Simple tips for improving yield

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Foundation for Ecological Research, Advocacy and Learning

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Introduction

Agriculture is the predominant occupation in India. 70 percent of its population is either directly or indirectly dependent on agriculture. Though there is no dearth of innovations in agricultural technology, yet very few farmers get to use them. One of the reasons for this gap is the lack of awareness amongst farmers.

Over the last five years, having worked on issues related to water management, farming practices and through close interactions with the farmers, FERAL has been able to assess the current status of agriculture and farmers in the Vanur and Marakkanam Blocks of Villupuram District, Tamil Nadu.

The chief crops in this area are paddy and groundnut. The baseline information collected from farmers on these crops includes costs of cultivation and total expenditure, productivity, awareness of farming practices, fertilizer management and crop protection mechanisms and their associated problems.

This booklet is a compilation of information and experiences and provides practical information to farmers. It is also meant to generate awareness amongst farmers.

Introduction to the Project Area

The ICEF project being implemented by Palmyra covers twenty-four villages in the Vanur and Marakannam blocks of Villupuram district. The main objective of this project is to form Water Users' Associations and to undertake tank rehabilitation. FERAL is involved on the project as the planning and monitoring agency. The command area farmers are dependent on the tank for irrigation. Being a rain fed area, the major cropping season in the project site is during the northeast monsoons

The command area (Ayacut) is classified as 'Wet land' (Nanjai) and those that are not irrigated by the tank are classified as 'Dry land' (Punjai). Paddy is the main crop and depending on the amount of tank water available, it is cultivated either once or twice a year.

The dry lands are completely rain fed or depend on ground water for irrigation. Other than paddy, groundnut is an important crop. Additionaly rain fed crops such as bajra, gingeely, blackgram, casuarina and horticultural crops like watermelon and ash gourd are cultivated

Cultivation Costs

The cost of cultivation would include all the costs involved from the tilling of the land up to the harvest of a crop. Such costs can be categorized as:

1. Land Preparation cost

Land preparation cost depends upon the type of crop and the soil involved. In areas with hard clay, ploughing is required twice or thrice for preparing the land for a fine tilth. Hence, the cost of preparation in these lands is higher than areas with sandy soil.

2. Seeds and sowing cost

Sowing costs vary with seed quality, seed rate, seed cost and labour costs involved.

3. Manure and manuring cost

Manure and manuring cost vary with the nutrients to be applied - farmyard manure, nitrogen, phosphorus, potash, micronutrients and bio-fertilizers. Since the fertilizer prices are almost uniform throughout the state, the changes in costs would only vary with the quantity of application. Transportation of farmyard manure is another factor that would influence the total cost.

4. Crop protection cost

This includes the costs involved in weed control, levels of pest and disease and their corresponding control measures. Depending on the climatic factors, the costs would vary significantly from region to region.

5. Harvest cost

The costs incurred depend on the use of machinery or manual labour for harvesting. Another factor that contributes to the same is the distance between the land and threshing floor.

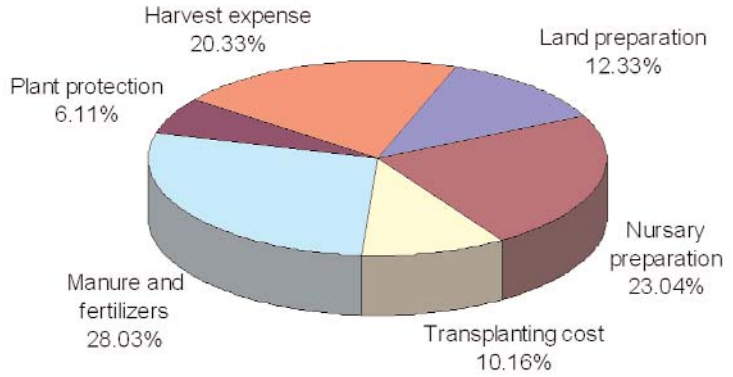
Though, the costs under above heads vary from region to region, the total average spent tends to be the same throughout the state of Tamil Nadu. On an average, in the project site, cost

of cultivating one acre of paddy varies between Rs. 5500 to Rs. 6000. In the case of groundnut, it is between Rs. 4000 and Rs. 4500. The subsequent sections looks at expenditure for each of the following components - land preparation, sowing, manuring, crop protection and harvest.

