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An Analysis of Innovation and Green Growth Technology for Agriculture Development

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Abstract – Green growth is the pursuit of Agricultural growth and development, while preventing environmental degradation, biodiversity loss and unsustainable natural resource use. The aim is to maximise the chances of exploiting cleaner sources of growth, thereby leading to a more environmentally sustainable growth model.

Agriculture faces considerable challenges in implementing a green growth strategy. Anticipated growth in the demand for food and agricultural raw materials due to expanding world population and incomes will place considerable demands upon scarce natural resources, particularly land and water, used in the sector.

Policies introduced to address the emission of greenhouse gases (GHG) could have both an indirect and a direct effect on future agricultural growth. Agriculture has become increasingly dependent on purchased inputs, such as fertilizer and agro-chemicals, whose prices could be affected by economy-wide measures designed to reduce carbon emissions.

Organic agri-biotechnologies are environmentally safe, economically viable and socially replicable that promotes green growth and sustainability. It is the most modern as well as the most ancient method of low cost eco-friendly and sustainable agriculture. Organic agriculture is essentially an agriculture employing a knowledge/understanding of naturally occurring processes that ensures livelihood security, quality food and nutrient security. Organic farming maintains soil health, re-enlivens soil fertility and balances useful and harmful insect-pests ratio and thus produces tasty, nutrient rich food and fodder. About 74% farmers in India are small and marginal farmers and more than 55 per cent of the net sown area of the country is rain-fed, organic practice is most relevant to them.

For many years, the international community has approached environment and development challenges through the lens of sustainable development—usually conceived as meeting the needs of the current generation while not sacrificing the ability of future generations to meet their own needs. Though this approach has been constructive and successful in many ways, it lacks a clear pathway for how to realize those goals.

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INTRODUCTION

Green growth" seeks to establish pathways for sustainable development through a combination of private sector innovation and engagement within a supportive national and international policy context. It aspires to tackle three challenges simultaneously: encouraging development and poverty reduction; creating new and more vibrant economies based on clean technologies; and securing an increasingly greener world. Of course, tackling such challenges as climate change, energy access, environmental degradation, sanitation and water availability while achieving economic and development goals will require unusually creative approaches based on new and profitable business models, novel approaches to financing and innovation in both U.S. and global institutions. Though not sufficient in isolation, green growth innovation will enable the advances toward goals in human health, natural resource sustainability and social equity. Countries can also benefit from cultivating new green industries as a matter of domestic economic policy. Innovations in green technology therefore represent potentially transformational approaches to some of the world's thorniest development and environment challenges—but realizing that potential will require creative approaches for vibrant private sector engagement.

The emergence of the concept of Green Growth marks a shift in the paradigm for economic progress to an approach which emphasizes environmentally

sustainable development. Traditional economic models have tended to treat environmental protection as an economic burden which detracts from or slows growth. The Green Growth model recognizes that steps to protect and conserve environmental resources can be a driver for national and global economic progress. Future economic growth will itself be put at risk if the Green Growth paradigm is not put in place. The principle obstacle to Green Growth is not an inherent tension between economic and natural systems, but the political economy of change and the need to address the environmental consequences of current economic development patterns.

The realization of Green Growth depends on policies which spur economic development and job creation which devise value-added from the environment. This requires longer-term policy perspectives rather than the current stress on short and medium-term results as well as adjustment strategies to manage the successful transition to low-carbon, resource-efficient economies. Green Growth also demands policy coherence across economic, environmental and sector interventions. A broad range of government and corporate departments should be involved in implementing Green Growth policies and approaches rather than stand-alone environmental agencies or business units.

A primary conceptual change in the Green Growth policy paradigm is the need to transform production and consumption patterns from resource intensive processes to eco-efficient and low-carbon trajectories. Current OECD environmental policies have been relatively successful in addressing pollution, including through end-of-pipe and more integrated processes, and encouraging the adoption of life-cycle perspectives. However, more efforts are needed to alter fundamental patterns of economic activity in order to decouple growth from environmental degradation and to support the expansion of commercial eco-industries and eco-services. In developing countries, realizing significant gains in material living standards without imposing excessive burdens on environmental carrying capacity is the primary goal.

