP (2014), Statistical Yearbook for Asia and the Pacific 2014, P1 and P16.

and elderly agricultural workers, thus contributing to Sustainable Development Goal 5 (Gender Equality) and the commitment to ‘leave no one behind’.

9. *Environmental challenges:* Agriculture accounts for 80 per cent of water use in the region.¹⁰ With the rapidly increasing demand for water from industrial and municipal users, competition for water is becoming increasingly fierce. Soil degradation and erosion, pollution from chemical fertilizers and agrochemicals, and loss of biodiversity, also hinder the sustainable development of agriculture. Moreover, climate change has potentially grave consequences for food systems and consequently for global food security. Agricultural production systems in most developing Asian countries in tropical and sub-tropical areas, are highly vulnerable to climate risks and often have limited capacity to cope with its impact.¹¹ Sustainable Agricultural mechanization using efficient machines improves the utilization efficiency of inputs like fertilizers and agro-chemicals and reduces negative impacts on the environment. Similarly use of micro-irrigation techniques, not only improves water use efficiency significantly but also reduces deep percolation of water through which fertilizers like nitrates leach and pollute ground water. The use of conservation tillage and minimum tillage methods improves soil health, reduces soil erosion and reduces costs. Thus, appropriate and sustainable agricultural mechanization can play a major role in making agriculture sustainable. In addition to Sustainable Development Goal 12 (Responsible Consumption and Production), it can assist in the achievement of Sustainable Development Goal 13 (Climate Action) and Sustainable Development Goal 15 (Life on Land) through conservation of soil and restoration of degraded land.

II. Current challenges in promoting sustainable agricultural mechanization in the region

10. Promoting sustainable agricultural mechanization in Asia and the Pacific is both promising and challenging. The region has made great progress over the past six decades in transforming the farm power situation from over 90 per cent from animate sources in the 1960s to over 60 per cent from mechanical sources in 2014 in many countries.¹² However, the overall level of agricultural mechanization development in the region is still comparatively low with vast disparity among countries and different districts within the same country. Major gaps also exist among different crops and different stages of production.

11. Some of the key constraints and challenges in developing sustainable agricultural mechanization in the region are as below:

i. *Small land holdings:* About 90 per cent of the world’s small farms (<2 ha) are in the Asia-Pacific region¹³ while the average size of land holdings in Asia is only about 1 ha. In a number of countries, even these small

¹⁰ Singh G. and Zhao B. (2016), “Agricultural Mechanization Situation in Asia and the Pacific Region”, *Agricultural Mechanization in Asia, Africa and Latin America*, Vol. 47, No. 2, P16.

¹¹ FAO (2015), *Climate-Smart Agriculture: A call for action - Synthesis of the Asia-Pacific Regional Workshop*, available at www.fao.org/3/a-i4904e.pdf.

¹² FAO (2013), *Climate Smart Agriculture Sourcebook*, available at www.fao.org/docrep/018/i3325e/i3325e.pdf.

¹³ Singh G. and Zhao B. (2016), “Agricultural Mechanization Situation in Asia and the Pacific Region”, *Agricultural Mechanization in Asia, Africa and Latin America*, Vol. 47, No. 2, P21.

holdings are scattered in small plots in different locations. Many of these plots have limited access to the more large-sized farm machines. Meanwhile, a large proportion of smallholders in the region do not have adequate investment capacity and often find it challenging to afford even small machines. This has led to a situation where adoption of relevant mechanization technologies, equipment and practices by smallholders is severely restricted.

ii. *Limited manufacturing capacity:* Aside from a few countries like China, India, Japan and the Republic of Korea which have a well-developed industry for agricultural machinery manufacturing, the majority of the countries in the region have limited capacity to manufacture machinery and equipment and rely predominantly on imports to meet their domestic needs. In some cases, low manufacturing capacity reflects limited infrastructure and other facilities for science and technology research and development.

iii. *Weaknesses in policy environment:* Sustainable agricultural mechanization is one of the important drivers for development of the whole agricultural value chain. An enabling policy environment is required for the rapid development of agricultural mechanization and to leverage its full potential for food and livelihoods security, particularly in rural areas. However, in many countries, the necessary strategies and policies are either not yet developed or formulated in isolation without considering the overall agricultural and rural context, thus lacking the desired impact. Moreover, policy formulation is often not sufficiently backed up by rigorous research and analysis or involves very limited consultations with stakeholders.

