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Diversity of ginger cultivation in India - a GIS study

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Abstract

The climatic conditions of important ginger (*Zingiber officinale*) growing states of India were analysed with the help of Geographic Information System (GIS). The Eco-crop model of DIVA-GIS indicated that Orissa, West Bengal, north eastern States and Kerala are environmentally most suitable for ginger cultivation.

Keywords: ginger, GIS, site suitability, *Zingiber officinale.*

Introduction

Ginger (*Zingiber officinale* Rosc.) is a tropical plant adapted to grow even in regions of subtropical climate at high elevations. Ginger grows well in warm humid climate from sea level up to an altitude of 1500 m above MSL (optimum elevation is 300–900 m). Ginger is grown usually under rainfed (3000–4000 mm) and sometimes under irrigated conditions. For successful cultivation of the crop, good and well distributed rainfall during the growing period and dry weather of one month prior to harvesting is required. Ginger thrives best in well drained sandy loam rich in organic matter and in clayey loam soil with good drainage and aeration, supplemented with organic matter (Johny & Ravindran 2002).

India is the largest producer of ginger in the world. The area under the crop has increased to 62,000 ha in 2003 compared to 17,000 ha in 1950–51. Similarly, the production has also increased from 15,000 t to 1,86,000 t over the same period (Datta *et al.* 2003). However, the area, production and yield has started declining since the early seventies; in fact the productivity has declined in absolute terms during the nineties (Datta *et al.* 2003). Though ginger is cultivated in almost all the states, some of the states show growth in acreage while others in productivity. The aim of this paper is to highlight the reason for the increase in acreage and decrease in productivity with the help of Eco-crop model of DIVA–GIS software. Similar models have been used extensively to evaluate the potential impact of climate change on shifts in the production and growing regions of various crops (Easterling *et al.* 1993; Rosenzweig *et al.* 1995; Tubiello *et al.* 2000; 2002).

Materials and methods

The data on area, production and productivity (2002–03) of ginger were collected from Spices Board, Kochi. The varieties cultivated in different states and the important centres of cultivation were also collected and plotted on the map. The data were plotted using DIVA-GIS to study the climatic influence on the production and productivity. The Eco-crop model of DIVA-GIS which is used here

to study the suitable places for ginger cultivation is the module which uses FAO's database of the environmental requirement of various plant species. This can be used to identify possible crops to be grown in particular environments. This model predicts the adaptation of a particular crop over geographic areas (Robert *et al.* 2003). In this study Eco-crop model of DIVA-GIS (Robert *et al.* 2005) was used and only temperature and rainfall are considered.

In this model the growing period is defined in days between Gmin and Gmax (start of growth and end of the growth, respectively). The suitable temperature and rainfall parameters used are KTMP-absolute temperature

