CURRENT SCIENCE

Volume 66 Number 6 25 March 1994

NEWS

Medicinal and aromatic plants

The Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow, organized a five-day training programme between 7 and 11 December 1993 Over 100 scientists and private entrepreneurs from all over India participated in the programme of which the central theme was *cultivation and processing of medicinal and aromatic plants* Medicinal and aromatic plants constitute a major source of natural organic compounds widely used in medicines, food products, cosmetics and paints that are of paramount importance in everyday life Therefore, their importance in today's global economic scenario cannot be overemphasized. The most important messages that emerged from the programme were. (i) it is vital for the scientists in the lab and the cultivator/entrepreneur in the field to work hand-in-hand; (ii) effective land use combined with mixed cropping is the best way to achieve sustainable development.

After formal inauguration, A. Singh summarized the present status and future prospects of cultivation and processing of medicinal and aromatic plants. The total export value of major essential oils and crude drugs in India (1990–91), was Rs 34 04 crores, Rs. 76 47 crores and Rs. 8 84 crores from essential oils, medicinal plants and others, respectively. The total import value for major essential oils and crude drugs was Rs 18.87 crores during the same year. B. R. Tyagi reviewed recent developments in mint cultivation. A Kumar presented a brief account of the activities of CIMAP, particularly in developing new agro-technologies and processing techniques towards attaining self-sufficiency Details of CIMAP's Integrated Information Services like Current Awareness Services covering information on agronomy, genetics, plant physiology and biochemistry etc; statistical data on production, marketing and international trade, and requirements of Indian pharmaceutical perfumery and flavouring industries are available in the form of published articles/books/reports.

Tajuddin revealed some startling facts on the annual production of lavender and rose oils, which varies from 2–5 and 5–50 kg yr^{-1} respectively in India to several tons yr^{-1} in Bulgaria, which has a tiny area of only 43 square miles. A vast country like India has to import lavender and geranium oils worth Rs 3 5 crore annually. The annual requirement of lavender oil in India is 60 tons while the world requirement for rose oil is about 40 tons. It is estimated that lavender cultivation would yield profits of the order of Rs 75,000 ha^{-1} after the third year.

Other important crops discussed were mint, Japanese mint, Indian basil, lemon grass, vetiver, ergot rye, citronella, pamarosa, belladonna and patchauli. The significant role of Vetiver (*Vetiveria zizanioides*), commonly known as 'Khus', was visualized in reclaiming the problem soils as this plant generally grows in a variety of degraded soils which include waterlogged, saline and alkaline as well as sandy soils. M. Alam and D. Singh discussed at length the pest and insect problems. S. K. Agarwal summarized the latest about the distillation units and various problems during their operation.

J. Singh presented data collected during various ethnobotanical surveys on medicinal and aromatic plants. He mentioned a herbal product which has been claimed to mop up uranium and other longlived isotopes from nuclear waste The product, originally isolated from the seeds of *Strychnos potatorum*, can remove cadmium, mercury and other toxic heavy metals from factory effluent and can bind to metals such as gold, silver, cobalt, copper and nickel The pH plays a significant role in binding the metal The ability of seeds to bind metals stems from the presence of certain proteins. This was subsequently confirmed by Clement Furlong of the University of Washington.

An entire forenoon was devoted to field demonstrations which included. (i) nursery-bed preparation (ii) transplanting and (iii) distillation The penultimate session was dominated by S. K. Varshney, a leading entrepreneur from Delhi, who was concerned about the prevailing gap between market surveys and development of various agro-technologies. He felt that the research projects undertaken by government-funded agencies were not preceded by adequate surveys to ensure the viability of such projects. Critical of scientists, he offered to fund pilot research projects provided they were result-oriented The role of the National Bank for Agriculture & Rural Development (NABARD) and Canara Bank as funding agencies was also discussed. NABARD formulated model schemes on Palmarosa, Germanium, Belladona and Sarpgandha for potential areas The refinance disbursement share of medicinal and aromatic plants of the bank rose from 0 03% (1983-84) to 0 59% (1991-92) in the total disbursement of horticulture sector It offered the entrepreneur bank finance for the cultivation of medicinal and aromatic plants, cultivation and distillation units, distillation and further value addition, such as *Menthol crystal* *manufacturing* in four different ranges, (i) up to Rs 50,000, (ii) Rs 50,001–100,000, (iii) Rs 100,001–7.5 lakh, and (iv) over Rs 7.5 lakhs. Canara Bank also presented the general guidelines governing their agricultural finance as crop loan.

