

**The Bali Declaration**  
**on**  
**Climate Change Adaptation and Mitigation in Agriculture in the Asia-Pacific**

We are convinced that the effects of climate change on agriculture are becoming more obvious and pose serious threats and challenges to food security and sustainability in agriculture under the business-as-usual situation. It is therefore critical to transform agricultural practices for increasing agricultural productivity, while reducing greenhouse gas (GHG) emissions to ensure sustainable agriculture and food production to feed more than nine billion people in 2050. To explore ways of mitigating the negative effects of climate change on agriculture and to share strategies, approaches, and good practices of climate change adaptation and mitigation in agriculture, the Asian Productivity Organization (APO) in collaboration with the Ministry of Agriculture and the Ministry of Manpower and Transmigration of the Republic of Indonesia organized the Forum on Mitigating Negative Effects of Climate Change on Agriculture in Bali, Indonesia, 30 September to 3 October 2014. The Indonesian Agency of Agricultural Research and Development (IAARD) in collaboration with the National Productivity Organization (NPO)-Indonesia implemented the program.

More than 50 policymakers and planners, government officers, agricultural professionals, scientists, practitioners, and executives of NGOs and NPOs representing 18 economies contributed in-depth knowledge, discussed related issues and challenges, and provided valuable inputs for promoting climate change adaptation and mitigation policies, strategies, approaches, and practices in the agricultural sector.

The forum consisted of six thematic sessions: Assessment of climate change impacts on agricultural productivity; Efficient, effective resource management for climate change mitigation and adaptation; Innovations in farming systems for mitigation of and adaptation to climate change; Tools and technologies for agricultural adaptation to climate change; Policy and institutional settings for building resilience for adaptation to climate change; and Mainstreaming good practices of agricultural adaptation to climate change into sectoral planning.

After intensive deliberations the forum agreed on the findings and recommendations listed below:

**Findings:**

1. Climate change, combined with growing global food demand, is a serious threat to food security everywhere. Smallholder farmers and rural people, especially those who live in fragile and coastal ecosystems, are the most vulnerable to the negative effects of climate change as their livelihood depends on agriculture including crops, livestock, fishery, aquaculture, and forestry.
2. The agricultural sector is highly vulnerable to changing conditions. Climate change affects agriculture through higher temperatures and an increase in CO<sub>2</sub> concentration, rainfall variability, and increases in the frequency of extreme weather events such as high/low temperatures, droughts, floods, and storms. Higher temperatures also increase the incidence of disease and insect pest infestation. The consequent crop failures and livestock deaths

cause huge economic losses, contributing to volatility in agricultural markets and higher food prices, thereby undermining food security in many developing countries.

3. Agricultural activities and the associated food production system contribute about one-third of total global GHG emissions. In developing Asian countries, such emissions are expected to rise in coming years. Despite their continuing rise, emissions from the agricultural sector are growing at a much slower rate than those from other sectors, demonstrating the increasing carbon efficiency of agriculture.
4. Major sources of GHG emissions in agriculture are livestock due to enteric fermentation, inefficient use of synthetic fertilizers, flooded rice cultivation, and burning of biomass.
5. On a global level, soils have been seriously depleted of their organic carbon content (up to 75%). Restoration and sequestration of soil carbon could offset some of the global emissions from agriculture and to a great extent that of the related food industry. A farming system resilient to climate change (e.g., organic farming, integrated livestock-crop farming) would have high capacity to sequester CO<sub>2</sub>.
6. The agriculture sector can play a key role in the low-carbon green growth paradigm, especially through climate-smart agriculture, but the economic potential of emission cuts is constrained by poor incentives for investment in the agriculture sector. At the same time, a major challenge lies in aligning growing demand for agricultural and food products with low-emission development paths that are economically sustainable for smallholder farmers.
7. A majority of producers in the Asia-Pacific are smallholders that practice rainfed farming, which is the backbone of food security in their countries. They require simple, cost-effective adaptation and mitigation practices and technologies as well as policy support. They are currently exposed to high weather variability risks that will increase in future.
8. The capacity of producers, especially smallholders and rural communities, to mitigate and adapt to climate change is limited.
9. Options to increase the resilience of agricultural and food production systems against climate change risks include planning and implementation of both structural and nonstructural measures, such as developing input-efficient crop varieties, maximizing water-use efficiency, formulating new standards for infrastructure design, exploiting co-benefit approaches, institutional capacity building, and changing the policymaking environment under which all adaption activities typically occur.
10. Tools, technologies, and practices to reduce GHG emissions along with enhanced income earning potential for farmers and associated benefits from reduced natural resource degradation exist but there are technological, social, and economic impediments to their upscaling.
11. There is a wide range of soil, water, and crop management technologies available to minimize the adverse effects of extreme environmental conditions. These include