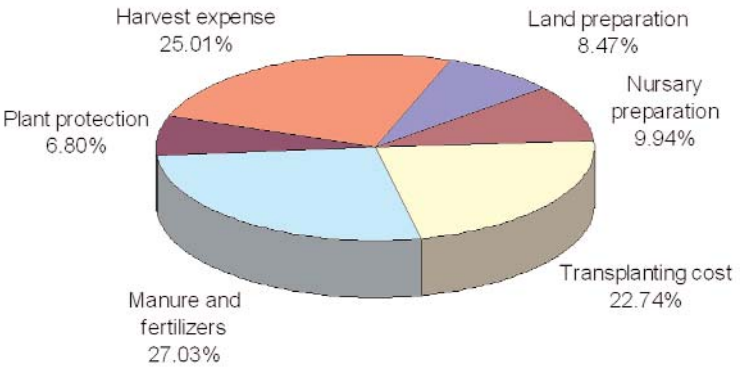
Cultivation cost for Paddy

As mentioned above, in our project area the cultivation cost for paddy is between Rs. 5500 and Rs. 6000 per acre. From the figures, one can see that the cost of land preparation in the hard clay soil areas is higher by 15 percent than in the sandy soil areas. If the main field is far from the nursery plot, the transplantation cost for paddy cultivation increases by 10-12 percent. However, manuring and crop protection cost remain the same. This goes to show the farmers in this area use similar manuring and crop protection strategies. Another significant factor that can be noticed is the substantial

Heavy textured soil/ soils with high clay content



Light sextured soil/ sandy soils



amount of money spent on nutrient management in these areas.

Cultivation cost for groundnut

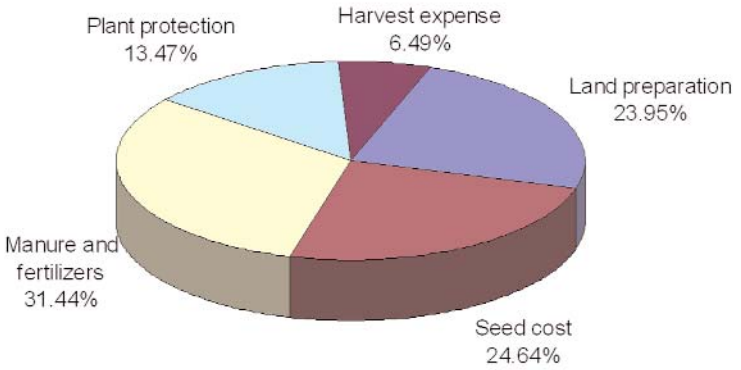
Since groundnut cultivation involves, deep ploughing and bed formation, the cost of land preparation is high for groundnut. The amount spent on nutrient management is significantly higher as in the case of paddy. Since farmers tend to pay harvest wages in kind, the cost is lesser than that of paddy.

From the above, it can be noticed that the cost involved in cultivation do not produce a proportional yield. The average yield per acre of paddy in project site is 1880 kgs, which is much lower than the national average of 2900 kgs and very few farmers in our project area manage to achieve this.

Lack of awareness with respect to several factors seemed to be the cause of this situation. Some of the factors are:

- Lack of adoption of modern techniques.
- Lack of awareness about seed quality.
- Although sufficient quantities of nutrients are applied, they are not applied at the right time.
- Lack of understanding of the required proportion of nutrients and the amount of fertilizer that needs to be applied.
- No measures adopted to enhance the crop's intake of nutrients.
- Unnecessary application of fertilizers at unwanted time.
- Low application of micronutrients.
- Doubts related to pest management.
- Lack of awareness about disease management.

Cultivation cost for groundnut

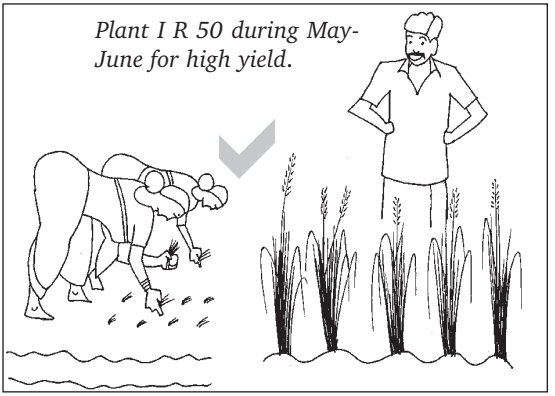


FERAL has taken up the task of creating awareness among farmers about these issues and as a result of its interaction with the farmers further insights have been gained and the same are detailed below.