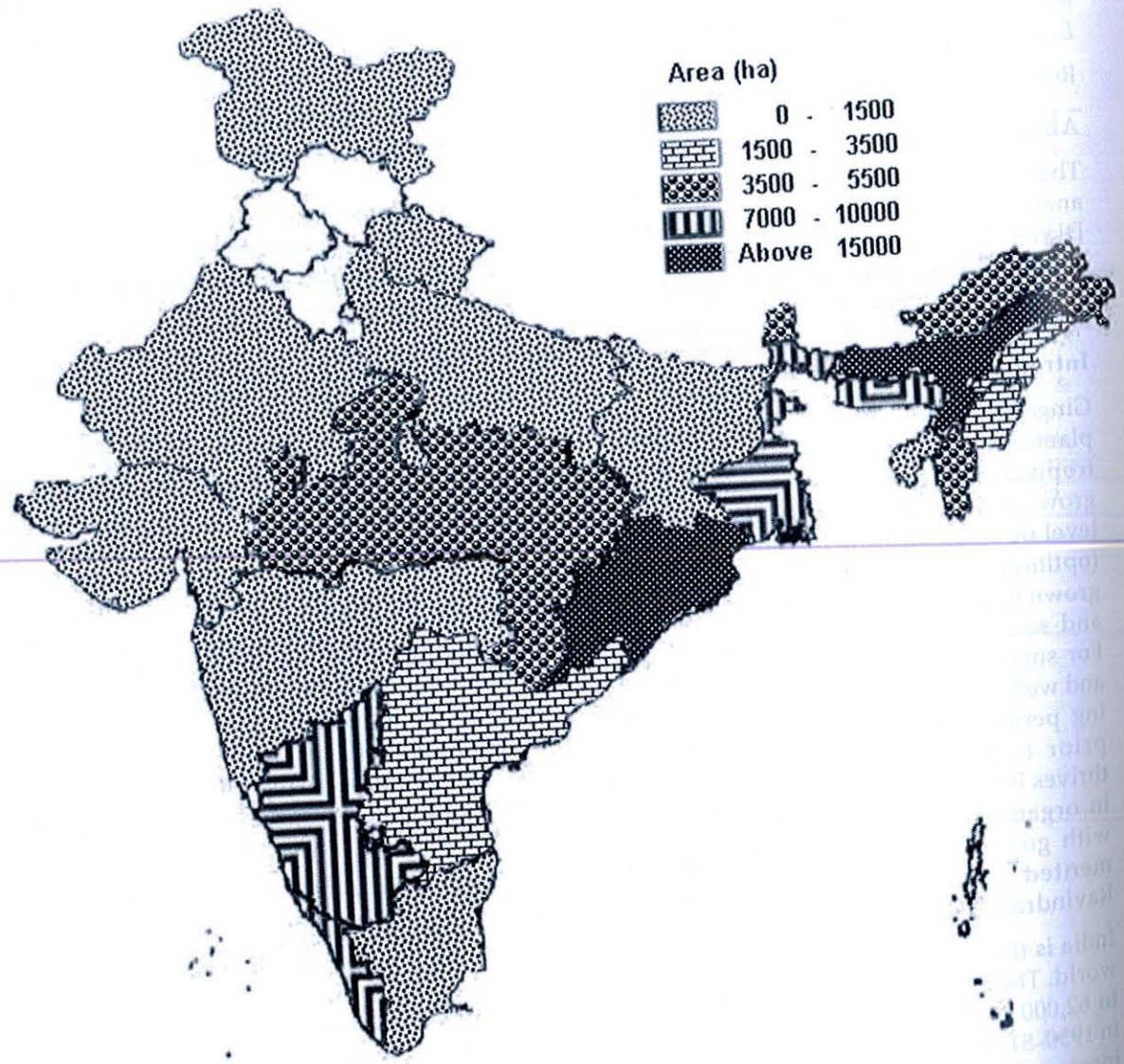

Fig. 1. Area under ginger cultivation in various states in India (2002-03)

that kills the plant, Tmin-minimum average temperature at which the plant will grow, TOPmin-minimum average temperature at which the plant grows optimally, TOPmax-maximum average temperature at which the plant will grow optimally, and Tmax-maximum average temperature at which the plant ceases to grow. In the same way for rainfall Rmin and Rmax–minimum and maximum rainfall during growing period and ROPmin and ROPmax-optimum minimum and maximum rainfall of growing season were used. The suitability map was prepared on a 10-minute grid and included the maximum diversity of the climatic factors such as temperature and rainfall.

Results and discussion

Correlation between area and production of ginger in different states revealed that though

