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Sustainable Agriculture: An Imperative to Feeding People and Protecting Earth

by

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Mr. Chairman, Dr. H.S. Gupta, Director of IARI, members of the family of Dr. B.P. Pal, distinguished personalities and authorities on the podium and in the auditorium, ladies and gentlemen,

I am here in your presence today with a feeling of immense honor and gratitude. Honor because I have the opportunity to deliver the 2014 Dr. B.P. Pal Memorial Lecture, and gratitude especially to Director-IARI for considering me worthy of this honor. I am also delighted and honored to see Dr. Mangala Rai chair this session. I have known him for a long time, and have the privilege of calling him my friend. During 2010 and 2011, when I served in a different capacity at FAO, we had an opportunity to work together on the topic closely related to my talk today. That brief association made me an even greater admirer of his knowledge, wisdom, experiences, and energy and much of what I shall say today will reflect what I learned from him and others.

I know that you know more about Dr. B.P. Pal than I do. Dr. Mangala Rai in an earlier Memorial Lecture here has talked in some detail about Dr. Pal and his work. I cannot add anything to that, except to say that I believe that Indians in general and Indian agricultural scientists in particular owe much to Dr. Pal and a few other scientists who have followed his footsteps. Today, we bow to Dr. Pal for his contributions to Indian agriculture, our food security, or science, and to IARI itself for sure, and we also salute other giants of Indian agricultural research and education, some of them present here today, for giving us a much better platform to work from than they inherited. If India holds her head high today, for she has gone from being called a basket case in the 1960s to being called a bread basket at present, it is mainly because her agricultural scientists have had the benefit of wisdom, resolve, hard work, mentoring, and protection of strong hands of Dr. Pal, his students and followers.

Mr. Chairman and ladies and gentlemen,

Every day, agriculture produces an average of 2.4 crore tonnes of food, including almost 2 crore tonnes of cereals, roots, tubers, fruit and vegetables, 11 lac tonnes of meat, 210 arab litres of milk, 4 lac tonnes of fish, and almost 1 crore m³ of timber and fuelwood. The total value of that one-day of agricultural production is estimated at US$7 arab or roughly 4 kharab
and 20 arab Indian rupees. In addition to meeting humanity’s basic needs for food, feed, fibre and fuel, agriculture employs more than one in three of the world’s workers, and provides livelihoods for rural households totalling some 2.5 arab people. That is the science and profession we call home!

The world’s population is projected to grow from around 7.3 arab today to 9.3 arab in 2050. That population increase and the expected dietary changes associated with income growth indicate that, by 2050, agriculture will need to produce 60% more food globally, and 100% more in developing countries, if it is to meet demand at current levels of consumption. In the past, technological innovation and improvements in institutions have led to significant gains in agricultural production and productivity. Using high-yielding varieties, irrigation and high levels of chemical inputs, the Green Revolution boosted global agricultural production as much as threefold in 50 years, with only 12% increase in the farmed area. Crop production intensification not only allowed farmers to feed the world but, by saving crores of hectares of forests from conversion to farm land, it also saved an unquantifiable quantity of ecosystem services and avoided the release of an estimated 590 arab tonnes of carbon dioxide into the atmosphere.

However, the current trajectory of growth in agricultural production and productivity is unsustainable. In one day, crop production uses 74 kharab litres of water for irrigation, and 3 lac tonnes of fertilizer. Agricultural productivity growth rates of major food crops that averaged 3.2% per year in the 1960s are averaging 1.5% a year now. Agricultural land per capita that averaged 4.3 ha in 1961 will go down to 1.5 ha in 2050. The “negative externalities” of agriculture include land degradation, salinization of irrigated areas, depletion of groundwater, erosion of biodiversity, reduction of wildlife habitats, pollution of fishing areas, and overfishing of oceans. Agriculture has also damaged the wider environment through deforestation, the emission of greenhouse gases and nitrate pollution of water bodies.

Current food production and distribution systems are failing to feed the world. While agriculture produces enough food for 12 to 14 arab people, some 85 crore – or one in eight of us – live with chronic hunger. The vast majority of the hungry live in developing regions, where the prevalence of undernutrition is estimated at 14.3%. The main cause of hunger and malnutrition is not lack of food supply, but lack of access caused by poverty. Disproportionately, 60% of the undernourished are women, who make up 43% of the agricultural labour force and suffer deep discrimination in access to land and other resources.