Notes on Integrated crop management

Season and Varieties

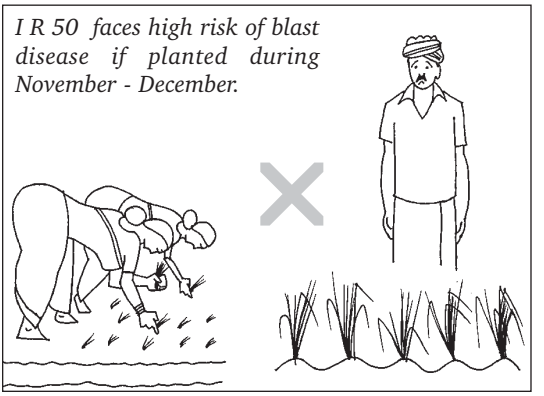
Each crop requires specific climatic conditions that influence its growth and yield. For instance, colder climatic conditions produce fewer tillers and also affect root development. Where as in extremely hot conditions, the rate of evapo-transpiration is higher resulting in lower yields and also in lesser water available for irrigation. It is only during the blooming stages, that higher solar energy enhances the photosynthetic rate thus increasing starch production. Therefore it is important that crop choice is made keeping in mind the prevailing climatic conditions.



Plant I R 50 during May-June for high yield.

Season	Months
Navarai	December January
Sornavari	April - May
Munkar	May - June
Kuruvai	June - July
Munsamba	July - August
Binpogasamba and thaladi	September-October

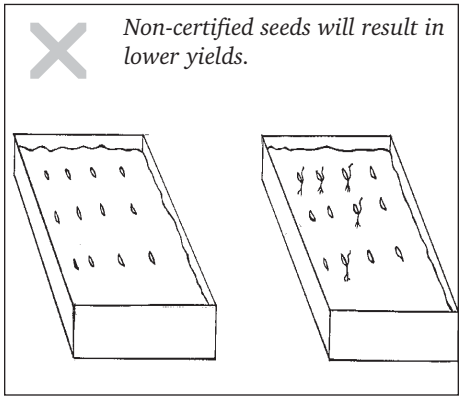
Crop varieties are also prone to diseases under unfavorable conditions. For example, I R 50, a variety of paddy produces higher yields when planted during the months of May, June and July. On the other hand, if planted during the months of November and December, due to cloudy conditions and lower nighttime temperatures, this variety is prone to *blast* disease.

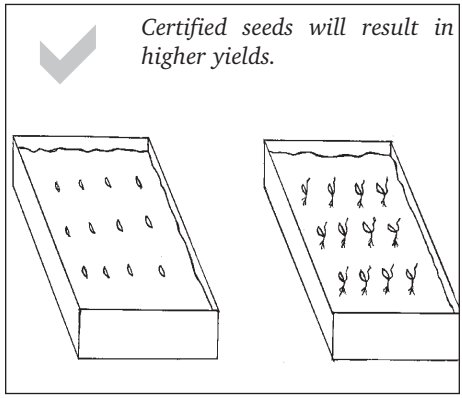


I R 50 faces high risk of blast disease if planted during November - December.

Seed Selection

Seed quality is an important factor for profitable yields. Better quality seeds would result in better yields. Quality of seeds depends both on physical purity and genetic purity. Seeds have to be free from other variety seeds, weed seeds, less prone to pest; disease & injuries and should possess good germination rates. Using certified seeds will result in higher yields. Certified seeds can be procured from the State Agriculture Department, Agricultural Extension office or from an authorized government dealer. The advantages of using certified seeds are:





1. Good germination capacity
2. Quality seedlings
3. Lesser seed rate
4. High yielding capacity
5. Lesser pest and disease related problems

Seed Rate

Since seed rate is an important factor in determining plant population, proper attention should be paid for each crop. Seed rate is dependent on spacing and weight of seeds.

