A chapter from

Adaptation of Chickpea in the West Asia and North Africa Region

Edited by

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1.3. Geographical Information System: Its Use and Relevance in Adaptation of Crops in Varied Agroenvironments

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Introduction

The adaptation of a crop or its cultivar and the associated production techniques are the resultant of an interplay of biological (genetic), physical (soil, climate), and environmental (management, socio-economic) factors. According to Byth and Mungomery (1981), the term adaptation has been applied to both a process and a condition. On one hand, it is used to refer to the actions or processes that keep on changing to suit new circumstances. On the other hand it may be used to refer to the state or condition of "adaptedness", i.e., to the performance of a genetic population in an environment or a range of environments. They concluded that both these aspects influence the degree of adaptedness, and that it is generally difficult to distinguish one from the other.

The central interest of this discussion is the agricultural adaptation of chickpea in the WANA region. In this study, the performance of the crop, will be assessed in terms of the physical environment to understand the causes of differences in response to biotic and abiotic factors.

The aim is to predict the outer limits of the physical environment in some well-defined terms, and compare and contrast the adaptation zones across varied "agroenvironments" within the WANA region.

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The GIS Approach

Geographical Information System (GIS) is a computer-based tool which allows overlaying of geocoordinated maps so as to relate the current intensity of the distribution of the crop and its yield to the physical environment. It is assumed that within- and across-location adaptability reflects the response to a continuum of interactions between physical, biological, and management-related environmental parameters. The software used in this study is PC ARC-INFO version 3.3 (ESRI 1990). This approach would help in understanding fully the factors underlying the differences in performance of the crop across "environments" in the WANA region. An example of this type of study for chickpea in Myanmar, a participating country in the ICRISAT-coordinated Cereals and Legumes Asia Network (CLAN), is given in order to explain the significance of GIS as a tool and to apply it to the WANA region.

Myanmar, a Case Study

Myanmar is located between 11-28°N and 93-99°E. The administrative boundaries of the country are shown in Figure 1.3.1. Chickpea, pigeonpea, and groundnut are important crops in Myanmar.

Crop Distribution in Relation to Agroclimatic Factors

Myanmar's diversity of climate and parent rocks have given the country a wide range of soils, but only Fluvisols, Luvisols, and Aerisols are agriculturally important. Fifteen agroclimatic zones are recognized. These are derived by combining five major soil zones, identified as S1 to S5 (Fig. 1.3.2), with three rainfall regimes, high, moderate, and low, identified as zones R3 to R5 (Fig. 1.3.3).

