of which could be distributed among many owners or shared by patent holders, but human genes are owned by humans.

Biologists, ethicists and judges need to form a forum and discuss the future, because the gene database indicates that the tentacles of patenting may engulf the life forms; today each and every human chromosome has patented loci. Within a decade, whole chromosomes will be patented. Patenting genes, and then heading for patenting chromosomes would definitely restrict research, minimize wider applicability and sanctity of scientific freedom to investigate the fields of genomics, proteomics and related therapeutics. I also intend to endorse the statement[1], 'does that mean that researchers must spend more time fighting in the courts than looking for a cure'?

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Climate change and crop breeding objectives in the twenty first century

The earth's climate system is experiencing a warmer phase. Concomitantly, India is facing a climate change of considerable magnitude. Recently, researchers have projected region-wise scenarios of rainfall and temperature changes, impact on hydrology of river basins and consequences for India in the twenty-first century respectively[1–3]. High-resolution climate change predictions[1], based on the Regional Climate Modelling (RCM) system PRECIS (Providing Regional Climate for Impact Studies) developed by Hedley Center, envisage that as the twenty-first century progresses, there will be (i) rise in temperature ranging from 2 to 6°C, with higher levels of warming in the northern part of India than in the southern parts; (ii) rapid increase in night temperatures compared to day temperatures; (iii) 15 to 40% increase in rainfall over all the states, especially those in the western and central-west parts of India, excepting Punjab, Haryana, Delhi, Rajasthan and Tamil Nadu; (iv) a general reduction in the quantity of run-off water, and (v) an adverse effect on agricultural productivity. The effects of climate change, predicted far in the future for India by the models, are in fact already on the horizon.

Food (and fuel) security is a national imperative. About 60% of land in India is already under crop cultivation; the adverse effects of climate change on agricultural production are impossible to be mitigated by adding area under agriculture[4]. Accordingly, crop productivity must be stabilized against climate change, by adoption of all possible measures, including better water management on the one hand and induction of agricultural technologies that meet the challenges of warmer temperatures and local scarcity or sudden excess of water, on the other hand. India needs to tailor its agriculture according to the emerging agro-ecological changes in a region-specific manner. This discussion pertains to the need for new cropping patterns and crop varieties to meet the imminent climate changes in the northern Indo-Gangetic Plains (parts of Himachal Pradesh, Punjab, Haryana, Rajasthan, Uttar Pradesh, Uttaranchal, Bihar, Jharkhand and West Bengal) and central-western Indian region (parts of Madhya Pradesh, Andhra Pradesh, Gujarat, Maharashtra, Goa and Karnataka), where the climate change effects on agricultural productivity are predicted to be most pronounced. The Indo-Gangetic Plain has been the bread-basket and now in the present changed climate scenario, the central-western India can also be made to assume this role.

Increase in temperature and atmospheric CO_2 concentration are the other two major effects of climate change, besides increase or decrease in the local rainfall[1–3]. Higher temperatures are expected to improve or retard seed germination, plant growth and/or plant development, depending on the relative sensitivity or tolerance of crop genotypes. The increased CO_2 concentration will have a positive effect on productivity, albeit in a crop genotype-dependent manner. The new crop varieties for large parts of the country, including the Indo-Gangetic Plains and west-central regions, will have to be tolerant to high temperature throughout their life cycle. To take advantage of faster growth under higher temperatures, the new varieties, especially of the *rabi* cropping season should have characteristics of early flowering (photo- and temperature-insensitivity, but development-related onset of flowering) and early maturity and high produce. Wheat, mustard, chickpea, lentil, pigeonpea and potato varieties should have alternate genetic make-ups to fit into area- and need-specific cropping patterns and schedules. There will be requirement for the so-called upland rice varieties that can be cultivated aerobically with irrigation, not requiring standing water conditions like those for conventional rice varieties, without major compromise in yield. In the changed climate scenario, at places where assured irrigation facilities exist despite rain-water deficit, with the availability of suitable varieties, it may be possible to take up to four crops in a year, instead of three, two or one in the past.