iv. *Limited institutional capacities:* There are important capacity gaps that are constraining the development of agricultural mechanization, particularly in Least Developed and Landlocked Developing Countries. Existing skills and capacities of various stakeholders including policymakers, researchers, practitioners, entrepreneurs and farmers are inadequate in many countries and targeted capacity development efforts are not in place to plug the gaps. The capacity gaps are at times particularly severe in areas which have been suffering from conflict or population displacement.

v. *Inadequate regional coordination:* The Asia-Pacific region as a whole faces a diverse range of challenges and opportunities with respect to sustainable agricultural mechanization development. Many of these such as climate change and limitations on technology transfer are cross-border in nature but gaps in existing mechanisms for regional coordination limit a cohesive and synergistic response. Moreover, there is insufficient cooperation to share knowledge, experiences and learning to quickly scale up innovative approaches and solutions.

III. Programme and policy priorities

12. Based on current challenges in the Asia-Pacific region, a number of priorities can be identified in regard to programme development and policy formulation for sustainable agricultural mechanization.

13. Greater focus is required on addressing needs of smallholders and other vulnerable communities while designing and implementing programmes for sustainable agricultural mechanization development in the region. Emphasis should be placed on strengthening the knowledge and capacities of change agents who work closely with this target group such as research and development centres, and extension agents in order to support development, adaptation as well as adoption of suitable technologies for smallholders.

14. Machinery renting services such as custom hiring should be promoted for sustainable mechanization of operations in agri-food chains. Custom hiring is an important mechanism through which smallholders can access machinery without requiring to own them. At the same time, a suitable regulatory framework and support policies are needed to attract private sector investment for providing such custom hiring services. Moreover, establishment of sound mechanization supply chains and dealer franchise networks across the region is important. Given the constraints presented by lack of after sales services and spare parts in rural areas, manufacturers and dealers should be provided with assistance to strengthen the supply chain of agricultural machinery and to develop repair-and-maintenance networks in remote areas.

15. Regional cooperation to promote sustainable agricultural mechanization must be strengthened in order to address trans-boundary, regional, and sub-regional issues that cannot be resolved by individual countries such as bottlenecks on cross-border technology transfer. Intensification of efforts is required in the area of setting norms and standards for agricultural machinery to boost development of the mechanization industry in the region. Innovative mechanisms for sharing of experiences and best practices between countries through meetings, working groups and online interactions must also be promoted. Given the importance of the private sector in scaling up new technologies, networking and knowledge sharing amongst private sector entities needs to be emphasized.

16. In view of the dependency on import of agricultural machinery for many countries, institutional initiatives to facilitate trade and investment must be promoted. There is a need to encourage measures that can alleviate barriers to inter- and intra-regional trade in agricultural machinery. Moreover, a conducive national policy environment must be provided to strengthen the role of the private sector and enhance local manufacturing capacities to help in scaling up access to innovative mechanization technologies. In this process, due attention must be paid to promoting safe, efficient, reliable and environmentally sound machinery and equipment so that mechanization remains consistent with the goal of realizing sustainable agriculture.

17. In the area of analytical work, there is need to further assess and analyze the current mechanization technologies and practices for their respective contribution to the economic, social and environmental dimensions of sustainability. Such an exercise can be helpful to identify ‘hotspots’ or ‘unsustainable’ machinery and methods. It can also help inform the development of ‘Green Mechanization’ technologies including tools and equipment to support minimum/zero tillage and conservation agriculture. Moreover, the availability and quality of data on agricultural mechanization in the region must be enhanced as it is key to development and adoption of appropriate tools/machines. For instance, the current lack of anthropometric datasets for different population groups, across countries, results in deployment of unsuitable tools/machines which not only leads to low farm and labour productivity but also creates an unsafe working environment for men and women in agriculture. Role of women in agriculture should be given due attention through emphasis on gender-disaggregated data.