sustainable soil management techniques (e.g., crop rotation including legumes; cover cropping; mulching; terracing; balanced fertilization; reducing, reusing, and recycling organic agricultural waste; and integrated crop-livestock systems where livestock supply manure as a source of nutrients), high-efficiency irrigation technologies, farming systems for improved water-use efficiency (e.g., alternate wetting and drying/aerobic rice cultivation), and crop/animal breeds adaptive to climatic stress. These technologies can easily be adopted in Asian countries.

12. System modeling is an important tool to simulate the relationships of physical and biological processes related to climate change and feed them into a menu of adaptation options that suit farmers' socioeconomic circumstances. The effectiveness of the models depends on how well they simulate the current and future impacts of climate change on agriculture and the quality of data input.
13. Early warning/climate systems help reduce loss of life, property, and farm produce so that producers and communities can prepare for their protection against extreme weather events.
14. Biotechnology can be an important tool to help meet the challenges arising from climate change, food security, and natural resource constraints by producing crop varieties/animal breeds with low input requirements and more tolerance to biotic and abiotic climatic stresses.
15. Plant factories with artificial light (PFAL) is an emerging modern concept of food production under a controlled environment. The PFAL could be a viable option, although still expensive, to sustain the production of food under extreme situations because yield and quality are not affected by weather, soil, pests, and water availability.
16. Actions in forestry and agroforestry are critical to the mitigation of and adaptation to climate change. Reducing emissions from deforestation and forest degradation and enhancing the forest carbon stock have been adopted as a tool to improve forest governance.
17. Financial tools and social capital are very important to enhance the resilience of farming and rural communities to climate change.
18. Both disaster risk reduction and climate change adaptation aim at reducing the vulnerability of agriculture and communities and contributing to sustainable development. However, integrating disaster risk management and climate change adaptation in the overall development process has not yet become a high priority in most parts of the Asia-Pacific, as policymakers are preoccupied with other developmental priorities.
19. Many countries in the Asia-Pacific lack comprehensive policies and action plans for climate change mitigation and adaptation.

**Recommendations:**

1. There is an urgent need to transform agricultural practices for increasing agricultural productivity while reducing GHG emissions from agriculture.

2. Comprehensive efforts are needed to build climate-resilient agricultural systems to increase agricultural productivity, promote sustainability in agriculture, and ensure food security in the Asia-Pacific region. It is necessary to promote agro-ecological production models such as agroforestry, organic farming, and integrated farming to sequester CO<sub>2</sub>, and improve soil productivity.
3. There is an urgent need to promote and implement methods and technologies for the mitigation of and adaptation to climate change. There are currently already a range of soil, water and crop management technologies available which can alleviate the adverse effects of extreme events, but they need to be tailored to the specific and differing needs of each Asia-Pacific country.
4. Some farming systems are major sources of methane emissions and are characterized by low input-use efficiency. Such systems need to be transformed for reducing GHG emissions and increasing input-use efficiency. For example, growing rice in standing water should be replaced with an alternate wet and dry method or aerobic rice cultivation for increasing water-use efficiency while reducing methane emissions. Similarly, feeding of livestock must be properly managed to minimize methane emissions.
5. The immediate effect of climate change on agriculture is substantial, but the scientific knowledge base for choosing different options and strategies is weak. More efforts are necessary for collection of baseline data, downscaling of system models, and developing empirical studies to incorporate considerations at the outset of developing plans for increasing productivity and efficiency of the agricultural sector.
6. Serious efforts must be made to enhance scientific capacity and reduce uncertainty about the reliability of information and data on climate change. For this purpose, policymakers need full access to specific information on predicting the probability of climate change at the local level, its potential effects on the agricultural sector, and implications for food security and economic development in the long term.
7. Both early warning systems and climate change forecasting depend on the availability and reliability of prospective data. Governmental and private-sector organizations are urged to install and maintain such systems to predict climate change accurately, especially its impact at the local level on the agriculture sector and farming/rural communities.
8. Climate change adaptation and mitigation in agriculture are complex issues. Therefore transdisciplinary research should be strengthened to generate easy-to-implement solutions for producers and farming communities.
9. There is a need to sensitize policymakers to the ecological and socioeconomic implications of climate change through effective communication.
10. Climate change mitigation and adaptation strategies are largely handled in isolation without integrating them into the main development process. To mainstream climate change impacts,