Inadequate diets lacking in protein, vitamins and minerals have left one-third of the developing world’s population with micronutrient deficiencies which, if severe, can lead to blindness, mental retardation and early death, while 1.5 arab adults are overweight or obese and at greater risk of non-communicable diseases, owing to over-consumption of low-cost, high-energy and nutrient-poor foods. At the same time, enormous financial and environmental resources are being spent to produce food that is lost or wasted, currently at the rate of some 1.3 arab tonnes a year. Food losses and waste are indicative of poorly functioning food systems, represent wasted energy, water, soil and other resources, and generate methane emissions during disposal.
Agriculture impacts and is impacted by:

Land degradation and soil depletion

FAO projections indicate that 80% of the additional food required to meet demand in 2050 will have to come from land already under cultivation. Unfortunately, 33% of this land is moderately to highly degraded owing to the erosion, salinization, compaction and chemical pollution of soils. Drought and desertification are responsible for loss of about 1.2 crore ha of land each year.

Water scarcity and pollution

Agriculture uses 70% of the world’s fresh water, and with the rate of water consumption growing twice as fast as global population, agriculture’s share of water will be drastically reduced. Inefficient use of water for crop production depletes aquifers, reduces river flows, degrades wildlife habitats, and has caused salinization of 20% of the global irrigated land area. In about 11 more years, two-thirds of the world population is projected to live under conditions of water stress. The bulk of capture fisheries production comes from coastal waters, where both the productivity and quality of fish stocks are severely affected by pollution. Capture fisheries and aquaculture are also threatened by competing demands from hydropower development and water diversion for industrial uses.

Loss of living resources and biodiversity

Biodiversity is essential to the productivity and adaptability of species and to the sustainability of agriculture. Most of the world’s major crops and animal breeds have a very narrow genetic base. Up to 75% of the genetic diversity of crops has already been lost, and a study published in Nature in 2004 predicted that another 15 to 37% is “committed to extinction” by 2015. Deforestation poses one of the gravest threats to biodiversity, as forests harbour three-quarters of the world’s terrestrial biodiversity. Up to 22% of the world’s 8300 animal breeds are at risk and 8% are already extinct. In the oceans, close to 30% of stocks are overfished and 57% are fully exploited.

Climate change

Agriculture contributes significantly to climate change, which is the most serious environmental challenge facing humanity. About one-third of total global greenhouse gas emissions are produced by crop and animal production and forestry. Agriculture already suffers the consequences of climate change – rising temperatures, pest and disease pressures, water shortages, extreme weather events, loss of biodiversity and other impacts. Crop productivity is expected to decline in tropical areas, where the majority of the world’s food insecure and undernourished people live, with yields in Asia and Africa falling by 8% by 2050. Climate change will also increase market volatility, again affecting most those who are already vulnerable.

Stagnation in agricultural research and development

There is a growing divide between a small group of countries with high levels of investment in agricultural research and development, and a large number with very low
The impacts of the interaction between the two systems flow both ways. The natural system provides natural resources and ecosystem services such as climate regulation, nutrient recycling, biodiversity conservation, ocean and water cycles, and environmental health. Agriculture uses natural resources – land, water, biodiversity, forests, fish, nutrients and energy – to produce food, feed, fibre, fuel and other services to humanity. The production, distribution and consumption of agricultural products themselves generate social and economic services, including food security, economic growth and poverty reduction, health and cultural values.

Achieving sustainability in food and agriculture is envisioned as an ongoing process of identifying and striking a balance – between the needs of the human and natural systems, between agriculture's social, economic and environmental objectives, and between agriculture and other sectors of the economy. This implies a large, complex and dynamic set of interactions with multiple entry points. However, within this complex system of “moving parts” there are hard boundaries as well as soft constraints within which human and natural systems must operate in order for the overall process to be sustainable.

The relative importance of the economic, social, and environmental dimensions of human development will differ according to location and time frame. Approaches to sustainability must take account of a range of factors, from the relative importance of agriculture in national economies to the existing degree of intensification of agricultural production; from the constraints and opportunities that are determined by the availability of agricultural resources, to the needs of individuals in communities.