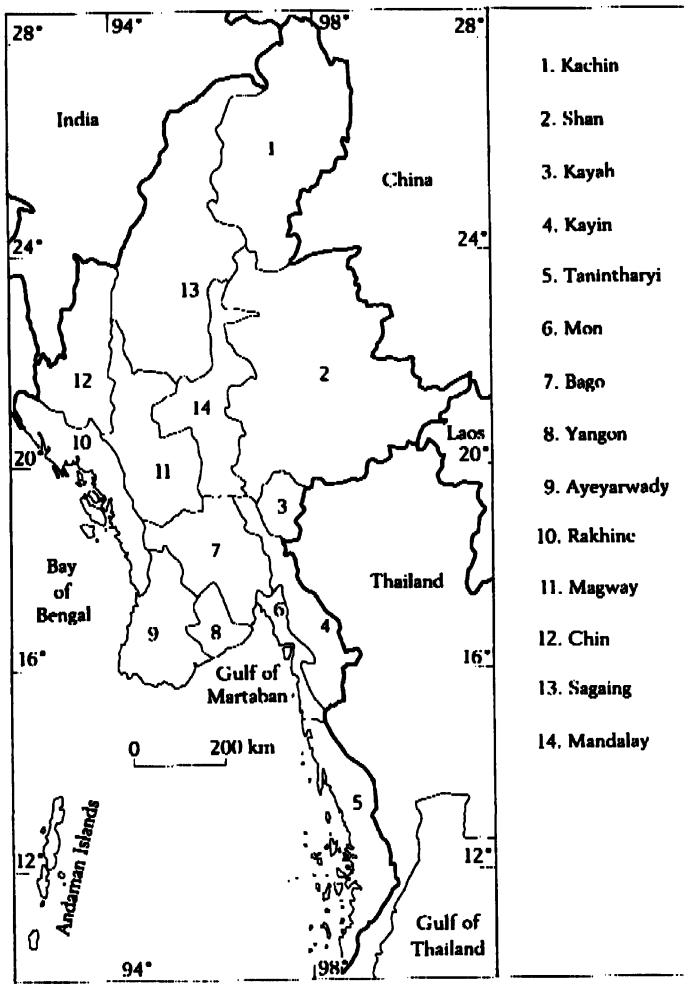

Figure 1.3.1. Administrative boundaries of Myanmar.

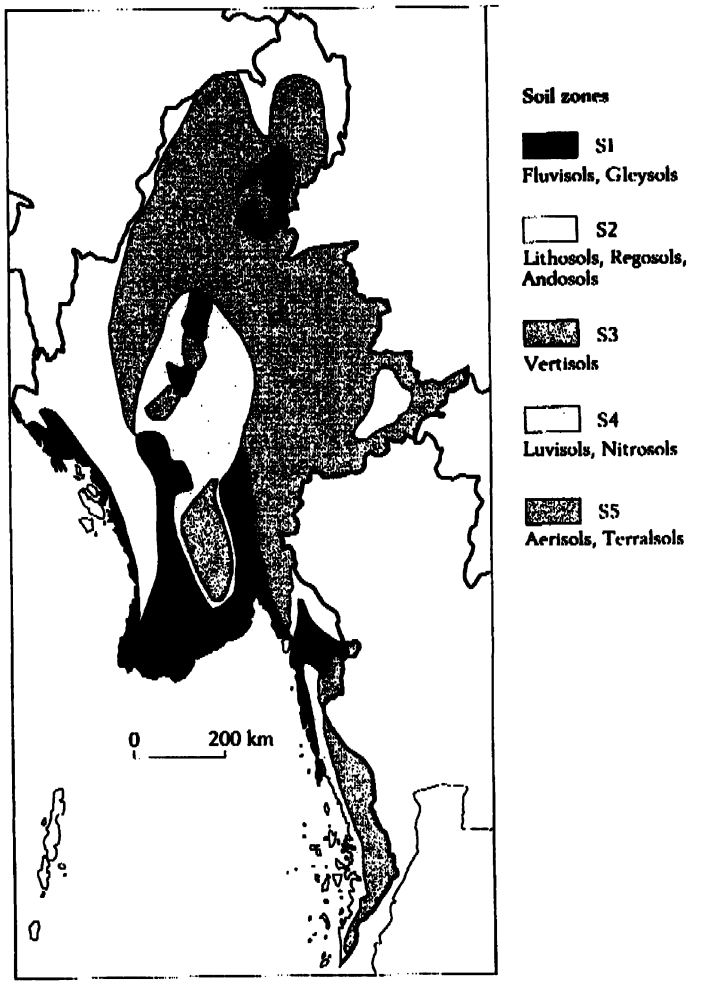

Figure 1.3.2. Major soil zones of Myanmar.

