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1. INTRODUCTION

Although the U.N. Framework Convention on Climate Change (FCCC) has been signed and ratified by 168 countries, global greenhouse gas (GHG) emissions have increased substantially since the 1992 Rio Summit. In both developing countries (DCs) and industrialized countries (ICs), there has been a need to find mechanisms to facilitate environmentally sound mitigation strategies. This need led to the formation of Activities Implemented Jointly (AIJ) at the first Conference of the Parties (COP) in 1995. In Article 4A, para 2D, the COP established an AIJ pilot phase in which Annex I (IC) countries would enter into agreements to implement activities jointly with non-Annex I parties. DCs would engage in AIJ on a purely voluntary basis and all AIJ projects should be compatible with and supportive of national environment and development goals. AIJ does not imply GHG reduction commitments by DCs. Neither do AIJ projects undertaken during the pilot phase qualify as a fulfillment of current commitments of Annex I parties under the COP. The current pilot phase for AIJ ends in the year 2000, a date which may be extended.

Current AIJ activities are largely focused on the energy sector. The Nordic countries, for example, feel that the most important potential areas for cooperation in AIJ are fuel conversion, more effective energy production, increased energy efficiency, and reforms in energy-intensive industry (Nordic Council of Ministers, 1995). Denmark does not want to include non-energy sector projects such as carbon sink enhancement projects in the pilot phase (Nordic Council of Ministers, 1995). However, other countries, including the US, have already funded a number of forestry sector projects (Development Alternatives, 1997). Moreover, energy-sector projects involving high technology or capital-intensive technology are often a source of controversy between DCs and ICs regarding the kind of technology transferred and sharing of costs and benefits. There are good reasons to explore the non-energy sectors (in this report, non-energy refers largely to land-based activities), particularly the forestry sector:

- large potential for mitigation (Brown et al, 1996),
- low cost (Ravindranath and Somashekar, 1995),
- high local socio-economic and environmental benefits (Ravindranath and Somashekar, 1995), and
- minimal technology transfer involved, thus less controversial.

Further, the pilot phase provides an opportunity for capacity-building and learning about methods of planning, implementation, and monitoring of GHG abatement in land-based non-energy sector projects.

AIJ in the non-energy sector:

Many DCs, including India, have not formulated guidelines and criteria for processing AIJ projects because of the many apprehensions and concerns regarding technology transfer, costs, and fear of reducing their low-cost options. India has a vast potential for mitigation in the land-based non-energy sector: over one-half a million villages use nearly one-third of the total electricity generated with a potential to shift to decentralized bioenergy options (Ravindranath and Hall, 1995) and vast degraded lands amounting to 66 to 130 Mha ripe for forestry mitigation projects (Ravindranath and Somashekar, 1995).

Methods of monitoring the GHG balance and of estimating the costs and benefits are believed to be more complex in the non-energy sector than in energy sector. The emissions or sequestration rates vary from location to location depending on altitude, climate, soil, anthropogenic pressures, vegetation types, rates of extraction, and cultivation practices. **Gestation periods** involved can also be very long; for example, soil carbon accumulations or emissions take place over decades. It is precisely because of these complexities that there is a need to initiate land-based AIJ projects in the pilot phase, to enable IC as well as DC partners to start the process of capacity-building and standardization of methods of monitoring. The authors of this report disagree with the views of some analysts who suggest that forestry projects should not be included in the pilot phase (Culpeper and Parikh, 1997). After all, the pilot phase is meant to be a learning phase.

Before global negotiations progress further, it is necessary for countries such as India with their vast mitigation potentials in the non-energy sector to gain experience in evaluating project proposals, implementing the projects, monitoring the GHG balance, and estimating the costs and benefits—both local and global. This would help the donor and particularly recipient countries in future global negotiations.

In this paper, the opportunities and concerns from the perspective of developing countries, particularly that of India (as perceived by the authors), with respect to AIJ are presented, followed by three examples of non-energy sector project proposals. Finally, the concerns are reconsidered with reference to the three case studies and conclusions and closing suggestions presented.

1.1 The Pilot Phase of AIJ

The broad aims of the pilot phase of AIJ, according to the COP, are to be supportive of national environment and development priorities of DCs, to contribute to the cost effectiveness of achieving global benefits in mitigation of climate change, and to attract financing other than normal Overseas Development Assistance (ODA) flows.

Some AIJ funds may simply be reallocated ODA funds. There is a need to recognize the financial additionality requirement of AIJ projects, over and above the baseline costs. However, many private investors are now recognizing the new opportunities in the field of environmentally sound activities. The exact nature of these new kinds of environmental partnerships is a central concern of DCs and will be worked out through the AIJ phase.

1.2 Current Status of AIJ Pilot Phase

Since the inception of the AIJ pilot phase in 1995, 74 projects worldwide have received official government approval (Development Alternatives, 1997). Of these, majority are in Central America, followed by in Eastern Europe and the former Soviet Republics, South America, Africa, and Asia. Clearly, there is a need to involve the large Asian, South Asian, and South East Asian countries in AIJ if the concept is going to be tested realistically. The types of projects funded are: energy-efficiency improvement, fuel-switching, renewable energy and afforestation and reforestation The main investor countries are the US, Germany, Netherlands, Norway, and Australia (Development Alternatives, 1997).

1.3 Perspectives of DCs

India's perspective can be gauged by the statement of the Indian Minister for Power and Non-Conventional Energy, who, in his inaugural address to an AIJ meeting, argued that in AIJ there is compatibility between the need for national development and the need for cost effectiveness in achieving global benefits. He said that these two imperatives are mutually harmonious and provide scope for the north and the south to work together. He argued that each of the economic sectors should have at least a few AIJ projects and that until this is done the very purpose of the pilot phase for learning and capacity-building in the developing countries will not be achieved (JI Quarterly, 1997). The reasoning behind the Minister's statement is that India should gain experience in different sectors such as energy, forestry, and agriculture. Many other DCs view the pilot phase of AIJ as a learning process too, focusing on attracting investments in renewable energy, energy-efficient technologies, forestry, biomass generation, and agro-forestry. DCs like the Philippines and Zimbabwe feel that AIJ should lead to appropriate kinds of technological exchange, the building of institutional capacity, and the flow of investments in renewable and energy-efficient technologies (Development Alternatives, 1997).

2. OPPORTUNITIES AND CONCERNS OF DCS: THE INDIAN PERSPECTIVE

2.1 Opportunities

2.1.1 Investments

AIJ can be viewed as an instrument to attract new private capital flows into priority sectors. These additional investments would come **without new debts** (Chatterjee and Fecher, 1997). One of the real opportunities of AIJ is to divert a significant part of private investment flows which are already taking place from ICs to DCs into environmentally and socio-economically beneficial projects in DCs. By demonstrating to the private investor community the range of attractive economic activities in DCs which also provide global environmental benefits, AIJ serves as a mechanism for increasing investment for sustainable development in DCs.