The configuration of sustainable agriculture and the means of stimulating sustainability processes will be necessarily different across varying conditions. As such, sustainable
Synergies between livestock and crop production are especially significant. Crops provide fodder and feed and contribute to sequestration of some of the greenhouse gases emitted by livestock. In turn, livestock produces manure that contributes to the productivity of crops and, by reducing the need for mineral fertilizer, improves sustainability. Manure can also be used to produce bioenergy, which reduces the need for fossil fuels in crop and aquaculture systems.

Sustainable intensification of crop and livestock production can reduce the need for additional land and with it the rate of deforestation. A number of productive mixed cropping and agro-forestry systems produce more food and feed from the same area of land, helping mitigate climate change through increased carbon sequestration and improving ecosystem services such as soil fertility.

Traditional aquaculture in rice-based farming systems in Southeast Asia boosts the productivity of rice by increasing nutrient availability to the plants. Rice-fish farmers generally enjoy higher incomes than those who produce only rice. The fish also provide a readily available source of protein, fatty acids and micronutrients that are especially needed by children and pregnant women, and biological control of mosquitos that transmit malaria. Although rice-fish systems may use more water than would be required for rice cultivation alone, the fish also feed on snails, weeds and insects in the rice fields, which reduces or eliminates the need for pesticides, which in turn protects water quality. Taken together with improved income, this is an example of synergy between sectors that improves livelihoods and promotes sustainability.

While in theory the idea is simple, maximizing synergies is complicated. Shifting from trade-offs to synergies requires knowledge of where synergies are possible, and political processes that support a shifting of benefits and costs across different groups locally and globally, and between the long and short terms. It also requires innovative technologies, multidisciplinary interventions, and institutions that are geared to capturing synergies rather than maximizing a single objective.

**KEY PRINCIPLES OF SUSTAINABILITY IN FOOD AND AGRICULTURE**

The vision of sustainable food and agriculture aims at realizing a world in which everyone is food secure and natural resources are managed in a way that maintain ecosystem functions to support future as well as current human needs. Numerous principles are embodied in international codes and standards for agriculture, science, good governance and equitable and sustainable development. We came up with five interconnected principles that consistently underlie governance and policies for the sustainable management and development of the natural and the human systems. They balance the social, economic and environmental dimensions of sustainability in agriculture, and provide a basis for developing policies, strategies, regulations and incentives to guide the transition to sustainability, while promoting resilience through an adaptive response to shocks and opportunities (Figure 3).
China, for example, the uptake efficiency of mineral fertilizer is about 26-28% for rice, wheat and maize and less than 20% for vegetable crops. The rest is simply “lost to the environment”, resulting in high rates of nitrate contamination of water.

A sustainable approach to crop production intensification seeks to harness the potential benefits of ecosystem services that can substitute for external inputs. For example, excessive use of nitrogen fertilizer is a major cause of water pollution. In addition, production of the estimated 11 crore tonnes of nitrogen used as fertilizer in 2013 required the use of some 96 crore m³ of natural gas, which adds considerably to greenhouse gas emissions. However, nitrogen can also be added to soil by integrating N-fixing legumes and trees into cropping systems. Since legumes fix up to 40 kg of nitrogen per hectare, their use as green manure on succeeding crops reduces the need for mineral fertilizer, produces good yields, and contributes to climate change mitigation.

Conservation agriculture also offers a means of enhancing resource use efficiency and mitigating climate change. Soil carbon sequestration, which transfers atmospheric carbon dioxide into long-lived pools and stores it securely, is enhanced by management systems that add large amounts of biomass to the soil, cause minimal soil disturbance, conserve soil and water, improve soil structure and enhance soil biological activity. Conservation agriculture practices, such as reduced or zero tillage, cover crops and diversified cropping systems, minimize soil disturbance, promote soil health and produce higher and more sustainable yields.

Currently, the livestock sector accounts for 14.5% of human-induced greenhouse gas emissions and significant growth in emissions is expected. The sector could reduce its emissions by 30% if producers adopted more efficient practices, such as using better quality feed and balancing livestock diets, improving animal genetics and health to reduce emissions per unit of production, recovering and recycling nutrients and energy contained in manure, and improving energy-use efficiency throughout the food chain.

The world’s marine capture fisheries are an underperforming global asset. The difference between the potential and actual net economic benefits from marine fisheries is in the order of 30 kharab rupees per year – equivalent to more than half the value of the global seafood trade. Overexploitation of capture fishery resources is found both in developed and developing fishing countries, regardless of their economic systems. Eliminating perverse subsidies and decreasing the number of fishing vessels and fishers globally would increase the profitability and sustainability of the sector provided social safety nets are put in place.

