CHAPTER VI

SUMMARY AND CONCLUSION

6.1. Conservation studies

6.1.1. Survey

Status of *Andrographis paniculata* and *Phyllanthus amarus* and its uses in Traditional Medicine in different parts of state Tamil Nadu was studied by interviewing 100 traditional medical practitioners (TMP) from 21 different districts. The survey results revealed that *P amarus* is found in all the 21 districts. However, its availability is not same in all the area. Thirty five TMP reported that it is abundant in their area, 44 persons have stated it is common and the remaining 21 persons told it is uncommon in their area despite it is called as medicinal weeds by botanist and taxonomist. This shows the population of *P amarus* is getting reduced in the natural habitats. The crude drug source is purely from wild collection as stated by the TMP. If special efforts are not made for conservation and promote cultivation there is a great chance of continuous exploitation from the wild.

Out of the 100' TMP surveyed, 67 per cent TMP reported that *A paniculata* is not found in their
area, Out of the hundred people, 24 TMP stated that this species has very high commercial value and there is lot of demand from drugs and pharmaceutical companies. However, some conservation and ex-situ cultivation efforts are taken in case of *A paniculata*. Six TMP collect the herb from HHG and another two TMP collect from cultivated sources.

*Phyllanthus amarus* is used in six formulations *Andrographis paniculata* is used in 14 formulations to cure various disease and ailments.

### 6.1.2. Herbal mapping

The herbal mapping done in 50 villages from five different districts showed that more number of medicinal plants are present in their natural habitat in Dindigul district (184), followed by Pudukottai (113), Sivagangai (110), Madurai (98) and Namakkal (99).

Out of 50 villages brought under herbal mapping only eight villages have *A paniculata*. Sivagangai and Namakkal districts reported the complete absence of *A paniculata*.

*Phyllanthus amarus* was observed in 42 villages. The absence of *P amarus* in eight villages and *A paniculata* in 42 villages denoted that steps have to be taken to conserve these two herbs in nature.
6.1.3. Focus group discussion

The herbal mapping done in 50 villages have immediate impact on medicinal plants conservation. During 2002, 20 women SHG started medicinal plants conservation and in 2003 the remaining 30 groups started. The number of species conserved in HHG varies from 20 to 30. Out of 940 women in the SHG 834 women established HHG.

A *paniculata* is found invariably in all the HHGs whereas *P. amarus* is found only in 179 houses. The propagation through seedlings not sounds good whereas seed distribution and broadcasting worked out well in *Phyllanthus amarus*. The women groups used *Andrographis paniculata* to cure various diseases like fever, diabetes, cold, cough and they also used this herb as antiseptic, anti-inflammatory, vermicidal and snake bite too. During 2002, *Andrographis paniculata* was used as home remedies in 878 cases and during 2003 it was 958. *Phyllanthus amarus* was used to cure mostly jaundice, fever and improve digestion in 235 cases during 2002 and 469 cases during 2003.

The role of women SHG in medicinal plants conservation is highly appreciable and HHG is an effective method for ex-situ conservation. HHG plays
vital role simple and common herbal remedies. NGOs are working as the backbone of women SHGs in medicinal plants conservation and training women in rural health care.

6.1.4. Scenarios

Scenario planning has helped to understand the problems of biodiversity loss and medicinal plants conservation.

- Indiscriminate collection of medicinal plants from wild leads to genetic erosion and permanent biodiversity loss.
- Medicinal plants cultivation is a possible wise alternative to meet the commercial demand of medicinal plants.
- \textit{In situ} conservation of Medicinal Plants a probable alternative for conservation of biodiversity and indigenous gene pool.
- Community based \textit{ex-situ} conservation - a preferable alternative will open a new avenue to regain the genetic loss and stop further genetic erosion of species from natural habitats.
The above said scenarios have provided multiple alternatives like in situ conservation, ex situ conservation and cultivation of medicinal plants for future.

6.1.5. Higher order impact

Higher order impact analysis reveals the impact of medicinal plants loss from the natural habitats at various levels in the society and the magnitude of the problem. It put forward the impact in the order viz., loss to biodiversity and indigenous gene pool, erosion of indigenous knowledge, threat to rural health care, economic loss to rural poor, livelihood loss to the TMP, increased demand for raw drugs to the pharmaceutical industries and finally vulnerability of bio-partnership between people and plants.

6.2. Development of agro technology

A series of experiments were conducted at two locations to study the yield variations in two medicinally important herbs viz., Andrographis paniculata and P amarus at two locations viz., Pudukottai and Namakkal districts in Tamil Nadu (The two locations were in Vamban village in Pudukottai district and Marankadu village in Namakkal district.)
For convenience the locations are referred to as Pudukottai and Namakkal, respectively. The sites were selected because of distinctly different soil characters. The soils at Pudukottai are acid whereas the soils at Namakkal are weakly saline.

In each crop and at each location three experiments were conducted to find out the optimum spacing, fertilizer dose and also to study the influence of organic manures on the herb yield and growth of the plants. The results obtained in the experiments are summarized here;

6.2.1. Influence of different levels of vermicompost on the growth and herb yield of *Andrographis paniculata*.

* With increase in the dose of vermicompost the herb yield increased and the increase in yield due application of vermicompost was 14.9 % during 2001-02 and 17.4 % during 2002-03. The improvement in herb yield was significant up to 1.5 tons/ha of vermicompost treatment. Application of higher doses of vermicompost beyond 1.5 tons/ha did not significantly increase the herb yield except in 2002-03 at Namakkal where the herb yield responded up to 2.5 tons /ha
of vermicompost treatment. Similar increase in herb yield was also noticed at Pudukkottai also. The yield obtained at Namakkal was higher than that obtained at Pudukkotai. The percent increase in yield was 80.5% during 2002-03 at Namakkal.