2.1.2 Grants

Some environmentally beneficial activities may not be candidates for commercial projects; for example, small-scale bioenergy, carbon sequestration, forest conservation, and methane emission reduction practices in rice cultivation and livestock rearing. These activities have not attracted commercial investment. AIJ in this case can act as a mechanism for channeling government and private sector grants into environmentally sound, non-commercial projects that have multiple global and local environmental benefits (Parikh, 1997).

2.1.3 Technologies

DCs need advanced, efficient, and environmentally sound technologies in many sectors. AIJ could provide an opportunity for DCs to obtain this technology at low cost. AIJ could also promote technology exchange among the southern countries, particularly in non-commercial activities.

2.1.4 Capacity-building

Under the FCCC as well as in the future, DCs will be participating in conferences and negotiations, formulating strategies and policies, implementing climate change mitigation projects, and monitoring mitigation projects. Experience gained in AIJ planning, implementation, and monitoring will assist in capacity-building in DC governments and other institutions—both private sector and non-government organizations (NGOs).

2.2 Opportunities for AIJ in the Non-Energy Sector

Energy, or the fossil-fuel sector, is the dominant sector contributing to GHG emissions and thus currently funded AIJ programs and projects generally concentrate on this sector. But DCs could also look at climate change mitigation projects as opportunities to promote socio-economic development in an environmentally sound way. One of the goals for DCs is to alleviate poverty and increase biomass availability for sustainable development. **The global capital flows ,** however, are largely focused on promoting conventional fossil fuel-based technologies. Poverty in rural areas in India is increasing, but investment in biomass generation is of relatively lower priority compared to investment in the modern fossil-fuel sectors (Planning Commission, 1992). India is facing severe shortages of fuelwood, industrial wood, and even sawn timber, leading to increased pressure on forests and timber imports. Investments in forestry and other land-based activities have been inadequate to alleviate these problems.

In the energy sector, India aims to initiate steps for fully meeting the basic energy needs of rural and urban households so as to reduce the existing inequities in energy services. However, national plans call for meeting the demand with coal-based power and petroleum in the short and medium term (Planning Commission, 1992). In the long term, it is committed to promoting an energy supply system based largely on renewable sources of energy. In rural areas of India, sustainable biomass-based bioenergy systems have a large potential to meet all the cooking energy requirement (through biogas systems) and electricity requirement (through decentralized biomass gasifier systems)—providing significant GHG emission reduction benefit (Ravindranath and Hall, 1995). By increasing biomass availability through a variety of opportunities, the present unsustainable trends in biomass extraction can also be reversed—with global benefits.

AIJ could be viewed by DCs as a mechanism offering incentives to private investors, farmers' cooperatives, NGOs, utilities and others to undertake programs in forest conservation, forest regeneration, biomass production, and bioenergy sectors. Numerous studies have shown that these activities (see case studies below) offer a 'win-win' situation (Ravindranath and Somashekar, 1995; Ravindranath and Hall, 1995). Forest plantations, bioenergy, and agro-forestry options are low-cost mitigation options which provide significant economic benefits to local partners (Ravindranath and Somashekar, 1995). The technology and expertise is largely available regionally in countries such as India and China. The key issue now is how to interest more IC companies in investing in land-based activities in DCs. AIJ could be a mechanism to persuade such actors of the global need for such investments.

2.3 Concerns about AIJ from the DC perspective

2.3.1 Sharing of Credits

In DCs, a large potential exists for efficiency improvements—clean coal technologies, low CO_2-emitting systems, CO_2-neutral technologies, CO_2 sequestration, forest carbon sink conservation, and a great number of renewable energy options. This large potential is due to the obsolete energy technology and systems in existence, large-scale deforestation, low efficiency of use of fossil fuels (and fuelwood), and growing levels of energy demand.

In an unequal world, any sharing arrangement between the wealthy and poor countries tends to be viewed with suspicion by the latter because of the likelihood that the project will end up favoring the rich or donor country, contributing disproportionately to their global agenda. One of the common arguments is based on the fears that the introduction of AIJ may be an excuse for the OECD countries to take no action at home, and that AIJ will not solve the larger problem, namely, the OECD countries' continued non-sustainable use of energy and the resulting major emissions of GHGs (Nordic Council of Ministers, 1995). Even though under the pilot phase of the AIJ, no credits shall accrue to any party as a result of reduced GHG emissions or sequestered carbon, many countries, including India, are skeptical about the issue of sharing GHG credits even in the future. Studies have shown that the cost of obtaining carbon emissions reduction or sequestration is lower in DCs than in ICs (Chatterjee and Fecher, 1997). Thus IC industries, utilities, and governments may look for opportunities to obtain carbon credits at low cost in DCs in the long term.

In OECD countries, shifts to energy-efficient systems is an ongoing process, initiated largely due to factors such as costs and local pollution control regulations. Under the FCCC, the ICs or Annex I countries may have to be the first to reduce or stabilize their emissions to 1990 levels. During this phase, in the process of obtaining foreign funds and technology, DCs fear that they may commit a part of their potential low-GHG-emitting options long before the start of their own legal FCCC commitment. The general opinion among the DCs is that Annex I countries must demonstrate their commitment to the global environment by shifting to environmentally sound technologies in their own countries instead of employing the easier option of abating GHGs in DCs at a much lower cost (Development Alternatives, 1997).

2.3.2 Transfer of Obsolete Technology

DCs fear that ICs may transfer environmentally unsound technologies no longer wanted by their own industries to DCs (Development Alternatives, 1997). Such technologies might include decommissioned nuclear reactors and other polluting equipment.

2.3.3 Transfer of High-cost Technologies

Some of the low-CO_2-emitting technologies to be transferred to DCs are likely to be high in cost. One example is the promotion of solar photovoltaics (SPV) in many DCs. SPVs bought from ICs under concessional loans are being disseminated in DCs at highly subsided prices, with the local governments bearing the cost of subsidy. **The priority of many DCs should be to provide quality energy services such as electricity, cooking gas, and faster transport at as low a cost as possible in a sustainable way.** By some, AIJ is considered a vehicle to transfer high-cost technologies to DCs or to create a market for such technologies in DCs through concessions made during the pilot phase (Puhl, 1997).

2.3.4 *Absence of Local Concerns*

Under AIJ, some of the technologies transferred or programs implemented may not have any regard for local environment and local needs. National governments, in their eagerness to acquire foreign currency or grants, may accept such projects and even implement them.

2.3.5 *Short Time Horizon for Pilot Phase*

The pilot phase period of four years is too short for any significant learning to accrue. For example, forestry projects require a long time to have any impact on the C stock and flows in the area and for monitoring the changes in carbon flows.

2.3.6 *Inadequate Consideration of Macro-economic Impacts*

It is likely that while preparing specific AIJ projects, the macro-economic linkages and impacts will not be considered—either by the donor or the specific recipient agency. In some situations, this could have significant negative macro-economic impacts, such as:

- outflow of foreign exchange (e.g., import of SPVs for rural electrification),
- excessive dependence on imported technologies and capital, and
- distortions in markets: over-production leading to market surplus and price declines.