The role of research, development and innovation in the transition to sustainable agriculture cannot be overemphasized. Countries will need to assign very high priority to strengthening their agricultural education and innovation capacities, and ensure the availability of affordable technologies that are locally adapted.

Solutions to the problems of low productivity and degradation of natural resources are needed at large scale, but the replication of sustainable practices is constrained by the vast range and diversity of site-specific conditions. Linking local, national and international
research and site-specific extension services will be particularly important in promoting the adoption of technologies and practices that improve resource use efficiency. In developing countries, the transfer of relevant knowledge could be dramatically increased with better access to information and communication technologies. The potential of continuous and new developments in the field of ICT in raising the levels of efficiency and effectiveness is large.

**Principle 2**

*Sustainability requires direct action to conserve, protect and enhance natural resources*

While improved resource-use efficiency can help reduce pressure on ecosystems and natural resources, it also increases profitability, which can lead, in turn, to the expansion of production and a subsequent increase in resource depletion and degradation. The degradation of agro-ecosystems directly affects the food supply and income of the poor, increasing their vulnerability and creating a vicious cycle of poverty, further degradation and hunger. That is why direct action is needed to conserve, protect and enhance natural resources.

Protecting and restoring the ecosystems that naturally capture, filter, store and release water – such as rivers, wetlands, forests and soils – is crucial to increasing the availability of water of good quality. A recent study showed that, each year, the world’s tropical forests remove from the atmosphere 4.8 arab tonnes of carbon dioxide, or about 18% of annual emissions from burning fossil fuels. Reforestation and reducing the rate of deforestation are essential, therefore, to climate change mitigation and adaptation, as well as contributing to soil formation, water purification, biodiversity and pollination.

Strategies for conserving, protecting, and enhancing natural resources should be based on the specific resource constraints faced in any given location, as well as the current and desired improvements in the rate of depletion and degradation. Policies and institutions will need to be strengthened in order to provide the enabling environment and incentives for managing natural resources to reflect scarcities and their full ecological and social values. That can be achieved through a variety of means, including reforms to land tenure systems or the elimination of perverse subsidies on chemical inputs. Policy-makers can do much to promote sustainability by ensuring payment – especially to smallholders – for their environmental services, such as soil conservation and biodiversity protection. The appropriate mix of actions will depend on existing institutional infrastructure, since it will have an important effect on the costs and effectiveness of any one instrument.

Applying this principle calls for action within the sector as well as strong coordination with the authorities responsible for the environment at national, regional and international levels. Global instruments that have been adopted by many governments – including the Convention on Biodiversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and the IUCN Red List – provide for inter-country collaboration in the conservation of natural resources.
Principle 3

Agriculture that fails to protect and improve rural livelihoods and social well-being is unsustainable

Agricultural development is, by definition, unsustainable if it fails to benefit those whose livelihoods depend on it by increasing their access to resources and assets, their participation in markets and their job opportunities. Since 75% of the world’s poor live in rural areas, broad-based rural development and the wide sharing of its benefits are the most effective means of reducing poverty and food insecurity. The status of women, who make up the majority of the world’s hungry and have disproportionately low levels of resource ownership, requires special attention. With equal access to resources and knowledge, female farmers could produce enough additional food to reduce the number of the world’s hungry by 15 crore.

Institutional and policy reforms may be needed to increase rural people’s participation in agricultural development and to ensure that they enjoy its benefits. However, building an enabling environment that addresses both social and environmental issues – thus connecting principles 2 and 3 – presents major challenges. It may take several years to realize the benefits of sustainable agricultural production systems and, in some cases, there may be reductions in income over the short term, which poses a significant barrier to adoption by the poor. Likewise, low-income producers can be discouraged from entering “green” value chains, if standards and criteria are set too high. Policy and institutional responses are needed to reduce the trade-offs between social and environmental objectives.

Building the capacity, including the entrepreneurial and managerial capacity, of producers to participate in local, regional and international markets is essential. Higher rural incomes boost demand for local products and services which, in turn, stimulates business, generates employment and income, and alleviates poverty. Initiatives such as “local production for local consumption”, and government procurements from family farmers for school meals programmes, have been very effective in increasing production and income, while improving food security, in Brazil and other countries.