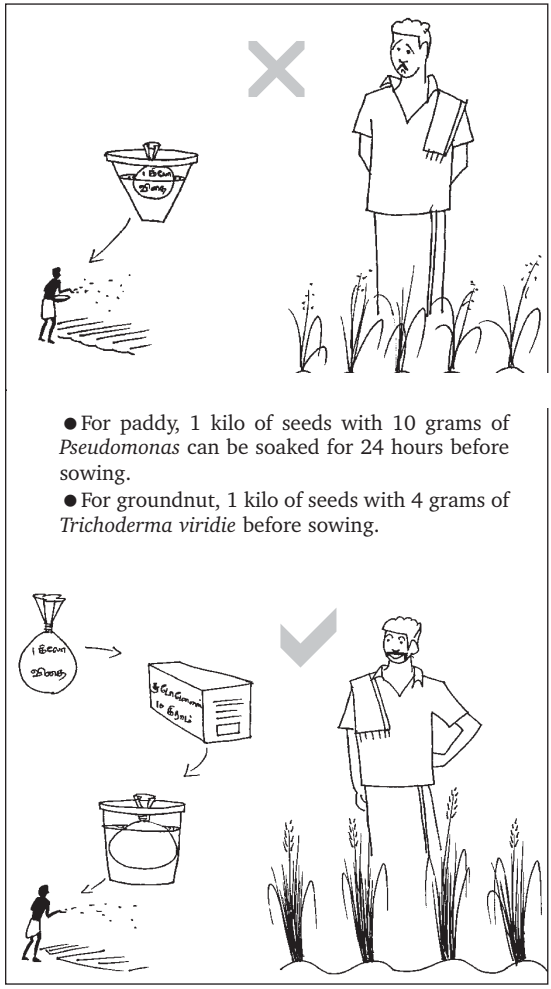
For example, for an acre of paddy the recommended seed rates are:

- Short duration varieties:
105 - 115 days, 24 - 28 kilos

- Medium duration varieties:
125 - 140 days, 12 - 24 kilos

- Long duration varieties:
145 days and more, 12 - 16 kilos

For groundnut per acre, 40 - 50 kilos should be used. For varieties with larger seeds, like JL 24, CO 2, TMV 10, ten percent more seeds should be used.

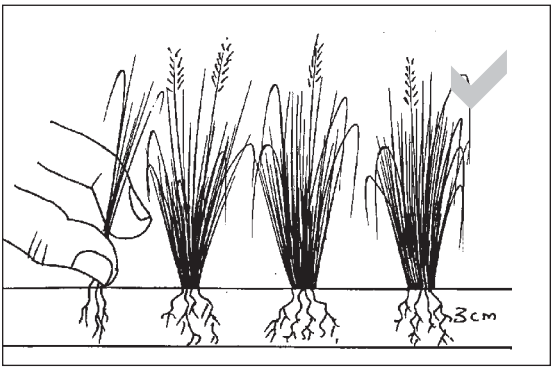


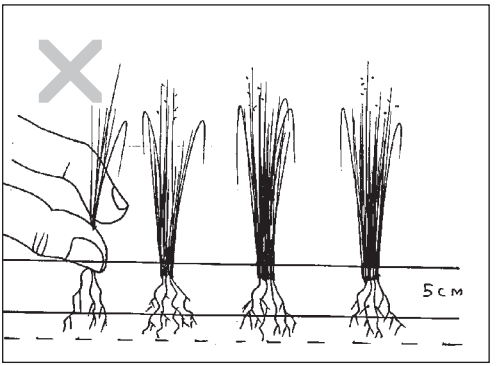
- For paddy, 1 kilo of seeds with 10 grams of *Pseudomonas* can be soaked for 24 hours before sowing.
- For groundnut, 1 kilo of seeds with 4 grams of *Trichoderma viridie* before sowing.

Seed Treatment:
Proper seed treatment methods will kill the pathogens on the seed coats in the early stages of growth. This would prevent diseases at later stages.

Sowing
Sowing depth is a very important factor that determines the germination capacity of the seeds. Greater depths affect germination capacity. Lesser sowing depth affects the stability of crops as it leads to the growth of surface roots. For example, the sowing depth for the paddy seedling should not exceed 3 cms. This will increase the number of tiller for a short duration crop.