For example, the expanded planting of eucalyptus trees in North West India, carried out without adequate attention to market impacts, led to excessive supply and price declines (Saxena, 1992). A large-scale expansion of teak plantations, implemented without proper consideration of existing and projected demands as well as marketing arrangements, could result in a disastrous decline in prices—permanently damaging timber production programs.

Because of concerns such as those discussed above, countries like India have not formulated guidelines and criteria for evaluating and accepting AIJ proposals, even though they are committed to the pilot phase.

3. CASE STUDIES OF NON-ENERGY (LAND-BASED) AIJ PROJECTS

The following three land- and biomass-based project concepts are potential AIJ projects and are being actively considered for submission to the AIJ process. The concerns expressed above are considered again in the context of the three case studies in the final section of this report.

The COMAP model was used for the assessment of the mitigation potential and cost effectiveness of these projects (Sathaye et al., 1995). Table 1 lists the basic features and data for the three proposals. Table 2 presents the mitigation potential and cost-effectiveness parameters for each project.

Proposal 1: Bioelectricity for Rural Electrification, Fossil Fuel Substitution, and Carbon Emissions Reduction

Proposal 2: Teak Plantation for Carbon Sequestration

Proposal 3: Agro-Forestry for Raising Fruit Trees and Carbon Sequestration

Table 1. Area to be covered under the three AIJ projects and other details of the projects.

	Teak	Agro-forestry	Bioelectricity
Area to be Planted (ha)	1000	1000	500
Phasing of imple-mentation years (ha)	250 ha/yr x4	250 ha/yr x4	250 ha/yr x2
Baseline Scenario C pool-vegetation i) tC/ha ii) C pool – soil tC/ha	 5 40	 5 30	 5 40
Mitigation Scenario i)Rotation (years) ii) Mean Annual iii) Increment I iv) (t/ha/yr)	 25 6	 30 4	 6 10
Soil C uptake tC/ha/yr	2	2	2
Species mix	Teak	Tamarind & teak along the plot borders	Fast-growing coppicing tree species such as eucalyptus

Table 2. Mitigation potential and cost effectiveness of the proposed projects

	Units	Teak	Agro-forestry	Bioelectricity
C abated over total area for the project period (total incremental C pool)	t C	145600	118975	61964
Cost benefit analysis, NPV of financial benefits	$/tC $/ha	23.3 3391	96.5 11,479	5.8 720
Initial cost or investment cost	$/tC $/ha	15.1 2194	5 600	3.8 466
Aggregate life-cycle cost	$/tC $/ha	28.8 4203	7.9 945	7.5 936
Total investment required for the project	$	2194000	600000	5233000
Total life-cycle cost	$	4203000	945000	5468000

Bioelectricity project proposal along the lines presented here is likely to be submitted to USIJI by a company or a NGO in South India. The teak plantation project proposal has been submitted to USIJI as well as Government of India by two plantation companies in Tamil Nadu state in India. The Agro-forestry project proposal was submitted to USIJI and it has been given preliminary approval by the USIJI and it is awaiting approval of the government of India.

3.1 Bioelectricity for Rural Electrification, Fossil Fuel Substitution, and Carbon Emissions Reduction

3.1.1 Introduction

Country situation: Rural populations dominate the developing countries of Asia, accounting for over 70% of the total population. Currently they are poorly served with electricity. In most countries, the extent of rural electrification is low. In India, even though over 80% of villages are electrified, less than one-third of rural households are. With economic growth, demand for electricity in rural areas is growing, currently accounting for one-third of the total electricity generated in India.

- Sectoral goals: The goal for the electricity sector in India is to electrify 100% of the villages by the turn of the century. The national plan highlights the need to initiate action for accelerated development of renewable energy and decentralized energy technologies in the medium term and the need to promote a shift towards an energy supply system based on renewable energy sources in the long term (Planning Commission, 1992).

- Current plans and programs: In India, coal-based power generation accounts for nearly 70% of total electricity. Large-scale expansion of hydroelectric systems is limited due to the absence of suitable locations, environmental problems (land or forest submergence and loss of biodiversity), and socio-economic problems (displacement of communities, high cost of resettlement). Nuclear energy has a very limited potential due to its high cost and waste disposal problem. Thus India has few **conventional** options other than coal-based power generation to meet the large growing demand. According to one estimate, coal consumption is projected to increase from 217 Mt in 1991 to 648 Mt by 2009 (TERI, 1992).

- Carbon emissions: Carbon emissions from coal combustion in power plants are projected to keep pace with increases in coal combustion. C emissions will also result from combustion of petroleum fuels for power generation and shaft power applications (such as diesel pumps for irrigation water lifting). Coal-based power generation is also associated with a number of other environmental hazards such as ash generation, deforestation, water pollution (from coal mines operation), and local air pollution.

- Need for C abatement option: To reduce C emissions and to overcome local environmental problems, there is a need to shift to renewable energy options for power generation. Biomass-based electricity, generated from a sustainable wood supply, is a C-neutral option for power generation, leading to no net C emissions. Further, there will be a net reduction of C emissions when bioelectricity is used to substitute for electricity from coal-fired power plants.

- Potential and scope for bioelectricity option: Currently, nearly one-third of electricity generated in India is used in rural areas. Bioelectricity has been shown to be a feasible option to meet all the current and projected rural electricity requirements—about 100 TWh annually (Ravindranath and Hall 1995).

- Potential for mitigation: Every MWh of bioelectricity generated and used to substitute for coal-fired electricity leads to a C emissions reduction of 0.3 to 0.4 t. Thus if 100 TWh of bioelectricity is generated, the potential for C emissions reduction is 30 to 40 Mt annually (Ravindranath and Hall, 1995).

3.1.2 Justification for Bioelectricity Option and Previous Initiatives

Why bioelectricity? The **major** renewable energy options for electricity generation are wind, SPV, and micro-hydroelectricity. Wind and micro-hydro are highly location-specific and seasonal. SPV is the most expensive renewable energy option. Currently, all of them require expensive storage for 24-hour power supply. Thus these options have limitations. Bioelectricity systems, on the other hand, can be installed in any rural location where biomass can be grown and harvested. It is possible to set up electricity generation capacity from 20 kW to multiple megawatts. Electricity generation all-year-around and 24 hours a day is possible. No storage costs are involved.

Justification for the proposed project: Experience so far has shown the need for large, visible, and viable-scale implementation of bioelectricity technology to convince policymakers, entrepreneurs, and financial institutions of its value. The successful implementation of this project could lead to the large-scale spread of bioelectricity.