Principle 4

Sustainable agriculture must enhance the resilience of people, communities and ecosystems, especially to climate change and market volatility

Resilience has emerged as a key factor in sustainability. It is defined as the ability of a system and its component parts to anticipate, absorb, accommodate or recover from the effects of a hazardous event in a timely and efficient manner, by ensuring the preservation, restoration or improvement of its essential basic structures and functions. In the context of sustainable food and agriculture, resilience is the capacity of farming communities, households or individuals to maintain or enhance system productivity by preventing, mitigating or coping with risks, adapting to change, and recovering from shocks.

Phenomena such as extreme weather events and market volatility, as well as civil strife and political instability, impair the productivity and stability of agriculture, which in turn increases
uncertainties and risk for producers. Decisions made under conditions of poverty or crisis can have far-reaching consequences for households and communities. Individuals may lose their assets, such as land, trees, water or fishing rights, or overuse them or trade them in order to meet their immediate needs, despite the potential negative impacts on natural resources and on their own future. Policies, technologies and practices that build producers' resilience to climate change and market volatility would also contribute to sustainability. Resilience can be enhanced through co-constructed policies, strategies and plans, and measures such as flexible fishing strategies, the introduction of pest-resistant varieties and breeds, improved market governance, social safety nets, insurance and credit.

**Principle 5**

*Good governance is essential for the sustainability of both natural and human systems*

Good governance helps ensure social justice, equity and a long-term perspective on the protection of natural resources. When sustainability processes are dominated by abstract environmental concerns, without adequate attention to social and economic dimensions, they are unlikely to be implemented. A transition to sustainable agriculture that follows the five principles requires enabling policy, legal and institutional environments that strike the right balance between private and public sector initiatives, and ensure accountability, equity, transparency and the rule of law.

Broad consultation and transparent discussion will be needed to build consensus around sustainability objectives, the need for trade-offs and the means of mitigating them. Developing a broad agenda for sustainable agriculture will provide the basis for formulating policies and putting in place effective institutions, operational programmes and instruments, including legislation, that support the adoption of appropriate practices on the ground.

Institutional frameworks will need to ensure enforcement and compliance with requirements and commitments. Promoting and improving people's ownership of the natural resources they need and use, through appropriate rights allocation policies, and their full participation in decisions on their management, will contribute to the efficient use, conservation and protection of natural resources. The participation of women, who make up less than 20% of land holders worldwide, needs to be greatly increased.

Many countries will need to increase their participation in international governance mechanisms, and follow up on implementing international commitments.

The above principles are complementary – Principle 1 and Principle 2 directly support the natural system, while Principle 3 directly supports the human system; Principle 4 and Principle 5 underpin both the natural and human systems. For application of the five principles, a range of actions should be taken to enhance sectoral as well as cross-sectoral productivity and sustainability.

To be sustainable and productive, agriculture will need to adopt a single, systems vision that maximizes synergies, mitigates negative externalities and minimizes harmful competition.
between its sectors. The proposed approach, when properly localized, would help identify cross-sectoral synergies, negative externalities and actions that would minimize their impacts in the source sectors or mitigate them in the affected sectors.

1.1.1 Four areas of action

In order to identify issues and possible interventions, build partnerships and ensure buy-in from critical stakeholders, the application of the five principles described above requires four main areas of action: building relevant and accessible evidence; engaging stakeholders in dialogue to build common understanding and joint action; formulating tools and levers to enable and incentivize changes in food and agricultural systems; and changing practices. The exact steps needed will differ according to location and scale (community, national or global level). Coordination among the different scales—from global to local levels—is essential. The process is not necessarily sequential. Communication can take place between any two action areas at any time during implementation (Figure 4).

![Diagram of four areas of action]

Fig. 4: Operating sustainability: four broad areas of action

Mr Chairman, ladies and gentlemen,

Why many countries are lagging behind in prioritizing and implementing agricultural sustainability can probably be better understood by looking at those countries that are doing better. On the whole, countries that have made greater progress have a few things in common:

1. They are economically better off. A farmer would not hesitate chop down a tree to feed her or his hungry family. Farmers of rich countries have much less need to make such
stark choices. Rich individuals can afford to save for tomorrow and the next generation, and protect for the society. They can wait for the benefits to appear a little than the poor. So, the rich can afford to take a longer-term view. Unfortunately, for the poor, future is now and no later than today!