Green Growth is a concept that brings together a suite of policies to promote a transformation of consumption behavior, industry structures and technologies. This involves regulatory and fiscal measures to reduce the energy and carbon intensity as well as the land and water intensity of production and consumption in all sectors. Green Growth policies also seek to stimulate investments and steer spending towards clean technologies, renewable energy, water services, green transportation and infrastructure, waste management, and bio-based businesses.

In the Green Growth paradigm, traditional economic and environmental measures of progress are replaced by indicators of the linkages between the use of environmental goods and services and economic growth. Green Growth calls for a focus on qualitative growth rather than measuring success based on traditional economic indicators such as gross domestic product (GDP) or economic productivity. Interrelated indicators of economic progress, environmental sustainability and social welfare are needed. In agriculture and other sectors, progress on Green Growth is measured by the ability to contribute to social well-being by providing sufficient goods and services in ways that are economically efficient and environmentally beneficial.

Moving towards greener growth in the agricultural sector will involve both synergies and trade-offs which will change over time. The implications of Green Growth for agriculture and the contributions of agriculture to Green Growth can be reciprocal or incongruent. Table 1 gives a broad view of the possible synergistic and conflicting effects of Green Growth on agriculture across and within the different pillars of sustainability: economic, environmental and social. In the cells on the main diagonal, the two perspectives are mutually reinforcing as indicated in the positive sign. Policy pairs below the main diagonal may work against each other particularly in the short-term (negative sign), while paired interventions above the main diagonal are mutually enhancing (positive sign).

In the short-term, Green Growth policies which place a premium on environmental protection may constrain agricultural output, reduce global food security and entail adjustments in the use of human, financial and natural resources. The implications of Green Growth for agriculture in the longer-term are mutually-reinforcing in terms of environmental sustainability, economic growth and social well-being. The complementarities and differences between Green Growth and agriculture are reviewed in more detail below in terms of traditional economic factors (i.e. productivity, farm incomes, employment) and environmental factors (i.e. natural resource use, pollution, biodiversity) as well as broader social factors (i.e. food security, poverty reduction, rural development). While this report discusses Green Growth with a focus on primary agriculture, there is a much longer agro-food supply chain including processing and distribution which has Green Growth implications. The end results will depend on the policy instruments adopted and the structural adjustment measures which are put in place to ease the transition to a greener agricultural sector.

	Economic Contribution of Agriculture to Green Growth	Environmental Contribution of Agriculture to Green Growth	Social Contribution of Agriculture to Green Growth
Economic Contribution of Green Growth to Agriculture	Agriculture is the basis of economic development while Green Growth can improve agricultural performance (+)	Green labels and eco-services can contribute to economic returns in agriculture (+)	Green jobs and activities can diversify and contribute to rural development (+)
Environmental Contribution of Green Growth to Agriculture	Environmental measures may slow agricultural growth in the short-term (-)	Green Growth will yield environmental co-benefits in agriculture through resource conservation and carbon sequestration (+)	Reform of supports to relieve environmental stress can promote more equitable farm incomes (+)
Social Contribution of Green Growth to Agriculture	Green Growth may detract from efforts to improve food security in the short-term (-)	Green Growth will necessitate structural adjustment measures in transition periods (-)	Food security, poverty reduction, and rural development will be enhanced through Green Growth (+)

Table 2: Agriculture and Green Growth: Complementarities (+) and Differences (-)

GREEN TECHNOLOGY AND THEIR INTER-LINKAGES

Studies have shown that energy costs would become the second highest cost in 70% of the world's data centres by 2009. In tomorrow's world, businesses that ignore environmental impact and don't reform business processes and working practices will be less credited.

For several environmentally-sensitive projects, the environmental impact assessment have been made mandatory by the respective governments to identify, estimate, evaluate and mitigate the biophysical, social, and other relevant effects of development projects.