3.1.3 Project Objectives and Activities

The broad goal of the project is to promote the dissemination of bioelectricity systems to meet growing electricity requirements, and to do so by effecting GHG emission reductions. The specific objectives are:

- to install and operate a 1-MW scale bioelectricity generation system,
- to raise an energy plantation,
- to demonstrate the operational and financial feasibility and viability of a bioelectricity system, and
- to reduce GHG emissions and prepare a plan of action for the major expansion of bioelectricity to achieve large-scale GHG emission reductions.

Participants in the project:

Domestic participants: NGOs or independent power producers.

Foreign participant: a power company in an IC.

Location of the project: A proposal to implement the bioelectricity project is being considered for a cluster of 25 villages in Tumkur district in South India.

Activities:

ACTIVITY 1: Planning and designing installation of a 1-MW biomass gasifier electricity system

- Selection of location and human settlement area (number of villages or population), estimation of the demand for electricity so that it can be served with a 1-MW system.
- Selection of suitable technology, biomass gasifier design, and manufacturer.
- Identification of entrepreneurs to undertake installation of the system.
- Installation of system, electrical works, feedstock preparation system, and power distribution network.

ACTIVITY 2: Organizational and institutional arrangement for operation and management of the system

- Exploration of alternative approaches to operation and management
- Training of operation, maintenance, and management staff
- Biomass feedstock supply arrangement: entrepreneur or wood contractor and farmers

ACTIVITY 3: Monitoring and verification of GHG flows

- Selection of parameters and methodology for monitoring GHGs
- Identification of institution for monitoring and verification
- Training of staff for monitoring GHG flows

3.1.4 Sustainability and Replicability of Bioelectricity Systems

Financial reliability: The electricity generated is proposed to be sold to households, farms, and industries that are willing to pay commercial rates for assured power supply.

Sustainability: Financial viability and proper institutional arrangements will ensure sustainability of the utility beyond the project period. An entrepreneur-based management system is expected to be organized to sustain the project. A reliable supply of electricity, leading to increased income generation from farms and local industries and an improved quality of life (from services such as lighting, piped water supply, grain milling, etc.), will also contribute to long-term stakes for the beneficiaries to sustain the system.

The carbon sequestration is sustainable because the woody biomass from the dedicated energy plantation is harvested sustainably.

3.1.5 Institutional Arrangements

The proposed assignment of tasks by institution is listed below.

- planning, designing, and field executions: manufacturer, utility managers, and entrepreneurs,
- operation, maintenance, management: utility managers.

- monitoring of GHG flows: local research institution and consultancy agencies.
- verification: donor country or a UN agency or international consultants.

3.1.6 Project Benefits

Land reclamation: degraded lands will be used for raising an energy plantation. Soil and water conservation will be achieved, leading to land reclamation.

Promotion of biodiversity: with appropriate choice of species and silvicultural practices, it is possible to promote biodiversity in the currently degraded lands.

- Local employment and income generation: significant employment generation would occur at the local level through the raising, maintaining, and harvesting of the energy plantation; transportation and preparation of biomass feedstock; and operation and maintenance of electrical utility.

3.1.7 Risks

A project based on land and the participation of local communities and farmers is likely to be exposed to some of the risks listed below.

- land tenure related disputes: litigation and encroachments
- pests, fire, grazing, and illegal felling of trees
- non-realization of projected biomass productivity

Institutional arrangements can be made to minimize these risks. Creating a stake for the entrepreneur and farmer in the operation and maintenance of the system and for women—as they are the real beneficiaries of the successful operation of the project—will lower the risks of the project's failure. Other means of reducing risk include the planning of income-generation activities using electricity from the bioelectricity system, so that households will have a clear interest in maintaining the system, and by entering into contracts with the manufacturer and technical group to provide continued support.

3.1.8 GHG Mitigation Potential

The GHG mitigation potential is estimated using the COMAP model. The incremental C abatement from C sequestration in soil and standing vegetation and fossil fuel electricity substitution (at 60% capacity utilization of power generation) is estimated to be about 62,000 t C **per MW** over a **period of 40 years.** For every hectare dedicated to the energy plantation for producing woody biomass for bioelectricity generation for substituting fossil fuel electricity, the C abated (sequestered and emissions avoided together) is 124 t C/ha. (Table 2).

Assignment of emissions reduction: This is still an issue for global negotiations; in the pilot phase no carbon-sharing mechanisms are involved.

3.1.9 Investment Costs and Cost Effectiveness

The details of investment costs and unit abatement costs are given in Table 2.

Investment costs required: The life-cycle cost of establishing and operating a 1-MW biomass gasifier-based decentralized system is about US$ **0.54 million.** This includes the cost of the 1-MW gasifier, operation and maintenance costs at a plant load factor of 60%, and the cost of the energy plantation. The investment cost is about US$ **0.52 million**. This does not include the transaction and transitional costs.

Cost effectiveness: When the life-cycle costs are considered, the unit abatement cost (UAC) is US$ 7.5 per t carbon abated. If the benefits are included then the cost of abatement is negative.

Cost-benefit Analysis: The net present value (NPV) of benefits is US$ 72/ha, or US$ 5.8/t C abated. Thus, the bioelectricity option is an economically viable venture.

3.2 Proposal 2: Sustainable Teak Plantations for Forest Carbon Conservation

3.2.1 Background

With the growth in population, economic development, and external trade, demand for sawn timber or hardwood (referred to as timber) is growing in India. Clearing primary forests to meet local, urban, and export demands for timber is one of the factors contributing to deforestation and forest degradation. In some countries such as India and Thailand, there is a legal ban on logging trees in primary forests. However, such a ban often leads to the importation of timber from other countries, causing deforestation elsewhere. Deforestation and forest degradation lead to emissions of carbon stored in soil and tree biomass: only a small fraction of tree biomass gets converted to timber and storage products. Other adverse environmental impacts are loss of biodiversity, soil erosion, and water runoff.

Demand for timber is bound to grow. Alternatives to timber such as steel and aluminum also contribute to environmental degradation, including GHG emissions. Compared to its substitutes, timber could be grown and harvested sustainably to meet the demand.

Timber forestry is increasingly becoming an attractive C sequestration project. Some projects are currently being funded or in the process of being considered for funding through AIJ. In India and many developing countries, vast areas of degraded forests, village commons, and of course private farm lands are available. These lands could be used for timber plantations. **Every ton of timber produced through plantations will lead to conservation of a ton of natural timber through avoided forest clearing (0.5 t of C).** Timber forestry projects could be implemented and managed by:

- State Forest Departments
- Timber plantation companies
- Farmers cooperatives.

A case study of a timber plantation option as a mitigation project is presented with the following specifications:

- Species: teak (*Tectona Grandis*)
- Private land to be used for teak plantation
- Plantation to be raised and managed by private plantation company
- Plantation managed as a commercial venture with a profit motive

3.2.2 Participants in the Project

- Domestic participant: Teak plantation company
- Foreign participant: A power corporation in an OECD country.