The issues such as the impact of the new liberalized global economic policy on the import/export of by-products of the aromatic and medicinal plants, high cost of distillation units especially where the production is low, lack of modern pre- and post-harvest techniques as existing conventional practices consumes considerable man-hours with low input, R&D project funding, and scientist-entrepreneur coordination formed the basis for much heated debate among the participants.

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SCIENTIFIC CORRESPONDENCE

Declining trend in MSc and PhD manpower: Modelling and forecasting

During 1938–47, the number of students graduating with Master's degree in sciences from Indian Universities was about 6560 of which 259 (4%) went on to take PhD degrees[1]. This number increased to 12% (23,934 PhDs out of 206,343 MScs) during 1980–89 (ref. 2).

In this paper we study this growth trend and look for a mathematical model which would capture the process of growth and make projections for future. We note that the observed trend is the result of not only the facilities (such as available seats) but of wider socio-economic factors such as supply and demand. It is this dynamics of growth that we wish to capture in model formulation.

Here we present in brief a model and forecasts for the total numbers of MScs and PhDs. For subject-wise analysis, details of various other models and a comprehensive review of literature, we refer to our report[3].

When a new course of study is introduced those who graduate influence the newcomers; one person talks to another and influences him/her about its utility, two influence four, four influence eight, eight influence sixteen and so on. That is the number of people who are convinced about the utility of the course grows. This mechanism of growth is similar to the colony of biological cells in a medium, which grows through cell division and is described by the logistic equation

$$dN/dt = qN\,[1-(N/M)], \qquad (1)$$

where M in biological growth denotes the carrying capacity of the environment and in the context of MScs and PhDs, represents the total possible number of people who ultimately acquire the degrees. N is the number of degree-holders at time t and q is a constant growth parameter. The growth follows a S-curve and is such that it is almost exponential in the beginning, slowly tapering off and ultimately vanishing when the total number N reaches M.

The above mechanism also holds for the growth of a new product, technology, or idea, where the person who adopts an idea influences another, two influence four and so on. This can be interpreted as a growth which takes place in any socio-economic environment through the interaction between those who have adopted the product N and those who are potential adopters, $(M-N)$. In fact, equation (1) which was formulated by Verhulst as early as 1835 for biological growth is known as the Mansfield model[4] of technology diffusion and is extensively used in modelling new product diffusion[5–8]. The mechanism of growth of an academic discipline is similar to that of a new technology, product or idea, as the MScs and PhDs can be thought of as products of the education sector.

In equation (1) N, the cumulative number of those who have acquired the degree, is not the same as the total stock at that time, since our influencing agents include even those who have retired. N must exclude those who leave because of death. However, since in India major expansion in academic manpower has come around early sixties, the number of those who leave because of death can be assumed to be small.

The meaning of M, in the context of cumulative manpower needs explanation. Since, in general, seats for MScs and to some extent PhDs, remain fixed, technically there should not be a finite M, i.e. an upper limit to the cumulative manpower. Why then do we introduce M? This is because, in a long-term perspective, once the existing degrees and qualifications become non-productive and unattractive, the facilities would remain unutilized. If this happens there will be a decline in the out-turn and such a data would visualize a finite M. Thus existence of M implies a possible saturation in growth. Such a trend is indeed noticed in the actual data (Figures 1, 2).

Within the framework of this model, the growth trends in Figures 1 and 2 are seen as consisting of three S-curves. Since two of them start at higher value of MScs and PhDs we introduce a parameter p which has the effect of shifting the y (out-turn) axis. Our model equation thus becomes

$$dN/dt = qN\,[1-(N/M)] + p. \qquad (2)$$

The model parameters q, M and p for three s-curves are determined by fitting the past data[2] to equation (2) using SYSTAT package[9]. The values of the parameters and their fit statistics are