necessary regulatory directions with a view to preserving and protecting the groundwater.

On 14 January 1997, the Ministry of Environment and Forests vide its notification SO 38 (E) constituted Central Groundwater Authority under sub-section (iii) of Section 3 of Environment (Protection) Act, 1986 (GOI, 1997) (ref. 1).

As per the notification, the jurisdiction of the authority will be the entire country and it will function under the administrative control of Ministry of Water Resources. The Central Groundwater Authority (CGWA) is vested with powers under Section 5 and 15 to 21 of Environment (Protection) Act, 1986 to carry out its functions. The Ministry of Water Resources prepared a model bill for enaction by all State Governments for regulation and control of the development of groundwater under Groundwater (Control and Regulation) Act (GOI, 1992) (ref. 2). Here, the procedures for constitution of State Groundwater Authority (SGWA), powers to notify areas and grant permission and restrictions for control and regulation of groundwater development have been described in detail.

CGWA is issuing notices to persons/agencies engaged in construction of wells to get registered. They should also submit information about the number of drilling machines and ancillary equipments, area of operation, etc. to the Regional Directors at 16 Regional Offices of CGWB before 31 December 1998.

Radhakrishna has rightly pointed out the important measures to check further deterioration of the groundwater. CGWA is vested with powers to conserve the groundwater resources and regulate the development of groundwater. The contention of Radhakrishna that Government agencies are not taking any interest is not true. The government of Andhra Pradesh has recently started an innovative scheme for storing of surface water for recharging the groundwater reservoir.

Wetlands including ponds and lakes should not be affected or used for any development activity in villages, towns and cities. The local panchayats and the State Governments have more role to play in this regard. Areas with declining groundwater level, pollution, salinity hazards, etc. should be immediately identified to help authorities to take appropriate steps to evolve district-wise groundwater management and planning programmes in the State.

Apart from this challenging problem to control the depletion of groundwater, more threat is now felt about pollution of groundwater sources. The ground water contamination is posing severe health hazards in many areas. The data collected by CGWB, Bhubaneswar for Orissa (CGWB, 1998) (ref. 3) reveal that groundwater is contaminated with high salinity, iron, fluoride and nitrate in many districts.

The pollution of drinking water sources need to be immediately tackled by concerned District authorities before it becomes a catastrophe for the human survival in these areas. Groundwater contamination has been reported in many parts of the country including many areas in West Bengal and Delhi. The local voluntary organizations, the district authorities and village panchayats should also help CGWA to take appropriate action and chalk out strategies for management of groundwater development. Industries, mining and housing organizations must not harvest groundwater resources in those areas where already significant adverse impact has been noticed. They must ensure that effluent discharge to any water source must meet the prescribed norms. Zero discharge concept is always advisable for projects to save precious water resource. Surface water harvesting may be encouraged in these areas.

It is hoped that the concerned authorities will act responsibly and the problem of groundwater depletion and pollution will be contained with the help of the public and legal instruments in force.

1. GOI, 1997. Notification No. SO (38E) dated 14.01.97, Ministry of Environment and Forests, New Delhi.
2. GOI, 1992. Model bill to regulate and control the development of groundwater, Government of India, Ministry of Water Resources, New Delhi.
3. CGWB, Groundwater quality problems in Orissa. (Table 11.1) Central Groundwater Board, South Eastern Region, Bhubaneswar, 1998.

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'Terminator' transgenics

'Genetically engineered crop seeds that turn sterile after first use threaten Indian farmers'; 'Scientists flay terminator gene; seek immediate government intervention'; 'Terminator seed'; 'Seed material with terminator gene banned'; 'Terminator gene may sneak in despite ban'; 'US co. not to be granted patent for terminator gene'; 'Centre warned of the repercussions if terminator gene sets foot on Indian soil'; 'IISc caught in terminator wars'.

The above is a sample of the headlines that have appeared in the past few months in our reputed general and financial newspapers. Much more than due publicity has been given in the press to the so-called 'terminator' gene technology and its hazards have been over-exaggerated. I wish that the newspapers give equal coverage to the more positive developments in crop biotechnology. The over reaction, not only of the activists and reporters, but also of the agricultural scientists calls for a more rational, scientific appraisal of the possible hazards. The multinational company Monsanto which is indicted for the 'terminator' refers to the new concept as 'the gene protection technology'. Monsanto has clarified that the technology is conceptually developed by Delta and Pine Lands (D&PL), and an idea patent has been filed jointly with the US Department of Agriculture in USA[1]. While Monsanto has stated that 'terminator' seeds or plants do not exist, one report mentions that the technology has been tested in tobacco and cotton[2]. It is also reported that the Government of India has banned the import of this technology, and further, the pat-

ent will not be granted to this technology in the country.