3.2.3 Brief Summary of the Project

The project aims to raise teak on 1000 ha of marginal land owned by the plantation company either directly or through arrangement with farmers. Timber produced is expected to substitute for timber extracted non-sustainably from primary forests. C abatement will occur through:

- Storage of carbon in long-term products
- C sequestration in degraded soil
- C conservation in primary forest vegetation and soil due to reduced extraction.

The plantation project will be implemented by a plantation company as a commercial venture. The company expects full funding from the utility in an OECD country. The host company contribution will be land and technical and managerial manpower.

Location of the project: The 1000 ha will include patches from a few hectares to a few hundred hectares spread over a number of locations, and is being planned for semi arid districts of Tamil Nadu in India.

3.2.4 Greenhouse Gas Sources and Sinks in the Location

- C density: The land being considered is marginal cropland or partially degraded fallow land. The standing vegetation C density is expected to be insignificant. The soil carbon destiny is also likely to be low (at about 30 to 50 t) in such marginal lands. The baseline C density in standing vegetation in the 1000 ha under consideration nearly zero.
- Current source of timber: The sources of timber in the region are primary forests, plantations, and imports.

3.2.5 Specific Measures to Reduce C emissions or Sequester C

- Raise 1000 ha of teak plantation in degraded lands
- harvest at maturity
- convert timber into long-term products for further carbon storage
- promote teak regeneration after harvesting
- -phased implementation of plantation: 250 ha to be planted annually over a period of 4 years.

3.2.6 Sources of Funding for the Project Measures

- Host agency: contribute resources such as land, technical and managerial inputs, and part of labor.
- External agency: dominant financial contributor to the project is expected to be
- power a corporation from an OECD country.

3.2.7 Assignment of Emission Reduction

Sharing of GHG credits from the project is subjected to the approval by the host country government. Currently, there is no sharing of GHG credits in the AIJ pilot phase.

3.2.8 Additionality of GHG Emission Reduction

The incremental carbon sequestration occurs due to the vegetation and soil pool created in degraded (low carbon density) lands. A large part of vegetation carbon sequestered is converted into long-term storage products. The incremental (over baseline scenario) carbon abatement for the teak plantation project is assessed using the COMAP model. The additional carbon abatement is estimated to be 145,600 tC for 1000 ha (or 145 tC/ha).

Any timber plantation program will lead to forest conservation and therefore to C sequestration. The C sequestration is sustainable because the high-value teak when harvested is converted into long-term carbon storage products.

3.2.9 Compatibility with Host and Donor Country Regulations

Most developing country governments are likely to have policies to promote timber plantations due to their multiple benefits. India is currently importing timber. The Indian government is likely to promote any program aimed at timber production and degraded land reclamation. Thus, raising domestic timber plantations, particularly by farmers but also by plantation companies, is being fully encouraged. by the Indian government. Thus the project concept is fully compatible with national programs and regulations. **Similar forestry projects have been funded under AIJ in other countries. Thus forestry projects are likely to be compatible with donor country regulations.**

3.2.10 Acceptance of Proposal Concept by Host Country Government

A majority of developing countries have agreed to an AIJ pilot phase for the purpose of learning the process. However, many governments have not formulated policy guidelines to process AIJ projects. The Government of India is committed to AIJ even though it has not yet implemented any projects.

3.2.11 Technical Assistance Required

To obtain high growth rates of teak trees, which is normally a slow-growing species, it may be necessary to adopt the following intensive practices:

- selection of high-quality planting material
- tissue culture technique for producing high-quality seedlings quickly
- intensive silvicultural practices
- irrigation and application of nutrients

It is not clear whether external technical assistance is required as it is already largely available in India. If needed, additional technical expertise may be sought.

3.2.12 Risks Involved

A timber forestry project could face the following risks due to the long growth period involved:

- fire or a pest attack on the plantation leading to mortality of trees
- additional timber supply could lead to increased demand for timber—leading to little or no forest conservation

3.2.13 External Verification

A committee could be set up consisting of the donor agency and the host agency along with a few technical experts from national research institution and international institutions. This committee should:

- review the parameters and methodology adopted by the host institution
- assess the technical capacity of the monitoring staff and provide any technical assistance required
- periodically verify the monitoring reports.

3.2.14 Environmental and Socio-economic Impact

- Any plantation or forestry activity will have a number of local environmental, social, and economic impacts. The commercial timber plantation is likely to have the following impacts:
- reclamation of degraded lands: if the plantation is on marginal or degraded lands, it will lead to organic matter accumulation, reduction in soil erosion, and rain water conservation.
- employment and income generation: plantation forestry is labor-intensive and thus leads to generation of employment in raising trees, periodic silvicultural practices, harvesting, transportation, and processing of timber.
- reduction in imports: India imports timber and thus the availability of in-country plantation timber will lead to foreign exchange savings.
- natural forest conservation: increased supply of plantation timber could lead to reduced pressure or halting of timber extraction from natural forests
- capacity-building: implementation of a commercial teak plantation as a mitigation option will lead to capacity-building in India in the following ways:
  - planning and implementation of mitigation projects
  - monitoring of GHG flows in land-based mitigation projects
  - institution development to manage the mitigation projects
  - assessing the potential for mitigation and risks involved
  - international negotiations in sharing GHG benefits in the final stages

3.2.15 Investment Required and Cost Effectiveness

The investment and cost effectiveness parameters are given in Table 2.

- Investment: The life-cycle cost per ha is US$ 4200/ha and the aggregate life-cycle cost of the project for the 1000 ha unit is US$ 4.2 million. The total initial investment required is US$ 2.2 million.
- Cost effectiveness: The initial investment cost per ton of C is US$ 15 and the life-cycle cost is estimated to be US$ 29/t C abated.
- Financial cost benefit analysis: The NPV of financial benefits is estimated to be US$ 3391 per ha. A more important indicator is the NPV of benefit per t of C abated, which is estimated to be US$ 23/tC.

Thus, even though the initial and life-cycle costs of the project are high, it is a financially viable project with positive NPV of benefits. Overall, if the benefits are also considered, the project financial analysis shows negative abatement costs.

Financial barriers: Even though the project is financially viable at a 10% discount rate, in reality there is a severe scarcity of capital in India and the cost of credit is very high (18 – 23%). Thus the project requires external funding.

3.3 Proposal 3: Tamarind Orchards: Agro-forestry for Dry Lands for Carbon Sequestration

3.3.1 Background

Many areas of the world are becoming desertified due to the pressure of population on marginal farm lands, resulting in over-cultivation and soil depletion. The Kolar district of the State of Karnataka, India, suffers from this condition, as do many parts of other states in India. Globally, there is an urgent need to find ways for small and marginal farmers in these areas to improve the ecology and economy of their regions. Rural populations dominate the developing countries of Asia, accounting for over 70% of total population. Bagepalli block, in the Kolar district in southern India, is a drought-prone semi-arid area suffering from severe land degradation. The present carbon content of the soil is low, and the lack of biomass in the ecology and economy coupled with the absence of alternative employment options keeps income levels low in this area.