mitigation, and adaptation into overall planning and development, policies should be integrated at the regional, national, provincial, and local levels. Efforts to mainstream mitigation find resistance as they come with additional funding requirements and tradeoffs between immediate climate change actions at the farm level and macro-level growth. Local governments are the best positioned to offer the appropriate incentives to ensure the coordination needed.

11. Governments must enhance their institutional capacity to make better use of existing funding opportunities. New financing mechanisms to support environment-friendly and climate-resilient agricultural and food systems need to be established with broader, more flexible approaches, integrating different funding sources and innovative delivery mechanisms to reach producers. There is also a need to enhance innovative financing schemes through promoting public-private partnerships.
12. The carbon market for the agricultural sector is underdeveloped because of a lack of inclusion in the Clean Development Mechanism (CDM) under the Kyoto Protocol and high cost of verification, monitoring, and transactions, especially for small farmers. The mitigation potential of agriculture should be exploited by improving the sector's access to carbon markets; reducing the cost of verification, monitoring, and transactions; simplifying and improving such systems; and building the capacity of key stakeholders.
13. Governments should use payment schemes as incentives for farmers to adopt agricultural practices that both mitigate and adapt to climate change. These could be based on direct payments through the Nationally Appropriate Mitigation Actions (NAMAs) and other United Nations Framework Convention on Climate Change (UNFCCC) mechanisms from the proposed Green Climate Fund. They can also be funded by market-based mechanisms such as cap-and-trade or voluntary schemes. Governments need to ensure a mandated carbon price to remove price volatility so that there is a real financial incentive for farmers to participate. Governments also need to ensure that the bulk of funds go to farmers and not to the money market or scheme administrators. The appropriate schemes can turn agriculture from a problem to a solution.
14. There is a need for a sustainable, agroecological paradigm shift in agriculture for mitigating climate change, halting the loss of biodiversity and the degradation of the environment at large. Agriculture and allied organizations including governments should take the appropriate steps to support this paradigm shift for the benefit of their farmers and rural communities.
15. The collaboration among relevant ministries such as agriculture, livestock, forestry and fisheries, water resources, rural development, environment, climate change, planning, and finance must be strengthened for effective implementation of projects and programs.
16. Governments and international organizations should pool resources to create synergies in efforts to combat climate change and promote mitigation of and adaptation to it.

17. Concerted efforts must be made by governments and NGOs to raise awareness and strengthen the capacity of all key stakeholders (e.g., policymakers, scientists, practitioners, and producers) to address climate change challenges effectively.
18. There is an urgent need for regional cooperation in implementing an integrated approach to climate change adaptation and mitigation.
19. The impacts of climate change involve multiple stakeholders such as farmers, rural communities, the state, international organizations, the private sector, and NGOs. Therefore overcoming climate change impacts is a joint responsibility. Collective, participatory efforts by all relevant stakeholders are necessary. Each stakeholder has a role to play. One of the greatest challenges is mobilizing the support of all relevant stakeholders in an effective manner. To overcome this, strong networking among key stakeholders at various levels must be established and sustained as a priority.
20. International organizations such as the APO should continue to organize projects relating to the development of sustainable agriculture and food systems, in particular climate change, aiming at creating awareness of the socioeconomic importance of climate change adaptation and mitigation in agriculture and other sectors, strengthening capacity of key stakeholders, and assessing and monitoring progress, among others.

At the end, those attending the forum resolved that they would do their utmost to contribute to advances in climate change mitigation and adaptation in agriculture and other sectors, reduce the impact of agriculture on climate change, and develop climate change-resilient agriculture and food production systems for achieving sustainable national food security in their countries by utilizing and disseminating the lessons learned from this forum.