I would not go into the need for such technology; it can be argued both in favour or against. The intention here is to examine the 'terminator' threat and the concerns that have been raised in the press. It is important to recall that just about 10 per cent of the area sown in the country uses the purchased seed, the rest is planted with seed saved by the farmers from the previous harvest. Seed industry has many players, including the Government-owned National and State Seed Corporations and several local, and a few multinational private seed companies, mainly selling hybrid seeds of vegetables, cotton, sunflower, *sorghum*, *bajra* and maize. In the absence of any protection of the breeder's rights, private seed companies are reluctant to develop and sell seeds of self-pollinated crops. Hybrid seeds are protected by guarding the parental stocks, and if the produce is used to raise the next crop, yield is significantly lower.

Only if the concept works satisfactorily, the 'gene protection' traits would be introduced in other predominantly self-pollinated crops. Let us assume that the technology works well and is profitable for the seed company. For introducing such transgenics in the country, the company will have to follow the biosafety regulations for experimentation and field release of transgenic crops. It would require approvals from the Institutional Biosafety Committee (IBSC), Review Committee for Genetically Modified Organisms (RCGM) of the Department of Biotechnology and the Inter-Ministerial Genetic Engineering Approval Committee (GAEC) of the Ministry of Environment and Forests, besides the mandatory evaluation under the Coordinated Crop Improvement Programmes of the Indian Council of Agricultural Research and/or the State Agricultural University before they can sell the seed. The new cultivar with 'gene protection' traits should also be significantly superior to the existing cultivars to compensate for the higher seed cost. Farmers will buy the seed of new cultivar only if they are convinced of tangible benefits and higher returns from the crop raised using new seeds, just as they pay a higher price for hybrid seeds of several crops mentioned earlier. It is difficult to understand how a seed company can force the farmers to plant only the seeds which they sell. How can any company make the farmers dependent upon their seed alone? This does not happen in other areas, for example, in pharmaceuticals or pesticides used by the farmers. Even for life-saving drugs, cheaper, though less effective, alternatives are always available. The apprehensions raised undermine the intelligence, and economic sense of the farmers. Even an illiterate farmer knows what is profitable for him.

It has been argued that some companies or individuals may smuggle such seeds and grow them. Items are smuggled only if they are advantageous, and imports are not permitted or are highly taxed. Besides how much area can be planted with smuggled seeds? In case of transgenic seeds, it would be violation of the law, and a crime under the environmental protection act.

Spread of 'gene protection' transgenes into other cultivars grown in the neighbouring fields, through pollen is a possibility which will have to be examined in depth by the IBSC and RCGM for each crop. The out crossing rates vary from less than 1% in most self-pollinated crops to 15–20% in often cross-pollinated crops such as pigeonpea (*Cajaus cajan*). However, the resulting seed of the outcross would not germinate and hence, would be the 'dead end' for the gene spread. Thus, the apprehensions raised on the spread of such genes to other crop cultivars and ill effects on natural biodiversity lack sound, scientific basis. Such seeds cannot 'wreak havoc' with our agriculture or 'end our entire biodiversity' or 'cause famine and political instability' as reported[3].

We as a nation fail to accept the realities. Though we have signed the WTO agreement, mandatory legal means for the protection of crop varieties, the plant breeders rights, and intellectual property rights are delayed. Crop Variety Protection would eliminate the need for 'gene protection' in self-pollinated crops and attract private plant breeding initiatives. The public and private plant breeding efforts, including transgenics, should complement each other to provide better seeds to the Indian farmers. Above all, the priority should be to make available certified seed of the new cultivars already released and notified.

1. US firm allays fears on terminator gene, *The Hindu*, New Delhi edition, 28 August 1998.
2. US co. not to be granted patent for terminator gene, *Economic Times*, New Delhi edition, 3 August 1998.
3. Seeds of discontent, *Hindustan Times*, New Delhi edition, 26 July 1998.

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The terminator: Saga continues

In my article entitled 'The terminator saga' (*Curr. Sci.*, 1998, **75**, 416–419), I had explained the basic principles of regulation of gene expression (based on Jacob–Monod model) and how gene expression can be possibly regulated tissue specifically or development stage specifically. Since the article was meant for the nonspecialist, I had tried to 'oversimplify' the concepts and had clearly mentioned that they were only the basic principles. Evidently, the technology used for the *terminator* concept is much more complex. For that reason precisely, I did not name the *terminator* and how its expression is specifically regulated or how a seed carrying only the endosperm but not the embryo can be generated. I had indicated that the *terminator* expression was under the dual control of a developmentally regulated promoter as well as the repressor control element in addition to the modulation achieved due to the presence of an intervening stuffer DNA flanked by the *lox* sequences. In an article on the terminator technology (appearing in this issue of *Current Science*), P. K. Gupta has explained some of these aspects more elaborately including the basis of terminator technology utilized in hybrid seed production. While adapting my figures, Gupta has