The goal of the project is to grow economically useful trees :

- to sequester C in trees and soil by growing commercially valuable fruit and timber trees which, because of their economic value as well as local tradition, will not be cut during their long lifetime, and.
- to halt land degradation.

3.3.2 Participants

-Domestic: an existing small farmers' society with 15,000 members, a society approved under

FCRA (Foreign Currency Regulations Act) and a professional horticulture company

-Foreign: a single corporate high-GHG emitter in an industrialized country; or an association of individuals with high emission life-styles.

3.3.3 Brief Summary of Project

The project aims to raise tamarind (*Tamarindus indica)* orchards with teak (*Tectona grandis,*) along the plot borders on 1000 ha of marginal agricultural land owned by individual marginal farmers in association with a professional horticulture company. The fruit of the tamarind is an everyday cooking ingredient in southern India and teakwood is a valuable wood product. The fruit and timber from the multi-species plantation will, therefore, provide economic benefit to farmers in a stable and well-organized market and thus ensure protection of the established trees.

The project will sequester carbon in the trees and in the soil. The soil carbon content is likely to go up by about 2 t C/year, as the soil is left untilled, grass left standing, and other leafy matter returned to it. The fruit tree plantation will also provide twigs and branches for fuelwood for farmers.

The project will be implemented by a small, marginal farmers' society and a horticulture company as a commercial venture. The host parties expect full investment grant funding under AIJ from an OECD country. The host parties' contribution will be land, labor, and technical and managerial manpower.

- Location: The 1000 ha will be spread over individual plots **in 1 block [as in Bagepalli block?]** with an area of 19,000 ha of cultivated land from a geographic area of 227 square kilometers. Plot size will be 1 acre (0.4 ha) per farmer. This project is being planned for the semiarid Kolar district in Karnataka state, India.

- GHG sources and sinks in the area: The land being considered is marginal cropland of low productivity put into cultivation only in the last 10 years. The standing vegetation includes approximately 20 dispersed trees per ha. The low soil and vegetation carbon density result in a baseline carbon density of about 30 t C/ha.

- At present there is a scarcity of fuelwood, timber, and tamarind trees in this area. The tamarind trees are dispersed and are not managed on an orchard basis.

- Specific measures to sequester C: The project plan calls for the planting of 200'000 tamarind trees and 50'000 teak trees (around the borders) on 2500 orchard plots. The tamarind trees will be raised to maturity and not felled thereafter. Teak will be harvested after 25 years. The harvested teak will be converted into long-term products. The standing C in tamarind trees, the C incorporated into long-term products, and enhanced soil carbon density will all lead to C abatement. Other fuelwood species like mesquite, *Prosopis juliflora* and eucalyptus will be grown as fence rows and will be allowed to coppice for fuelwood, with carbon-neutral implications. The entire planting will be phased in over 4 years, covering 250 ha per year.

3.3.4 Project Design and Strategy

The project is designed in a modular form, with 25 clusters of 100 families each, each cluster consisting of 100 acre plots (40 ha) with 1 watering arrangement per cluster. Thus project implementation can take place on a phased basis depending on the investment level chosen by the foreign partner. The design calls for

:

- 2500 member families to be given subsidies to grow trees on a total of 1000 ha of land.
- 25 watering arrangements (borewell with tractor/tanker) to be established, 1 in each cluster of 100 families (40 ha).
- 25 nurseries to be established, 1 in each cluster.
- technical support to be provided.

Institutional arrangements:

The proposed assignment of tasks by institutions are:

- planning, designing, field execution: farmers' society with professional support from orchard company and local agricultural university.

- monitoring of GHG flows: local educational or research institution and consultancy agencies.
- external verification: local research institution or a UN agency and donor agency.

Sources of funding for the project:
Host agency will contribute land, labor and technical and managerial inputs.
External agency will contribute capital. The main financial inputs are expected to come from the donor agency.

Assignment of emissions reductions: These discussions will take place with due regard to policy formulated by the Government of India and the status of discussions in other on-going international negotiations. Currently AIJ is a learning process in which issues of crediting are not relevant.

3.3.5 Additionality of Emissions Reductions

The incremental carbon sequestration occurs due to the vegetation and soil pool created in degraded (low carbon density) lands. A large part of vegetation carbon sequestered is converted to long-term storage products. The incremental (over baseline scenario) carbon abatement for the agro-forestry project was assessed using the COMAP model. The additional carbon abatement is estimated to be 118,972 t C for 1000 ha (or 119 tC/ha) .(Table 2).

The stream of carbon sequestration benefits associated with this project will not occur in the absence of the project. At present the soil continues to be degraded and loses carbon content through over-exploitation of the land. With fruit trees there will be significant incremental carbon stored in standing vegetation and soil.

3.3.6 Compatibility with Host and Donor Country Regulations

Host country: Agro-forestry activities conducted by village communities is high on the list of priority in the eighth National Plan (Planning Commission, 1992). It provides employment and income in rural areas. In India nearly 55% of land area (excluding forest lands with more than 10% crown cover and areas under roads, settlements, etc.) is estimated to be degraded. These have to be revegetated to conserve soil, moisture, and soil organic matter (C). Activities by farmer cooperatives, village associations, and other bodies of organized small holders contribute to this form of integrated environmental and economic national development. The socio-economic benefits are high. Thus this project is compatible with host country development priorities. Suitable regulations in this regard for AIJ projects have yet to be established. From the donor's perspective, the proposed project satisfies most OECD countries' AIJ guidelines.

3.3.7 Acceptance of Proposal Concept by Host Country

India has a procedure for private partnerships under the RBI (Reserve Bank of India) and FCRA (Foreign Contributions Regulation Act) regarding foreign investment. Even though India is committed to AIJ, no guidelines or criteria currently exist for evaluating and accepting AIJ projects. With a set of potential proposals, government may be motivated to expedite the formulation of the acceptance process.

3.3.8 Technical Assistance Required

To obtain high growth rates of tamarind and teak trees (as both are normally slow-growing species), it may be necessary to adopt intensive cultivation practices:

- selection of high-quality planting materials.
- application of tissue culture technique for producing high-quality seedlings quickly.
- application of intensive silvicultural, irrigation and nutrient practices.
- introduction of advanced soil and water conservation measures designed specifically for the project orchards.

3.3.9 GHG Emissions and Sequestration

C abatement is estimated using COMAP model. The additional carbon abatement is estimated to be 118,972 tC for 1000 ha (or 119 tC/ha). (Table 2). Details were presented in Section 3.3.5.

3.3.10 Risks Involved

The only risk involved in this project is that farmers may fell and burn the trees. However, this risk is considered remote due to the local tradition of not felling tamarind trees coupled with the high financial returns expected from teakwood and tamarind fruit. Together, these factors are expected to ensure sustainability of sequestered C. There is a risk of low yields and consequent low economic incentives. This can be overcome with appropriate technical inputs from the horticulture company and experts in the region. The farmer's society is a 20-year-old, well-established organization with high credibility. Thus the institutional continuity of the partnership is assured.