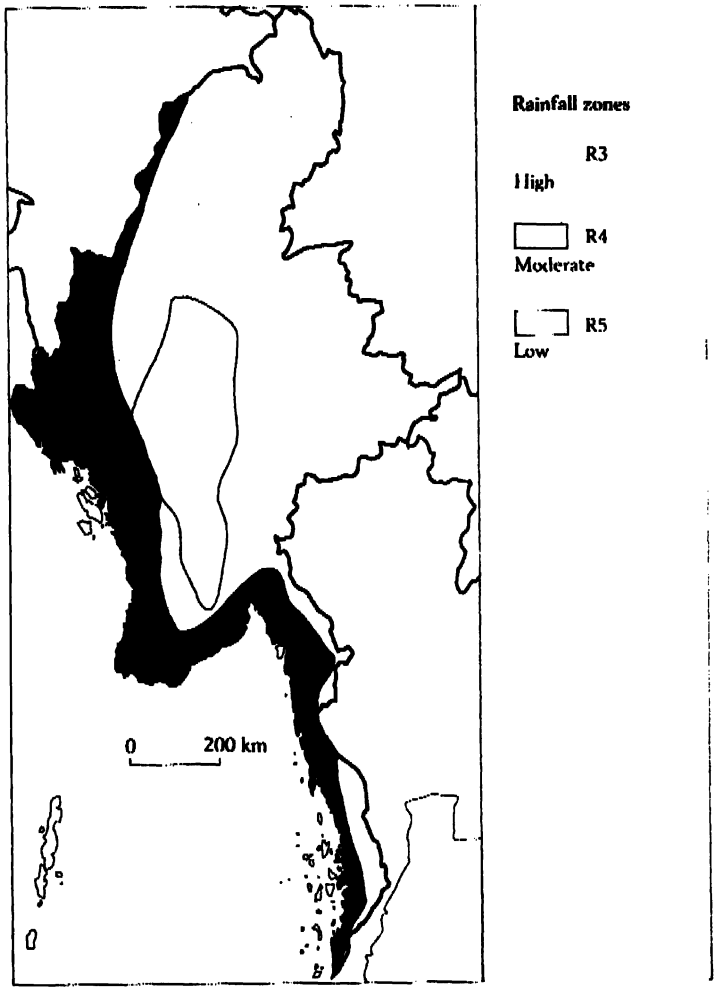

Figure 1.3.3. Major rainfall zones in Myanmar.

Chickpea, grown on 195 145 ha, occupies 31% of the total area under pulses in Myanmar, and is mainly produced in the Sagaing, Bago, Mandalay, Magway, and Ayeyarwady divisions (Fig. 1.3.4). It is chiefly grown as a relay or sequential crop after rice in the lowlands. In the uplands, it is grown mostly on soils with a good water-holding capacity, after an early, short-duration crop of maize or pulses, or after fallow, and is sometimes intercropped with wheat. On the banks of the Ayeyarwady River in the delta area, chickpea is also grown after flood waters recede.

During 1987/88, chickpea production was 163 960 t (Table 1.3.1), with an average yield of 0.75 t ha^{-1}. Chickpea in Myanmar is cultivated in winter and the crop matures in 100–110 days.

Table 1.3.1. Chickpea area, production, and yield in Myanmar, 1987/88.

State/Division	Area ('000 ha)	Production ('000 t)	Average yield (t ha^{-1})
Sagaing	72.32	55.54	0.76
Bago	44.39	48.77	1.09
Mandalay	36.33	29.21	0.80
Magway	34.98	25.82	0.73
Ayeyarwady	6.31	4.02	0.63
Shan	0.68	0.52	0.76
Yangon	0.08	0.05	0.62
Kayah	0.05	0.03	0.60
Total	195.14	163.96	0.75