2. They are better informed. Their education level and technology access are higher. For example, they know well that higher net income does not necessarily mean higher production. That is applying more fertilizer and pesticides does not necessarily mean higher income; in fact it pollutes our air, water and soils. They are also able to better use market and weather information to protect their interests.

3. Natural resource and social pressures, including those of population, are lower. For example, they do not have to cultivate most of their arable land three times a year. Usually, they grow one crop a year which gives their soils and ecosystems time to recuperate.

4. Their farmers and consumers have higher government support, i.e., they have higher subsidies and better social support systems than people of others. Up to 70% of the income of milk and meat producers in Europe comes from subsidies. You have heard that a cow in Europe receives a subsidy of $2.20 or about Rs. 150 a day. Compare than with India or countries of Africa!

5. They are all higher on the list of Transparency International for good governance, i.e., there is more honesty and transparency in their governments. There is more trust and accountability among people, and between people and their leaders, and there is less corruption. Most of their funds go to projects they are destined for and good things get done – unlike in many other countries!

Now, is the case of poor and developing countries lost? To be sure, it is not. First, not all developing countries are equally poor or corrupt. They differ in their land and water resources, in the support they provide to their farmers and consumers, and they differ in the level of education, advocacy and efforts. So, some developing countries are doing better than others with agricultural sustainability. Then, a developing country is not uniformly corrupt or poor or ignorant. You can see right here in our own country that some states and communities are doing better than others. Many developing countries have better established and more capable national institutions, organizations, and NGOs working on agricultural sustainability. There are many international organizations (e.g., FAO, CGIAR, and others) working in and with developing countries on sustainability issues.

Since even before the UNCED report of 1987, UN has been actively advocating for sustainability. In 1992, the first United Nations Earth Summit in Rio de Janeiro, launched Agenda 21, which provided a framework for action by governments, the UN system and other multilateral organizations aimed at achieving a balanced and integrated approach to environment and development issues. In 2012, the Rio+20 Conference called for promoting, enhancing and supporting a more sustainable agriculture that improves food security, eradicates hunger and is economically viable, while conserving land, water, plant and animal genetic resources, biodiversity and ecosystems and enhancing resilience to climate change and
natural disasters. It also initiated the formulation of Sustainable Development Goals (SDGs) that would build on the Millennium Development Goals and be integrated in the UN’s Post-2015 Development Agenda.

At the Rio+20 Conference, the UN Secretary General launched the Zero Hunger Challenge, aimed at achieving 100% access to adequate food all year round, zero stunting in children less than two years old, the sustainability of all food systems, a 100% increase in smallholder productivity and income, and zero loss or waste of food.

UN organizations and agencies have also adopted a framework for advancing environmental and social sustainability, which calls for a common vision, rationale, objectives and indicators across the UN system. They will develop policies and strategies that embed a broad view of sustainability, avoid unnecessary trade-offs or harm to people and the environment, and systematically integrate environmental and social considerations in all programmes and projects.

Mr. Chairman, ladies and gentlemen,

Everybody knows that we cannot live without food and agriculture. Many also know that agricultural development is 2 to 3 times in reducing poverty and hunger as any other kind of development. If 75% of the world’s hungry and poor live in rural areas and derive their livelihoods from agricultural, agricultural development is clearly the obvious first choice to reduce global hunger and poverty. The only thing we have to do is ensure that agricultural development we pursue today “meets the needs of the present without compromising the ability of future generations to meet their own needs”, i.e., it is sustainable.

Agricultural development is country-specific and is achieved through right policies and technologies. Right technologies require sound agricultural education and research (which is in decline in much of the developing world), which in turn requires right policies and political commitment. Right kind of political support means, among other things, no political interference in agricultural education and research, respect for countries’ farmers and agricultural scientists, and financial support. Those countries that have got it right are way ahead of others in feeding their people and protecting their ecosystems. Countries that have got it partly right are still ahead of many. Those who have got it wrong must wake up now, before it is too late.

It is up to each country and community to recognize the importance of sustainable agriculture in alleviating hunger and poverty within its boundaries, and improving lives and livelihoods of its people. They must take responsibility and act; they have no time left to wait for others to do it for them.

Ladies and gentlemen, thank you, and my grateful thanks once again to Dr. H.S. Gupta and IARI for this opportunity of being with you today; and to Dr. Mangala Rai for chairing this session.