Spacing
Spacing is an important factor that determines airflow between crops, capacity for energy absorption, optimum sunlight and crop density. The prescribed spacing standards for higher yields are as follows:





▾ *Spacing for paddy*

Variety	Low fertile soil	high fertile soil
Short duration variety	12.5 x 10 cm	20 x 10 cm
Medium duration variety	20 x 10 cm	20 x 15 cm
Long duration variety	20 x 15 cm	20 x 20 cm

Spacing for Ground nut:
30 centimeters between rows and 10 centimeters between plants

Fertilizer Management
Integrated fertilizer management involves a judicious mix of organic fertilizers, green and green leaf manure, chemicals and bio-fertilizers.

Apart from this, quantity of fertilizers, ways of application and time are equally important. This ensures that the required energy for crops is in a form that makes absorption easier and at the required rates. Excessive use of chemical fertilizers would only harm the crops. Applying fertilizers in small

	Time period	Nutrients		
		Nitrogen	Phosphorus	potash
Basal dressing	During the time of transplantation	25 %	100 %	50 %
First top dressing	20 days after transplanting	25 %		
Second topdressing	40 days after transplanting	25 %		25%
Third top dressing	60 days after transplanting	25 %		25 %

quantities, at each stage of growth is a good strategy that facilitates higher absorption rates. Also the required amount of micronutrients should be administered with proper mixture to avoid deficiency of micronutrients during different growth stages.

A fertilizer management study conducted by FERAL recommends the following application of major nutrients for medium duration paddy: (*see table above*)Some interesting findings:

- Per acre an application of 70 kg of nitrogen, 10 kgs of Phosphorus and 20 kgs of potash are found to produce higher yields with lower investment. A yield of 31 bags of paddy per acre.

- Per acre an application of 60 kg of nitrogen, 30 kgs of Phosphorus and 20 kgs of potash produces the maximum yield, an yield of 35 bags of paddy per acre

Using bio-fertilizers for paddy

Application of 2.5 tonnes of Azolla per acre during the last tilling is one way of using bio-fertilizers. Or 4 kilos of powdered blue green algae can be broadcasted on water on the 10th day after transplanting or 3 kilo of *Azospyrillum* can be mixed with 25 kilos of farmyard manure. If bio-fertilizers are used only 75%of the recommended amount of nitrogen needs to be applied.

In one of our experimental plots, an application of 3 kilos of *Phosphobacteria* and 3 kilos of *Azospyrillum* has yielded 2.5 more bags (188 kilos) of paddy.

In case of groundnut, land administered with 3 kilos of *Rhyzobium* yielded 2 bags (78 kilos) more than the normal yield.

Weed Management

Weeds have been defined as unwanted plants in agricultural plots. But, anything that competes with the crop for nutrients, water and sunlight should be perceived as weeds. These weeds not only utilize the inputs meant for the crops, they also reduce yields and affect the quality of the produce. They also become hosts for pests and pathogens that affect the crops. Weeds

could affect the crop yield by about 40 percent. Therefore, instead of using a single strategy, integrated weed management techniques with the following methods can be considered.

Summer ploughing
Crop rotation
Manual removal
Controlling weeds with weedicides

Water Management

Although, three-fourth of the earth is filled with water, only a small portion of it is useful. Since the demand for water is far exceeding levels of availability, proper management of water is becoming a necessity. Good water management involves providing adequate water in required proportions and at the time of requirement.

No.	Name of crop	Total water requirement	Critical stages of water requirement
1	Paddy	120 cms	Panicle initiation stage, Dough stage, flowering and milky stage
2	Groundnut	60 cms	Life irrigation, flowering, pegging and pod formation

Integrated Pest Management

One estimate shows that the country is losing about 6000 to 7000 crores due to pest and disease attack on crops. The following table illustrates the loss in terms of percentages. in terms of percentages.

Reasons for loss	Percentage of loss
Diseases	26
Pests	26
Birds and Nematodes	48

Since World WarII, India has mostly relied on pesticides for crop protection. Their sustained use has polluted our land, water and air. Moreover they kill beneficial insects like honeybees and other pollinators. They increase resilience among pest and make them immune. It is impossible to remove pests using only pesticides. It is therefore important that we use integrated pest control strategies that also suit the social, economic and environmental conditions.