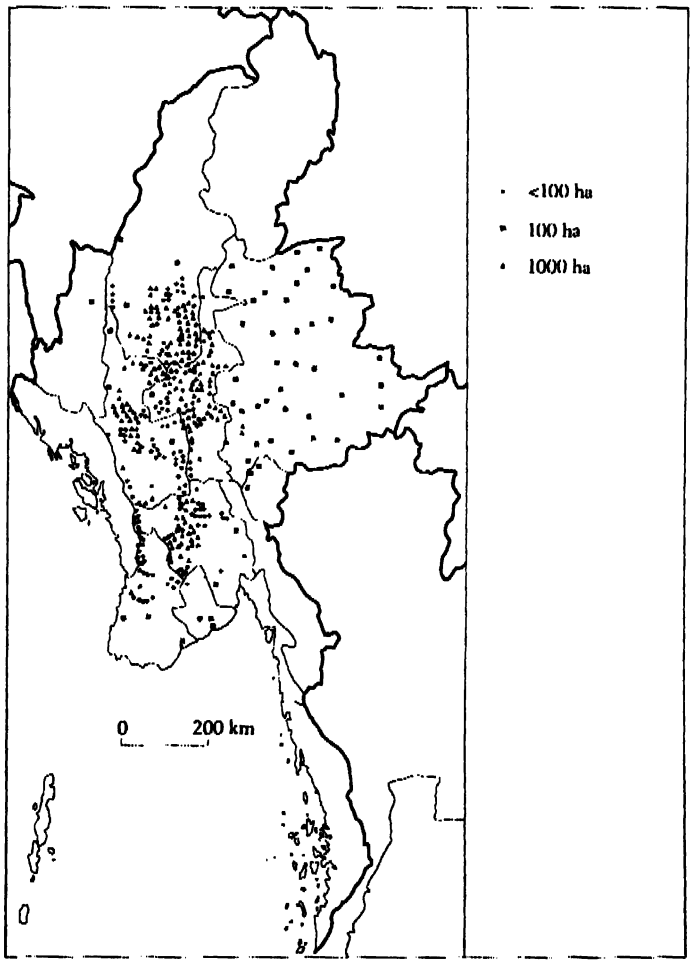

Figure 1.3.4. Chickpea distribution in Myanmar.

Major Stress Factors

The major abiotic stress is drought in the agroclimatic zone R5 S4, where rainfall is low. The soils in the zone are Luvisols and chickpea is grown under conditions of receding soil moisture. The length of the growing period here varies from less than 120 days to 180 days (Fig. 1.3.5).

Fusarium wilt (*Fusarium oxysporum*) (Fig. 1.3.6) and root rot (*Rhizoctonia solani*) diseases are moderately important in Mandalay division, and marginally important in Sagaing, Bago, and Magway divisions. Pod borer (*Helicoverpa armigera*) is the most important pest of chickpea (Fig. 1.3.7) in Myanmar.

Future Prospects

There is considerable scope for expanding the production of chickpea in Myanmar. Farmers could profitably diversify by including legumes to a greater extent in several of the country's cereal-based cropping systems. Chickpea cultivation could be expanded in agroclimatic zones R3 S2 and R4 S2, and also in lower Myanmar, provided varieties tolerant of high temperatures and acid soils become available (Fig. 1.3.8).

Conclusions

The study of the adaptation of chickpea in WANA countries will follow the general outline of the exemplified multidisciplinary analysis for Myanmar. Two main thrusts will be followed. First the development of the GIS methodology as a tool for adaptation studies, and second the identification of factors influencing adaptation, and biotic and abiotic stresses. The intention is to integrate the environmental factors contributing to differences in adaptation of a crop in a given region.