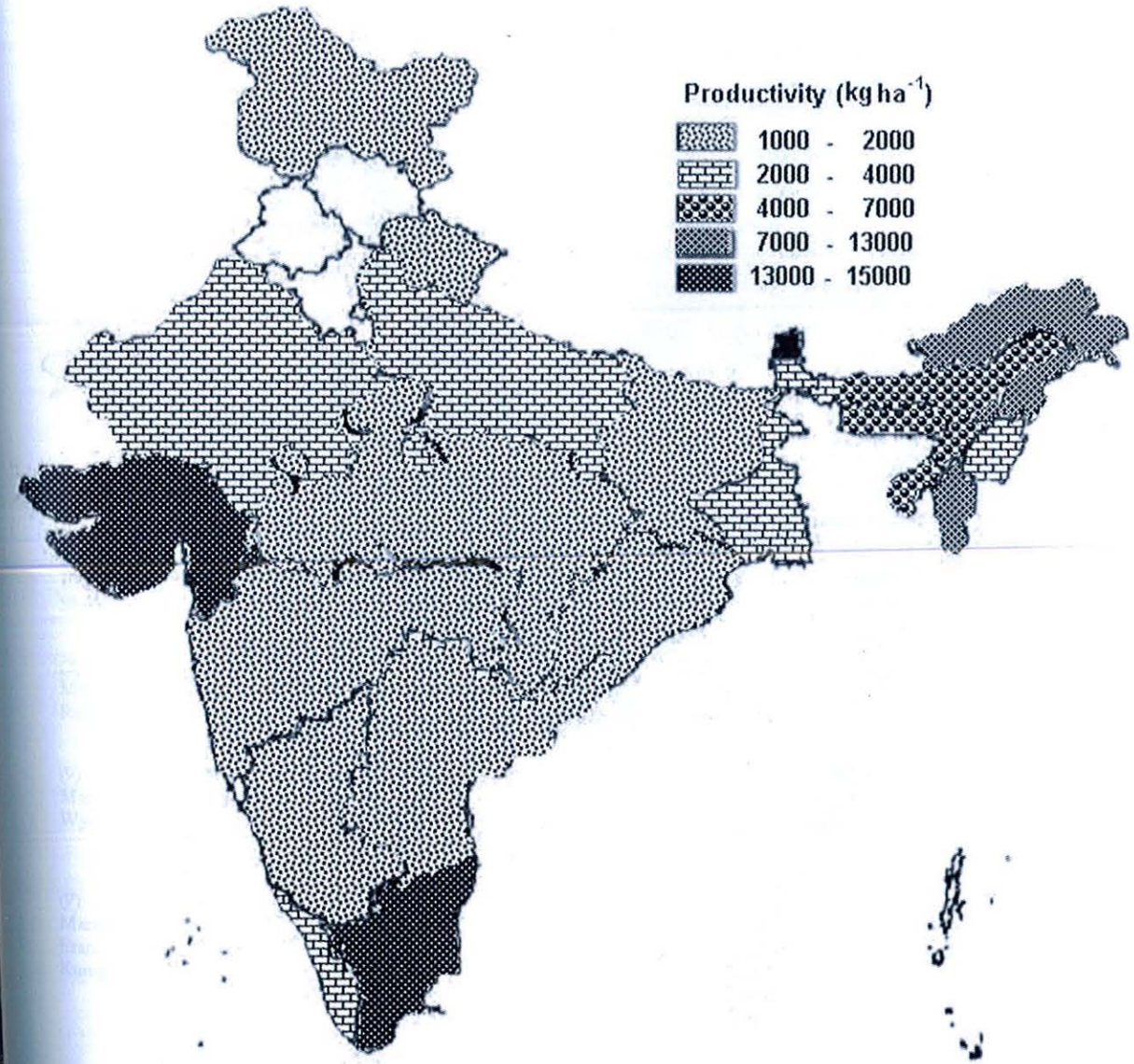

Fig. 2. Productivity of ginger in various states of India (2002-03)

Orissa has a significant growth in acreage under ginger cultivation during the period under study over the earlier periods, the production is low, varying between 3000–7000 t. On the contrary, Gujarat, Kerala and Mizoram have moderate or low area under cultivation but very high production (30,000–46,000 t for Mizoram and Kerala and 10,000–20,000 t for Gujarat (Figs. 1 & 2). In Tamil Nadu insignificant growth in acreage is taken care by its significant growth in yield. The productivity levels of Tamil Nadu and Gujarat were highest followed by Uttaranchal, Mizoram, Manipur and Arunachal Pradesh (Fig. 2). It should be noted that some of the states like Manipur, Tamil Nadu, Andhra Pradesh, Kerala, Meghalaya and Gujarat have recorded more growth in yield than that in acreage; hence productivity is high. On the other hand,