The wastewater and sewage disposal has been major threat to human health in developing Asia. The liquid waste discharged by domestic residences, commercial properties, industry or agriculture generates potential contaminants and concentrations that to some extent is minimised or recycled in the developed world. It necessitates the adoption of available and affordable technology for renewable energy including sunlight, wind, rain, and geothermal heat, which are naturally replenished. The technologies that are available are solar power, wind power, hydroelectricity/micro hydro, biomass and biofuels for transport. The importance for considering primary energy use (includes both renewable and non-renewable energy contained in raw fuels) is because about 13 per cent of world's primary energy comes from renewable sources, most of which comes from traditional biomass like wood-burning. The understanding of these energies helps us devise policies for sustainable development, which includes environmental sustainability, economic sustainability and socio-political sustainability.

Environmental technology is the key to conservation ecology, a science of protecting biological diversity. Conservation ecology also termed as conservation biology refers to the application of science to the conservation of genes, populations, species, and ecosystems. The laws and regulatory measures are in operation to restrict activities that causes damage to habitat or wildlife by setting aside wildlife reserves, parks and other conservation areas. In conservation, sustainable development is allowed, however, under preservation, it is completely the restriction.

Technology for Environment-friendly Agriculture - Widespread environmental degradation, severe poverty around the globe and the burning concerns about achieving and maintaining good quality of life were the principal factors for taking interest in intergenerational equity, in relation to access to natural resources. As most good agricultural land has already been farmed and the region have exceeded the safe limit, primarily in Asia, the natural resources availability for further farming expansion is practically exhausted. Data shows agricultural land being increased by 13 per cent in the last 30 years at the expense of lowland forests and their rich biodiversity.

Green Technology and Rural Environmental Concerns - The major question today is to devise the technology that will save the environment without sacrificing growth. In the developing countries, majority live in rural areas and environmental degradation is more pervasive because of rapid deforestation, watershed degradation, loss of biological diversity, fuel wood and water shortages, water contamination, soil erosion and land degradation.

GREEN GROWTH INNOVATION

As a result of more widespread economic development in recent decades, global capacity for research and development is evolving broadly across the developed world and emerging economies. However, building on this progress will require action to encourage new ideas across the diversity of development contexts, and to ensure that these ideas can reach and transform new markets. The challenge of transitioning onto cleaner development pathways is particularly difficult for developing countries because their need for rapid economic growth often seems to outweigh the importance of “leapfrogging” onto cleaner development trajectories. Achieving sustainable economic development will require regional and international cooperation for implementation, supportive domestic policies, institutional capacity building, strong public–private partnerships, long-term financing and human capital development. In parallel, new mechanisms are needed to support the development and diffusion of intellectual property that can be shared with, and created in, developing countries along with enforcement mechanisms for its protection. Many existing initiatives have been launched to support this goal, but they have not achieved scale nor are they expanding at a rate sufficient to tackle the challenges.

Innovation for green growth can be characterized as frontier, adaptive or absorptive. Frontier innovations are novel solutions that have not yet been introduced to the world. They are typically adopted in the research phase of the technology development cycle. Adaptive innovations are modifications to existing technology

that make them more useful in alternative situations. They can occur across the technology development cycle. Absorptive innovation refers to changes to an institutional environment that makes the transfer, successful implementation of, and learning from frontier and adaptive innovations easier. This applies to the final two stages of the development cycle. Examples of this type of innovation include in-country infrastructure for knowledge and device diffusion, regulations to support intellectual property (IP) protection, and international agreements for technology transfer.

When the term “innovation” is applied to technological change, it is often conceived of as a change to a product or service—for example, a higher-yielding seed or a more efficient delivery system—but it can also describe improvements in business models or a process change. When applied to a process change, however, innovation for technological development has perhaps its greatest potential for creating an impact because it creates an environment supportive of continuous idea generation and capacity for research and development (R&D). This, in turn, creates opportunities for commercialization and financial sustainability. In contrast to many preconceptions about innovation and technology, it is important to consider all types of clean technology R&D—frontier, adaptive and absorptive—across development contexts, and by extension to consider the approaches that might accelerate each.