3.3.11 External Verification

The implementing agency, in this case the farmer's association together with the horticulture company, will gather data and monitor GHG flows on a continuous basis, with assistance from local research institutions. External verification could be the responsibility of the **foreign partner/donor country.** .

3.3.12 Environmental and Socio-Economic Impacts

Income is estimated to be Rs 35'000/acre (1 US$ = Rs.35) in the fifth year rising to Rs 90'000/acre after the ninth year. This compares with Rs 3000/acre profit from a popular cash crop, groundnuts, on this semi-arid marginal land (in a good year). Teak planted around the border provides additional cash after 25 years. The economics work out extremely favorably. There will be increased income to the region. Women and men will have additional employment. Soil will become more productive leading to the possibility of additional unplanned economic activity.

Implementation of agro-forestry projects as a mitigation option will lead to capacity-building in India among the various institutions involved: commercial companies, farmers cooperatives, research institutions, and even government departments.

3.3.13 Sustainability and Replicability of Agro-Forestry

Financial viability: As stated earlier, the tamarind fruit and teakwood will be sold at commercial rates and the farmers are assured of high financial returns.

Sustainability: Financial viability and proper institutional arrangements will ensure sustainability of the orchards beyond the project period. The farmers' society will sustain the project as one of the many projects run by the community in a highly efficient, holistic, and democratic manner. Income will improve the quality of life for member families. Thus the carbon sequestration is sustainable because a) tamarind trees are not felled in South India where there is active community presence and control over trees, b) teak when harvested will be converted to long-term storage products which sequester carbon, and c) local actors are fully aware of and agree wholeheartedly with the global aims of the project.

3.3.14 Investment Required and Cost Effectiveness

The parameters are given in the Table 2. Life-cycle costs: The life-cycle cost per ha is US$ 945/ha and the total life-cycle costs of the project are US$ 945'000.

Investment: The total initial investment required is US$ 600'000. Cost effectiveness: The initial investment cost per ton of carbon is US$ 5/tC and the life-cycle cost is estimated to be US$ 8/tC. The NPV of benefits is US$ 11478/ha. The NPV of benefit
per t of C abated is estimated to be US$ 96.5/tC.

Thus even the initial and life-cycle costs of the project are extremely competitive. It is a financially viable project with positive NPV of benefits. Overall, the project financial analysis shows negative abatement costs.

4. DISCUSSION OF OPPORTUNITIES AND CONCERNS

Some of the opportunities and concerns raised in Section 2 are discussed in the context of the three case studies to **evaluate their validity** and identify possible strategies to overcome any remaining concerns. The discussion on the concerns with reference to the three project proposals is summarized in Box 1.

Box 1. Summary of concerns regarding AIJ with respect to the three project concepts.

Concerns	Bioelectricity project	Teak Plantation project	Agro-forestry project
1. Compatibility with national development priorities	Ministry of Non Conventional Energy Sources has identified it as a priority area.	Teak plantations have been promoted in India on a smaller scale. The Government is promoting private timber plantations.	Agro-forestry and fruit tree gardening is already a part of the programs of the Ministry of Agriculture.
2. Sharing of credits	not yet relevant	not yet relevant	not yet relevant
3. Transfer of high cost or obsolete technology	Emerging technology	Does not involve technology transfer	Does not involve technology transfer
4. Absence of local concerns	-Relevant -Commercial farm forestry feasible	-Relevant -Commercial farm forestry feasible, arrangement between farmer and timber company	-Not of significance -Traditional practice exists, need to be strengthened, decision rests with farmers
5. Macro-economic aspects	-If degraded lands used for fuelwood production, only positive impacts - i) land reclamation ii) Promotion of biodiversity in degraded lands iii) Rural employment iv) reduced import of petroleum fuel	-India facing timber shortage -Only positive impacts i) increased income for farmers ii) reduction in import of timber iii) creating rural jobs	-No macro-impacts -Direct benefit for farmers i) Increasing and stabilizing incomes

4.1 Questions Concerning Sharing of Credits and Commitment of Low-cost Options

The issue of credit-sharing need not be the concern of the project sponsors in DCs or the IC companies which are likely to fund projects in the pilot phase. The issue will be decided at the highest governmental level in future global negotiations. When the governments jointly agree on the sharing of credits, the regulations will apply to all. The DC governments are likely to bear in mind the AIJ projects already implemented in the pilot phase during these negotiations.

As already pointed out, it is unlikely that in the short period of the pilot phase any significant share of low-cost mitigation potential would be committed or exhausted. In India, degraded land availability for mitigation options is in the range of 66-130 million ha. A few pilot phase projects of the scale described in the three case studies (about 1000 ha each for teak plantation and tamarind projects) will not have any impact on the total national sink capacity or low-cost mitigation potential available in India. Even the bioelectricity project will only involve about 20 villages, whereas there are a half a million villages with the potential for bioenergy options (Ravindranath and Hall, 1995) Thus AIJ projects are unlikely to have any impact on DCs' low-cost mitigation potential.

4.2 Transfer of High-cost and Obsolete Technology

Technology transfer is unlikely to be a major issue in the majority of non-energy sector projects. In the case studies of bioelectricity, agro-forestry, and timber options, there is no significant technology transfer component. This could also be true of many other non-energy sector options such as reforestation, forest restoration, forest conservation, and certain renewable energy options. Moreover, for many options, such as small-scale bioenergy technologies, biogas and producer gas systems, technology is already available in many DCs such as India, China and Brazil.

However, some other land- or biomass-based energy projects such as fuel cells and co-generation may require technology transfer. However, AIJ guidelines clearly state that any AIJ global tenders have to be accepted by the host party. Obsolete technology transfer can **also** be avoided through host government clearance processes—which are required regardless of the AIJ mechanism.

Possibly costs of individual climate mitigation projects may decline in the years to come as the transaction, transitional and monitoring costs may decline with improved methods and capacity building Implementation of a large number of AIJ projects could lead to declining costs due to learning.

4.3 Absence of Local Concerns

The IC utility executives and the decision-makers from investor countries are unlikely to be aware of location-specific socio-economic and environmental impacts of AIJ projects in DCs. Therefore, before approval of the projects, the participating DC institutions or the governments must consider the relevance of the project from the point of view of local costs and benefits. Land-based mitigation strategies, however, cannot easily be implemented without the involvement of local communities who reside in or near the project location and who will depend on it. The teak plantation and tamarind (agro-forestry) projects are proposed to be implemented on farmers' lands. Even in the bioelectricity project, the energy plantations will be on farmers' land as well as village commons land. In India, it is not possible to raise energy plantations without involving the local farmers or village community who will produce the woody biomass for energy. **Thus, community awareness of the projects guarantees that local concerns are addressed.**

4.4 Absence of Institutional Mechanism for Processing AIJ Projects

Nationally accepted guidelines and mechanisms for processing and accepting AIJ projects have already been implemented in many countries. In India, there are no AIJ projects yet; they are still in the early stages of project proposal development. An AIJ approval mechanism will probably evolve over time if a set of potential projects are prepared and submitted to the Ministry of Environment.