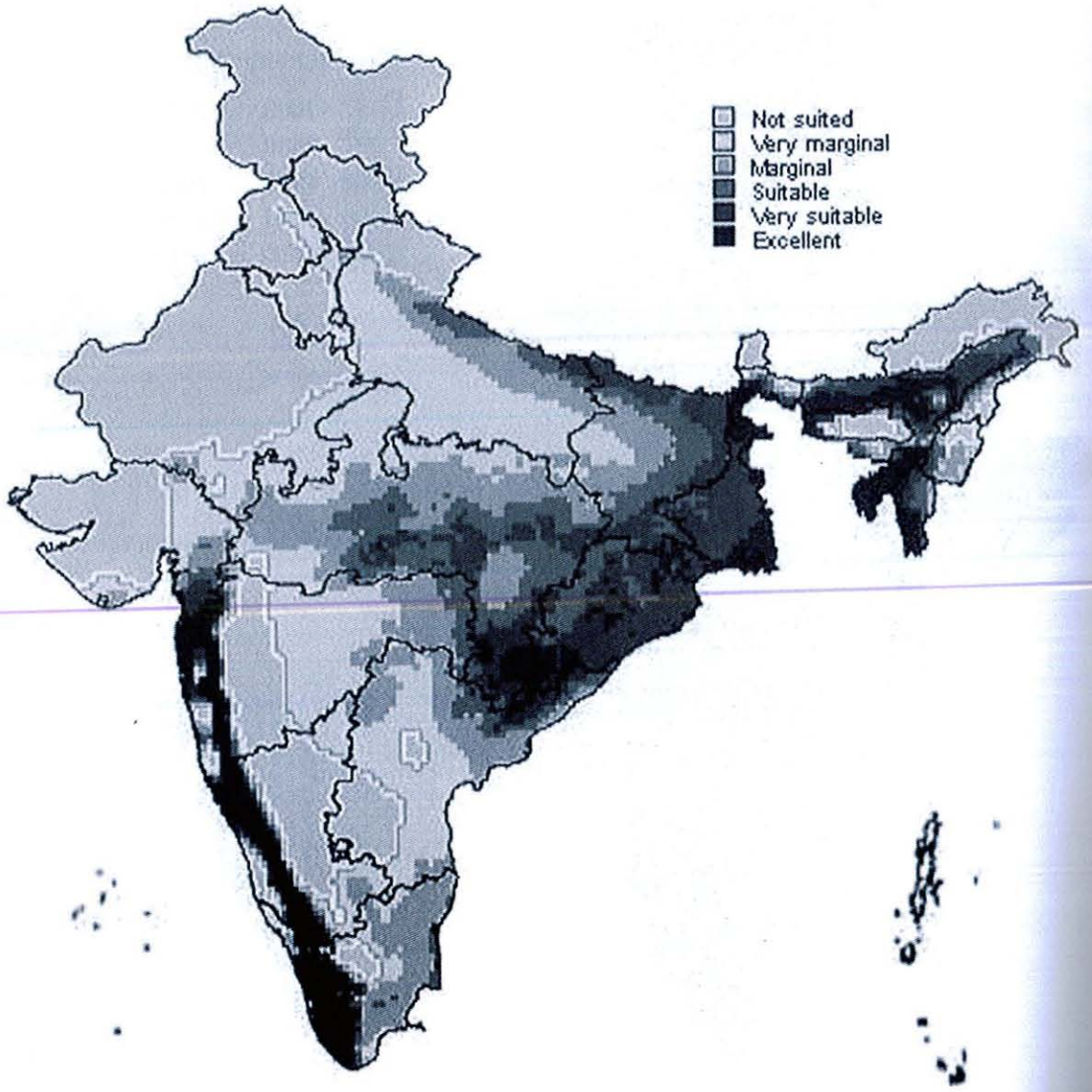

Fig. 3. ECO - CROP model of suitability of ginger cultivation in India

Orissa, West Bengal, Sikkim, Madhya Pradesh and Karnataka showed the opposite trend (Fig. 1).

The Eco-crop map (Fig. 3) shows that the suitability of ginger in Kerala, parts of Mizoram, Manipur and Assam are excellent while West Bengal and Orissa are very suitable. It is interesting to note that Meghalaya, an important state of ginger cultivation having a productivity of 5763 kg ha^{-1}, is partially suitable. The eastern and western parts of Meghalaya are very suitable, whereas central Meghalaya is not suitable possibly due to very high rainfall. The ginger bowl of Meghalaya is East Garo Hills followed by West Garo Hills. These two districts contribute 69% of total ginger production in Meghalaya (Mohanty *et al.* 1994), thereby supporting the Eco-crop model's prediction. It is interesting to note that the entire state of Tamil Nadu is only marginally suitable but has the highest productivity. This is apparently due to the cultivation of high yielding quality varieties like Maran, Nadia and Rio-de Janeiro (Fig 4).