ECO-FRIENDLY TECHNOLOGY

Organic farming is a Green Technology (GT), environmental healing technology that reduces environmental damages, which contributes to both poverty reduction and sustainable agricultural development. In the long run organic farming will secure the future for sustainable farming.According to public perception, organic food is the healthy option. Sales of organic produce have rocketed over the past few years with the organics industry sending out messages of safer, healthier food created by farming practices which are better for the environment. Organic farming communitybelief that it minimizes the need for chemical inputs thereby limits damage to health and the environment. It is a more sustainable method of farming than conventional techniques. Intensive farming is said to destroy the fertility of the land, but with organic farming and sustainable crop rotations, soil health is improved. In particular, lack of sufficient amount of bio-composting and non-availability of bio-fertilizers in local market further constrain organic producers (Gill et al., 2000).Modern-day need is to achieve sustainable agriculture that obtain higher yield and increase income without affecting the environment.

METHODOLOGY

The study is based on both the primary and secondary sources of information. Data collected through field visit and information generated from focus group discussions on green technology is primary source of information. The literature reviewed and stated in the text of the report is the basis for secondary source.

The feasibility study attempts to identify the gaps, if there are any, in the application of Green Technology and attempts to justify their feasibility based on the results from experiments through agricultural and environmental technologies. To do this, following activities are carried out; As reliable data on emerging technologies for sustainability assessment are still inadequate, the recommendations are largely based on qualitative methods and on an operational definition of sustainability using priority indicators.

Selection of Technology - In general, the seven criteria have been proposed to judge the appropriateness of technology. The issues have been analysed in the present study by linking the strength or weaknesses of the stated technological applications to find out if they help in meeting the stated objectives. In other words, the current study attempts to use most of these criteria while assessing the technology for sustainable development.

Situation Analysis - The situation analyses of selected technologies in selected countries are made to find out how they are working, what are the costs and benefits and how the system can be sustained. In our analysis following factors are considered;

a) Current Performance: Performance of the technology is explained on the basis of their success and failure stories. The current performance has also been assessed on the basis of percentage share of population adopting particular technology.

b) Policy: Current government policy towards such technology has been identified. The review of selected regulatory measures in the chosen countries is made to find out their strengths and weaknesses to facilitate GT initiative and recommendations are made to develop favourable regulatory frameworks for the further development of GT.

c) Cost-Benefit: Cost-Benefit analysis of the technology has been carried out. A detailed cost-benefit analysis with valuation in quantitative technique is not possible due to time constraint. So components of costs and benefits along with risk factors and externalities have been identified.

d) Performance Indicator: The performance and sustainability of the technology has been reviewed. Therefore, the operational, technical, economic and environmental aspects of the selected technology have been considered.

Expected Output - The study involves consultation with stakeholders, community, users, and others to properly assess the overall value of the application of GT. The extension of environmentally sustainable conservation agriculture through awareness creation in agronomic, economic and environmental benefits is achieved through interaction amongst agricultural experts, administrators/policy makers and farmers. The situation analysis of GT in general in the APCAEM region and evaluation of the good practice model of the application of GT in selected areas in the proposed countries, namely; India is expected to have produced the practical guidance for policy decisions in the subsequent phase (II) of the project with regards to the development and delivery of best practice model.

CONCLUSIONS

The review shows when used correctly agro-environment-friendly technology has promoted sustainable agriculture growth and reduced widening rural-urban income disparities. The application of green technology is the answer for sustainable development but poor countries have not been able to use applicable technology largely because of their inability to afford to the available alternatives.

The present study shows adoption of Green Technologies have increased agricultural output without depleting presently available resources beyond the point of recovery. Though selection of technology is by default condition dependent one or the other renewable energy technology and green agriculture strategy can in all circumstances be pragmatic. Interlink ages of technologies with society should be deliberated in advance to access their roles in achieving the expected outcomes.

Biodynamic is an innovative & activated organic farming system that has significant role to play in the areas of sustainable agriculture with emphasis on ecological conservation and renewable resources. The degenerative effects of intensive farming practices on soil fertility and ecological balance are surfacing which needs immediate attention for sustaining the productivity rate.

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