The concepts involved in the teak plantation, tamarind, and bioelectricity projects are already on the list of activities and programs of various Ministries in India (Planning Commission, 1992). Thus, are compatible with the national development. The non-energy sector projects of the type outlined in this paper are non-controversial and 'no regrets' types of projects which can show the usefulness of AIJ and help more local and regional governments, industry and non-government agencies to become aware of the mechanisms of AIJ, particularly in the non-energy sector.

The Indian government is a signatory to the FCCC; in many ways it is trying to put in place guidelines for local governments, NGOs and industry, to help build understanding of international mechanisms such as AIJ and the Global Environment Facility, and thereby contribute to attracting fresh investment flows into sustainable development projects.

4.5 Macro-economic Aspects of AIJ Projects

A few, small projects such as the teak plantation, tamarind, and bioelectricity projects conducted during the pilot phase are unlikely to have any macro-economic impacts. In the case of bioelectricity, there could only be positive impacts as long as degraded lands are used and adequate attention is paid to biodiversity and sustainable biomass harvest practices. Other than local considerations of land ownership, control, and other equity issues, there are generally no negative macro-economic impacts with respect to land-based mitigation options, at least in the forestry sector. A macroeconomics study of C sequestration projects in India has shown positive impacts on employment generation, GDP, and foreign exchange reserves. According to the analysis, forestry sector mitigation options are shown to have the following impacts,

i) enhancement of C stocks from 9578 Mt C to 17,094 Mt C,

ii) a trebling of the output of forestry sector from Rs.49 billion to Rs.146 billion annually,

iii) a three fold increase in GDP contribution of forestry sector,

iv) an increase in annual employment of 23 million person years, and

v) emergence of forestry as a net contributor to foreign exchange earning (Kadekodi and Ravindranath, 1997).

5. CONCLUSION

To combat the threat of climate change, the global community will have to adopt a new approach to environment, development, international trade, and technology transfer. There appears to be a global interest in and agreement on the need to promote sustainable development and create international mechanisms for reducing GHG emissions. AIJ should be viewed as supplementary to national GHG emissions reduction strategies, particularly in ICs. If ICs adopt GHG emission reduction domestic policies, a major concern of DCs will be removed and AIJ could become something more than a series of well-intentioned pilot projects. There is no doubt that AIJ presents an opportunity for initiating interactions between ICs and DCs for promoting sustainable development projects which also specifically reduce GHG emissions or enhance sinks. New parameters for what constitutes a successful partnership in development are emerging. Given that there is no carbon-crediting as yet, DCs do not stand to lose anything by participating in AIJ activities. The present period can be used to involve all sorts of private-sector actors including industry, farmers, forest dwellers, and others in learning how to deal with newly valuable environmental services at international level. on a global market. Non-energy or land-based projects seem to be less controversial and at the same time provide significant socio-economic and local environmental benefits (rural employment and land reclamation). India should utilize the pilot phase for learning and capacity-building, so that if, at a future date, GHG credit-sharing mechanisms are agreed to by the governments at the global level, Indian policy-makers, negotiators, industries, NGOs, and local communities will be in a position to benefit. Some conclusions and suggestions from the analysis are listed here and summarized in Box 2.

Box 2. Summary of recommendations

1. Development of policies and institutions for processing AIJ projects.
2. Capacity building among NGO's, farmers organization, private consultants regarding AIJ concept and potential for project formulation to conceive the projects, prepare project proposals, prepare implementation and monitoring plans.
3. Formation of brokerage institutions to promote partnerships.
4. Capacity building in monitoring, evaluation and verification.
5. Develop mechanisms to involve local communities in decision making process with respect to land based projects.
6. Identifying key locations in India and potential project concepts or briefs for dissemination among potential agencies.

A. Development of policies and institutions for processing AIJ projects. Countries such as India, as signatories to COP1, should formulate policies and mechanisms to process, evaluate, and accept AIJ projects The present analysis has shown that India stands to gain experience through capacity-building in planning, implementing, managing, and monitoring GHG mitigation projects. This would also help India in global negotiations and in marketing of carbon credits, if agreed to globally in the future.

B. Extension of the pilot phase. Given that many countries have not yet formulated policies for AIJ projects and very few projects have actually been implemented, there is a need to consider an extension of the pilot phase, to enable more countries to gain from the experience. Extension of the pilot phase is particularly relevant to the land-based mitigation strategies. In land-based projects, such as forest conservation, carbon sequestration, and bioenergy projects, the development period involved in planning, implementation, and obtaining GHG abatement is long, often lasting over decades. If an extension of the pilot phase is not feasible, at least the monitoring, evaluation, and learning could be extended beyond the pilot phase by providing support for institutions.

C. Capacity-Building. To promote AIJ and to benefit from it, capacity-building is required at various levels.

- Awareness building: The AIJ process is new and the institutions, such as industry, NGOs, farmers, companies, local governments, are not aware of the procedures and potential benefits arising from AIJ projects. There is a need to create awareness regarding AIJ. This could be undertaken by governments and UN agencies, through workshops and mass media.

- Brokerage institutions: In order to create a friendly environment for emerging AIJ partnerships, certain mechanisms should be in place to facilitate project development, appraisal, and monitoring. Centers, or brokerage facilities, could be established at regional locations within large countries such as India to assemble AIJ projects. This will provide the professionalism needed to attract commercial partners from ICs and also provide the capacity for generating local project proposals. In this way, DCs will have the assurance that certain basic national objectives are being met through AIJ projects. For example, the AIJ project will be seen to be country-driven and based on national priority.

- Monitoring and evaluation: Capacity-building is necessary to enable GHG monitoring activities, particularly in land-based projects. There is a need to develop suitable methodologies, training, and establishment of institutions to carry out monitoring work. There is an incorrect perception regarding the measurement of C abatement (sequestration), particularly in the forestry sector. In reality, the methods for monitoring of C uptake (by trees and soil) and C release (from soil and litter) are **well-established, simple, standard textbook methods (Ravindranath and Bhat, 1997).**

D. Involvement of local communities and institutions: To overcome the problem of possible negative local impacts as well as to maximize local benefits, the best insurance is to involve the local communities—the local municipalities and local governments such as Gram (village), Taluk (block), and Zilla (district) level institutions in India—in the decision-making process. This is particularly necessary for land-based GHG abatement projects, to ensure that local interests and environments are protected.

E. Promotion of land-based mitigation projects: Using India as a starting point, a few projects, such as the teak plantation, agro-forestry, and bioelectricity case studies presented above, could be implemented by local and IC promoters, as they are non-controversial, they contribute to sustainable development, and provide significant local and global benefits (GHG abatement). There is also a large potential for other land-based projects such as forest conservation, forest regeneration, plantation forestry, and methane emissions reduction.

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