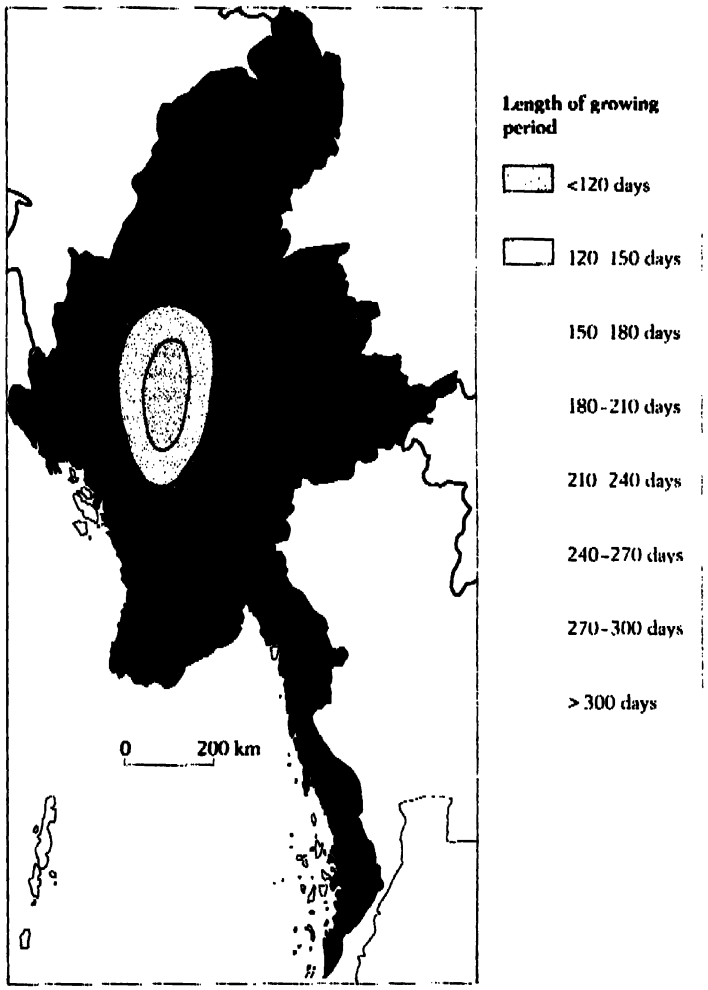

Figure 1.3.5. Length of the growing period in Myanmar.

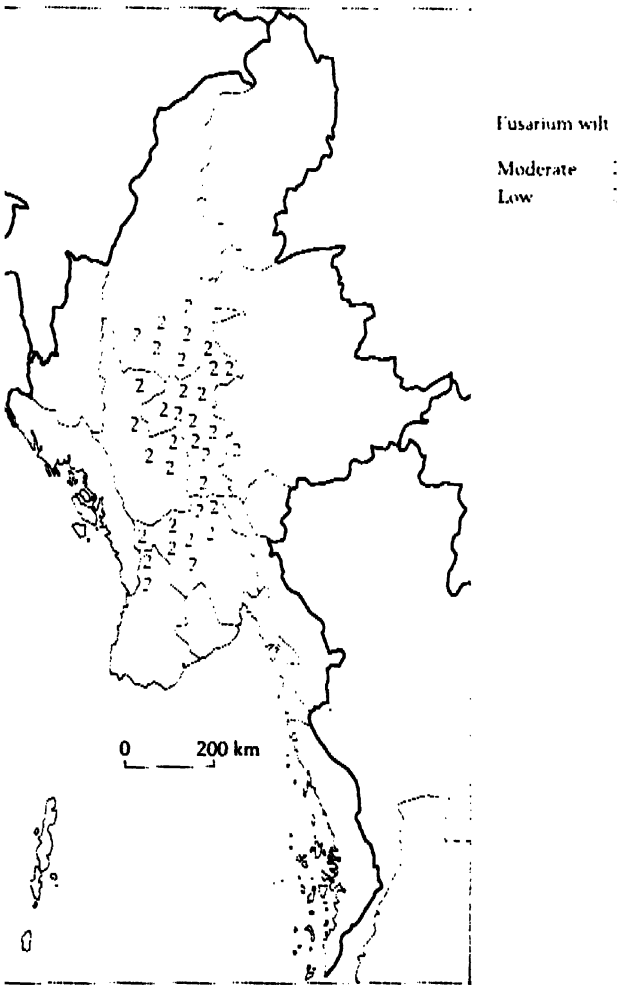

Figure 1.3.6. Disease incidence on chickpea in Myanmar.