IV. Solutions for sustainable agricultural mechanization and the work of ESCAP

18. The Centre for Sustainable Agricultural Mechanization is one of the six regional institutions of ESCAP, based in Beijing, People’s Republic of China. The Centre for Sustainable Agricultural Mechanization is guided by the vision

to achieve production gains, improved rural livelihood and poverty alleviation through sustainable agricultural mechanization for a more resilient, inclusive and sustainable Asia and the Pacific.

19. In pursuit of its mandate to promote sustainable agricultural mechanization in the Asia-Pacific region, particularly with a focus on addressing Sustainable Development Goal 1 (No Poverty) and Sustainable Development Goal 2 (Zero Hunger), the Centre for Sustainable Agricultural Mechanization has been working to address the programme and policy priorities identified above. Specifically, the Centre is assisting member States in implementing solutions in three areas, namely strengthening regional cooperation and networks, improving agricultural resource use, and supporting evidence-based policymaking. In its work, the Centre for Sustainable Agricultural Mechanization has maintained a strong focus on addressing the needs of smallholders and engaging a wide range of stakeholders including government, private sector, academia and other international organizations.

20. *Strengthening regional cooperation and networks:* the Centre for Sustainable Agricultural Mechanization is providing a multi-stakeholder platform to its member States through the Regional Forum on Sustainable Agricultural Mechanization organized annually to promote regional cooperation and high-level policy dialogue. Apart from providing a platform for assessment of regional priorities, exchange of experiences amongst countries and stakeholders, and exploring potential for synergistic action, the Regional Forum is a strategic event which enables the conception and incubation of new, demand-driven programmes and activities for the Centre. Some of the areas addressed by the Regional Forum in the past have included role of mechanization in climate smart agriculture, custom hiring, and promoting national sustainable agricultural mechanization strategies.

21. In recognition of the importance of engaging the private sector to upscale new technologies and machinery, the Centre for Sustainable Agricultural Mechanization's initiative titled the Regional Council of Agricultural Machinery Associations is helping promote sustainable agricultural mechanization in Asia and the Pacific by strengthening capacities and networking amongst national agricultural machinery industry associations. The membership of the Regional Council of Agricultural Machinery Associations network has now expanded to 19 agricultural machinery manufacturer and distributor associations from 14 countries. The Centre for Sustainable Agricultural Mechanization has also enabled members of the Regional Council of Agricultural Machinery Associations to attend several key agricultural machinery exhibitions and events and the exposure attained through these visits has contributed to an improved pool of knowledge on sustainable agricultural mechanization technologies in the region as well as sharing of experiences. Annual network meetings are held to facilitate knowledge exchange amongst the members, accompanied by business matching event to bring together those requiring specific types of machinery with those able to provide them. The business matching events have thus contributed to fulfilling existing needs for mechanization through matching of demand and supply. Apart from this, a Regional Council of Agricultural Machinery Associations Training and Study Tour is organized annually to strengthen capacities and deepen the understanding of association representatives on various dimensions of sustainable agricultural mechanization. For instance, in 2017, the 3rd Regional Council of Agricultural Machinery Associations Training and Study Tour focused on precision agriculture and harvesting technologies for rice and maize.

22. The Centre for Sustainable Agricultural Mechanization has also implemented regional cooperation initiatives for strengthening the resilience of smallholders through sustainable agricultural mechanization. In September 2017, the Centre for Sustainable Agricultural Mechanization and the World Food Programme (WFP) China Office co-organized a ‘Seminar on Building Smallholder Farmers’ Resilience under Climate Change through Value Chain Management’ in Kunming, China. Furthermore, in November 2017, the Centre for Sustainable Agricultural Mechanization collaborated with FAO, the International Fund for Agricultural Development (IFAD) and WFP to organize a side-event titled ‘Building Smallholders’ Resilience to Climate Change through South-South Cooperation - A Side Event for China Pavilion’ at the 23rd session of the Conference of the Parties (COP23) in Bonn, Germany. The side-event was attended by senior representatives from collaborating partners and leveraged the high visibility of the 23rd session of the Conference of the Parties to underscore the need for building smallholders’ resilience.