One key feature of integrated pest management strategy is that control measures are to be undertaken only when damage levels reach or exceed the economic threshold level.

The cost due to damage should exceed the cost of control. This is the economic threshold level.

For instance,
l10 pests - 12 panicles - Damage value = Rs. 25 and Cost of control = Rs. 50 this is clearly not right

25 pests - 12 panicles - damage value = Rs. 75 and cost of control = Rs. 50 then this is right.

Integrated pest management techniques

1. Choosing varieties that are resistant to pest attacks.
2. Removing or destroying roots of previous harvest.
3. Ensuring good drainage as this will help control armyworms, piercing and sucking insects
4. Applying nitrogenous fertiliz

Table for economic threshold level in paddy and groundnut

Name of the pest	Economic threshold level
Leaf miner	2 worms per plant or 10 percent of leaves
Red haired caterpillar	8 egg masses in 100 meters
Heliothis	8 egg masses in 100 meters

For paddy ▼ *For Groundnut* ▶

Name of the pest	Economic threshold level
Thrips	10 percent in one square meter or 60 pests on a wet palm, in 12 different locations
Stem borer	2 egg masses in one square or 10 percent of dry central shoots and 2 percent of white ears
Brown plant hopper	one pest per tiller or 2 pests for one spider in a clump
Armyworm	10 percent of damage in tillers
Leaf folder	10 percent in initial stages and 5 percent of damage in boot leaves during the flowering stages
Ear head bug	5 pests per 100 panicles during the flowering stages and 16 per 100 panicles during the milking stage
Green leaf hopper	60 pests per 25 net sweeps, 5 pests per clump during the growing stage, 10 pests per clump during flowering stage. In tungro affected areas, 2 pests per clump.
Black bugs	5 pests per clump or 10 percent damage in leaves

ers in split doses will help con trol sucking insects.

5. Timely weed removal helps prevent associated pest attack.
6. Pests can be estimated using light traps and proper control measures can be adopted.
7. A good water management practice is a preventive measure for all times.
8. Pesticides should be used only when the damage levels exceed the economic threshold level
9. Some spiders, damsel flies, ladybird beetles are natural pest killers. If they are found in more numbers, pesticides should be avoided.
10. Reflector tapes in the field will help avoid birds.
11. Using bio-fertilizers instead of chemical fertilizers.

The above low cost techniques helps pest control, preserve pest predators and prevent environmental pollution.

Integrated disease management

Disease attack is one of the several factors that affect crops. Often farmers wrongly believe that using fungicides after the disease has caused damage is the only way to manage diseases. Control after infection is not only troublesome but also expensive. But integrated disease management begins right from ploughing. Prevention of disease rather than control after attack is the fundamental idea behind integrated disease management. Some of the techniques are:

1. Proper ploughing of land disintegrating weeds and paddy shoots will prevent many diseases.
2. Using certified and quality seeds.
3. Choosing varieties that are not prone to infection.
4. Seed treatment with bio-fungicides before sowing
5. Optimal use of farmyard manure, green leaf manure, chemical fertilizers and micronutrients is a good preventive measure in itself.
6. Using nitrogenous fertilizers in split doses.
7. Adopting proper spacing tecniques.

Twenty-one out of 25 paddy trails plots that were established by FERAL showed marked improvement in yields after seed treatment. The seeds were treated with Pseudomonas and the same was applied after transplantation.

Fifty six percent of our 25 groundnut plots showed improved results after seed treatment using *Trichoderma* and *Pseudomonas*.

Conclusion

As farmers you are aware that agriculture is highly dependent on nature.

In today's context, agriculture is facing a crisis. Inadequate monsoons, water scarcity, subsidy cuts and price hike for fertilizers and other inputs tend to increase the cost of cultivation. However, adoption of proper cultivation techniques in itself can help reduce cultivation costs.

We hope that farmers make use of the information provided in this booklet and adopt integrated strategies to reduce cost and gain higher yields, and to make agriculture a profitable enterprise.

FERAL is a non profit Trust whose mandate is to apply ecological research to solve issues in natural resource management, conservation and advocacy through building capacities of the different individuals, communities and agencies involved.

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ICEF is a development cooperation project of the Government of India and the Government of Canada with the aim of enhancing the capacity of Indian organizations, public and private, to implement sustainable development projects in water, land and energy sectors.