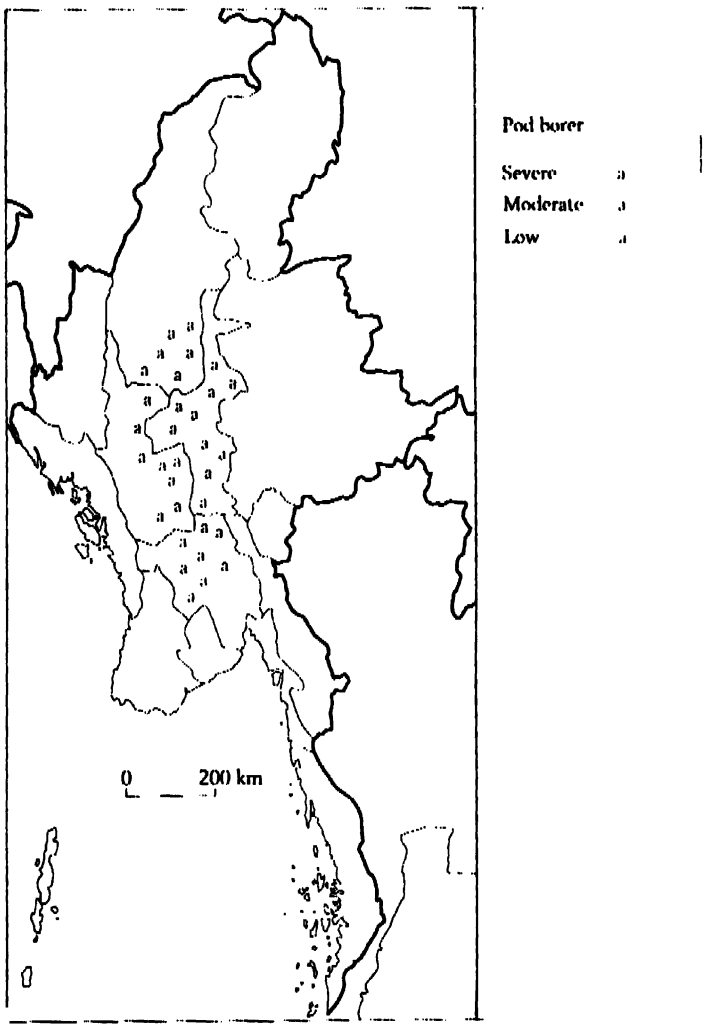

Figure 1.3.7. Incidence of pod borer, the most important pest of chickpea in Myanmar.

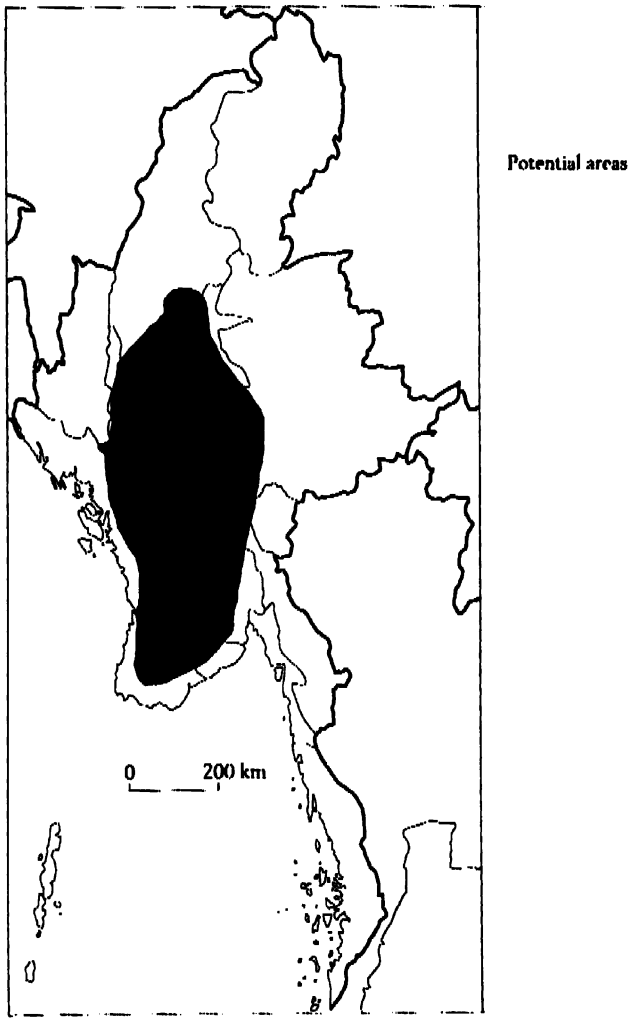

Figure 1.3.8. Potential areas for expansion and/or intensification o chickpea cultivation in Myanmar.

References

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