23. *Improving agricultural resource use:* For improving the use of agricultural resources, the Centre for Sustainable Agricultural Mechanization is promoting appropriate testing standards for agricultural machinery as well as encouraging more sustainable farming practices. The Centre for Sustainable Agricultural Mechanization’s initiative titled the ‘Asian and Pacific Network for Testing of Agricultural Machinery’ is enabling harmonization of testing standards of agricultural machinery amongst participating countries in the Asia-Pacific region in order to enhance the quality, performance, occupational safety and environmental dimensions of the machinery. Development and adoption of such testing codes and standards at the regional level can support greater and more sustainable use of agricultural machinery thus delivering benefits in terms of improved resource utilization and environmental preservation, enhanced productivity and rural incomes, strengthened food security and climate resilience, and more integrated trade. Through the Asian and Pacific Network for Testing of Agricultural Machinery, the Centre for Sustainable Agricultural Mechanization has achieved in-principle adoption by participating member States of harmonized regional standards for testing of three types of agricultural machinery having strong relevance for smallholders. An Asian and Pacific Network for Testing of Agricultural Machinery Training of Trainers is organized annually to strengthen capacities of national testing engineers in application of the Asian and Pacific Network for Testing of Agricultural Machinery testing Codes. Moreover, to support development of agricultural machinery testing stations, the Centre for Sustainable Agricultural Mechanization has provided technical and policy advisory services to selected countries through assessment visits to national testing stations.

24. A number of countries in the Asia-Pacific region are facing the issue of burning of straw residue which poses a serious public health and environmental concern while contributing to emissions from the agricultural sector. Given its cross-border impacts, this issue needs to be addressed at both the national and international levels. In this backdrop, the Centre for Sustainable Agricultural Mechanization has launched an initiative to encourage improved farm practices for integrated straw management through sustainable agricultural mechanization. Analytical work has been undertaken to identify a portfolio of good practices and based on the outcomes, pilot projects are being initiated in China and Vietnam to test promising approaches to straw management with a view to upscaling them in future.

25. *Supporting evidence-based policymaking:* The adoption of the 2030 Agenda for Sustainable Development has lent significant importance to collection and dissemination of quality data to provide evidence for policy

development and implementation and to monitor progress towards the Sustainable Development Goals. The Centre for Sustainable Agricultural Mechanization's initiative titled 'Regional Database on Sustainable Agricultural Mechanization' aims to enhance the effectiveness of regional as well as national strategies for promoting sustainable agricultural mechanization. By complementing and strengthening existing national databases, and improving the quality and quantity of comparable, timely and reliable data, this initiative seeks to assist member States in identifying the level of agricultural mechanization, and facilitate technology innovation and trade in agricultural machinery. A 'Guideline for Development of a Regional Database on Sustainable Agricultural Mechanization in Asia and the Pacific' has been developed and endorsed by participating member States, which will provide an overarching framework for collaboration and strengthening of national capacities.

26. The Centre for Sustainable Agricultural Mechanization has established a contact network for professors, researchers and engineers working on sustainable agricultural mechanization in the region to improve the dissemination and sharing of information, knowledge, technologies and research literature among research and academic institutions. The initiative aims to facilitate joint research and innovation as well as joint development of project proposals for funding from international and domestic funding sources, and to facilitate human resource development activities, including collaboration for visiting scholars, internships, tailored training, study tours, pilots, etc. An online platform titled 'e-Agriscientist' has been launched to facilitate the collaboration and it is witnessing encouraging uptake.

27. The Centre for Sustainable Agricultural Mechanization regularly undertakes research and development of knowledge products on sustainable agricultural mechanization focusing on the regional, sub-regional and national levels. In the recent past, these knowledge products have addressed critical areas of need expressed by stakeholders such as trade and investment policies on agricultural mechanization, development of national strategies on sustainable agricultural mechanization, and custom hiring of agricultural machinery.

V. Matters for consideration of the Committee

28. The Committee may wish to review the present report and provide guidance on the issues highlighted therein for promoting sustainable agricultural mechanization in the Asia-Pacific region. The Committee is also invited to share experiences and provide guidance to the Centre for Sustainable Agricultural Mechanization to further strengthen the relevance and effectiveness of its work.