To provide food security and some degree of energy security, India needs to meet its requirements for cereals (wheat and rice), pulses (chickpea, pigeonpea and moong- and urad-beans), oil seeds (rape/mustard, soybean, groundnut, sunflower) and potato and sugarcane (the latter three being simultaneously the fuel and food crops). Interestingly, all these crops are cultivated in the Indo-Gangetic Plains as well as west–central India, areas that are to face climate change in most drastic forms. It is believed that about 50% of the available irrigation water in India is used for rice cultivation and productivity of other crops is dependent on the remainder. Large requirements of water for rice cultivation dictate that in view of the expected/prevailing water-stressed condi-

tions due to growing deficit in rainfall, conventional rice cultivation must be lowered in the Indo-Gangetic Plains and greatly expanded in the northwestern peninsular or central–western region of India, wherein a highly significant rise in rainfall is predicted/occurring. To keep the western parts of the Indo-Gangetic Plains as a major food grain-producing region, despite the adverse effects of climate change, is the major challenge for future agricultural research.

The Indo-Gangetic Plains can continue to be the major producer of food crops, despite lesser availability of irrigation water, provided new varieties are cultivated in location-wise, judiciously selected cultivation schedules. Traditionally, there are three cropping seasons in the area: *rabi* or winter season from October/November to March/April; *zaid* or summer season from March/April to June/July; *kharif* or rainy season from July/August to October/November. The following cropping schedules could be practised with the use of suitable varieties for high yields in the era of climate change: potato/rape/mustard – wheat/chickpea/lentil (in *rabi*) – moong-bean/soybean (in *zaid*) – aerobic rice/pigeonpea/soybean/urad-bean/cotton (in *kharif*). For higher profits to farmers, the essential oil crop menthol mint and medicinal crop, Artemisia could substitute for mungbean/soybean/cotton in *zaid* season, as suitable varieties of these crops are already available. Sugarcane, a water-intensive crop, should be continued to be cultivated in the Himalayan *tarai*/foothill region for strategic reasons. Also, mustard may be grown in the area with irrigation for high yields, again for augmenting liquid biofuel supply.

Mustard crop could be taken twice in *rabi* season, if suitable short duration and early maturing varieties become available. Cotton crop gives lint as well as oil and it could be a grown in wider areas during *kharif* season. Potato should assume the role of a staple food. India will need to produce 120 million tonnes (mt) of wheat, 25 mt of pulses and 100 mt of oil seeds (50 mt for biofuel purposes) by 2025 (refs 4 and 5). The Indo-Gangetic Plains should become a major supply region for these commodities in the changed climate situation.

Crop breeding programmes to develop temperature- and drought-tolerant high-yielding cultivars of the identified crops should be initiated urgently, so that the desired kinds of varieties are available when climate change effects are experienced consistently. The genetic resources, especially land races from areas where past climates mimicked the projected future climates for agriculturally prime areas in India, could serve as the starting genotypes for building the genes for tolerance, maturity and yield features. Considerable progress has been made in the genetic dissection of flowering time[6,7], inflorescence architecture[8], temperature[9,10] and drought tolerance[11,12] in certain model plant systems and by comparative genomics in crop plants. A combination of conventional, molecular marker directed, mutational and transgenic-breeding approaches will be required to evolve the desired kinds of crop cultivars. Crop-based coordinated programmes need to be launched to develop early-maturing, high-yielding and temperature- and drought-tolerant varieties as early as possible. Recently, the Indian Agricultural Research Institute, New Delhi has released an early-maturing wheat variety suitable for late planting. It appears that desired kinds of genotypes can also be selected in some of the ongoing breeding programmes. There will be need for identification of areas where the climate change conditions already exist or are mimicked (for example, Rajasthan–Madhya Pradesh–Uttar Pradesh border areas for the Indo-Gangetic Plains) and/or setting up of suitable environmental chambers for the purposes of screening large segregating populations to make selections. The climate change needs to be converted from a difficulty into an opportunity.

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Counterfeit drugs: problem of developing and developed countries

There has been an alarming increase in counterfeit drugs, which now represent 10% of the global market for medicines[1]. In some countries the counterfeiting of drugs is endemic, with some patients having a better probability of getting a fake medicine than a real one.

WHO has defined a counterfeit drug as follows: 'À counterfeit medicine is one which is deliberately and fraudulently mislabelled with respect to identity and/or source. Counterfeiting can apply to both branded and generic products and counterfeit products may include products with the correct ingredients or with the wrong ingredients, without active ingredients, with insufficient active ingredients or with fake packaging.' Counterfeit medicine was first mentioned as à problem at the WHO Conference of Experts on Rational Drug Use in Nairobi, Kenya in 1985. Since then, WHO has received many reports from developing and developed countries.

Counterfeit medicine is the brainchild of criminals who want to make huge profits at the expense of innocent people.