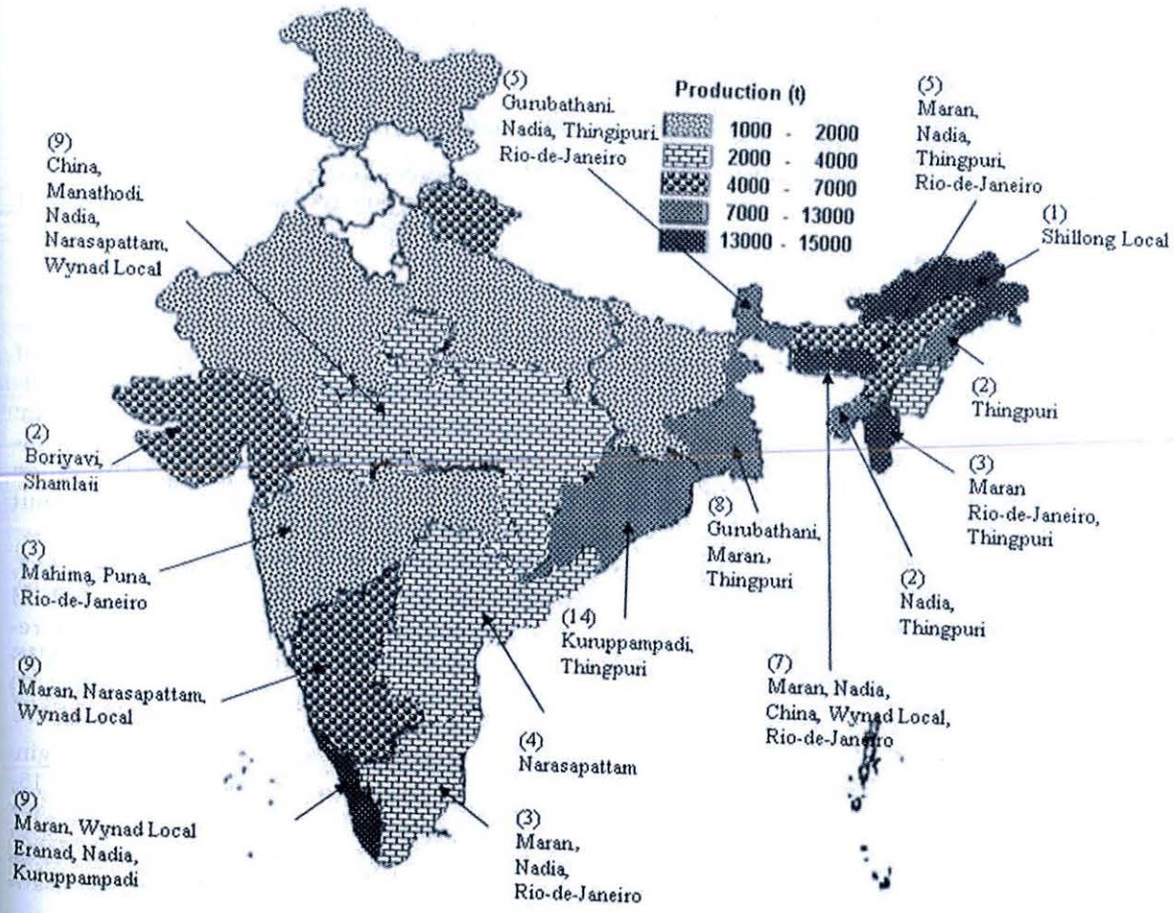

Fig. 4. Production, number of ginger varieties cultivated (in parenthesis) and high quality varieties cultivated in various states in India

Orissa is very suitable environmentally and has the highest area under ginger cultivation. However, the productivity (1920 kg ha^{-1}) is low. This is because the crop is mainly grown by tribal populations and dependent on traditional cultivars and methods (Rath 2004). In fact, the awareness on commercial cultivation of ginger in these areas is less. The north eastern states namely, Assam, Mizoram and Tripura, are very suitable and Meghalaya and Manipur partially suitable with good productivity since almost all the varieties cultivated are high yielders (Fig. 4).

The entire state of Kerala and the entire western part of Karnataka and Maharashtra are excellent for ginger cultivation and the area under cultivation is also distributed accordingly. Kerala has almost 9000 ha under ginger cultivation with a production of 32,410 t. But the trend is different in case of Karnataka which has a low productivity of 1316 kg ha^{-1}.

The results, in general, show that variety and modern cultivation techniques are critical for good productivity. The yield of ginger has been reported to vary greatly depending on cultivars, climate, planting time and maturity at harvest (Peter *et al.* 2005). A map was drawn showing the total number of varieties cultivated and the quality varieties cultivated in the states (Fig. 4). It shows that in Orissa out of 14 varieties cultivated, only 2 are very high yielding, whereas Kerala cultivates 9 varieties out of which 7 are of good quality. Similarly, it is evident that the north eastern states cultivate almost all the good quality varieties like Nadia, Maran, Thingpuri, and Gurubathani which are the local varieties of north eastern India but of very high quality. These states also cultivate China, Rio-de-Janeiro, etc. which are good exotic varieties. States like Bihar, Uttar Pradesh, Kashmir, Rajasthan and Maharashtra have very low area under ginger cultivation coupled with low production. Hence, these states along with Haryana and Punjab, where no data is available were excluded from the study.

Peter *et al.* (2005) mentioned that "environment being a major factor influencing productivity in ginger, demarcating areas having ideal soil and climatic factors is important to achieve high productivity". North eastern states naturally have some good varieties and their climatic suitability is also good leading to high production. But in states like Tamil Nadu and Gujarat, the climate is only marginally suitable and the area under cultivation is low. However, the production of ginger in these two states are significant, apparently due to the use of modern technology. Orissa, Karnataka, Madhya Pradesh and West Bengal which are environmentally suitable should give importance to high quality and high yielding varieties and modern techniques of ginger cultivation to improve the productivity.

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