- The dry weight/plant increased in all the treatments with increase in the days after planting in both the years and at both the locations.

- Application of vermicompost also significantly influenced the plant height, weight of root/plant, weight of stem/plant and weight of leaf g/plant.

- Due to increase in dry matter production associated with application of vermicompost nutrient uptake also increased.

6.2.2. Influence of different levels of nitrogen and phosphorus on the growth and herb yield of Andrographis paniculata.

- The herb yield in Andrographis paniculata increased significantly due to the application of nitrogen above 30-45-kg/ha levels only. Application of phosphorus did not significantly influence the herb yield.
Combined application of 60 kg N and 30 Kg P₂O₅ resulted in higher herb yield at both the locations. Herb yield obtained was higher at Namakkal compared to Pudukottai in both the years.

Plant height increased with increase in the dose of vermicompost applied and also with increase in days after planting at Pudukottai and Namakkal.

The differences observed in the plant weight at Pudukottai and Namakkal were significant due to application of different levels of nitrogen, phosphorus and their combinations. Total dry weight of plant increased with increase in the dose of nitrogen and phosphorus at Pudukottai and Namakkal. Plant weight was found to increase with time and highest weight was observed at 90 days after planting.

Similarly improvement in the dry weight of different component parts like root, stem and leaf also exhibited similar pattern as that total dry weight of plant (dry matter, g/plant).
Uptake of nutrients like N, P, K, Ca, Mg, Fe, Mn and Zn with increase in the application of N and P. Increased nutrient availability and uptake resulted in higher dry matter production and in return increased the herb yield.

A significant finding of this study is the uptake pattern of nutrients. This study revealed that *Andrographis* is a heavy feeder on nutrients like calcium, magnesium, iron, manganese and zinc. It can be seen that the uptake of calcium is almost equal to that of nitrogen and it is more in slightly alkaline soils of Namakkal compared to the acidic soils of Pudukottai. This indicates the adaptability of this plant to slightly saline soils. This also shows that and it can be grown in problem soils and also for soil remediation.

Though the soils at both the locations are low in available phosphorus the crop did not show any response due to individual application of phosphorus. This indicates that in these soils much higher doses than the dose tested (30 Kg/ha) may be required to
where the soils are acidic (the availability of P is more in acidic soil conditions) also the crop did not respond to phosphorus application, which further confirms the hypothesis that the applied level of phosphorus was not sufficient.

- But P in combination with N at 60: 30 Kg/ha combinations significantly increased the herb yield, which indicates the synergistic influence of combining the nutrients.

6.2.3. Influence of different inter and intra row spacings on the growth and herb yield of *Andrographis paniculata*.

- Inter and intra row spacing influenced the herb yield in both the locations. The herb yield increased significantly (from 1.26 to 2.87 kg/plot and from 1.33 to 2.07 kg/plot during 2001-02 and 2002-03, respectively) with increase in the inter row spacing from 15 to 45 cm at Namakkal.

- Among the combinations maximum herb yield was obtained at spacing of 30x30 cms during 2001-02 and 2002-03. The yield obtained at spacing
pattern.

- At Pudukottai the differences observed due to the direct effect row spacing were not significant, whereas a combination of 30x30 cm produced significantly higher herb yield during 2002-03.
- The dry weight/plant increased with time and reached maximum weight at 90 days after planting. The dry weight/plant was more at wider spacing and less at narrow spacing.
- In Andrographis paniculata it was observed that following a spacing of 30x30 cm is most ideal for obtaining higher herb yield. At this spacing plant produced significantly higher total dry matter/plant. Similarly, the uptake of nutrients was also significantly higher at this spacing. Favorable micro environment created by adopting this spacing resulted in the plants expressing their potential which ultimately resulted in higher herb yield.
6.2.4. Influence of different levels of vermicompost on the growth and herb yield of Phyllanthus amarus.

- The data on the influence of application of different doses of vermicompost on the herb yield in Phyllanthus amarus indicated that at both locations during 2001-02 and 2002-03 application of vermicompost up to a dose of 1.5 tons/ha significantly increased the herb yield in Phyllanthus amarus.

- Herb yield obtained was higher at Namakkal compared to Pudukottai in both the years. Application of higher doses of vermicompost beyond 1.5 tons/ha did not significantly increase the herb yield.

- The increase in herb yield was due to increase in the dry matter production (total dry weight, g/plant) observed due to vermicompost application. The total dry weight of plant increased significantly with increase in the application of vermicompost.

- The dry weight /plant increased in all the treatments with increase in the days after planting in both the years and at both the locations.
• Application of vermicompost also significantly influenced the plant height, weight of root/plant, weight of stem/plant and weight of leaf g/plant.

• Due to increase in dry matter production associated with application of vermicompost nutrient uptake also increased.

6.2.5. Influence of different levels of nitrogen and phosphorus on the growth and herb yield of P.amarus.

• The data on the herb yield in P.amarus as influenced by application of different levels of N and P during 2001-02 and 2002-03 at both locations indicated that herb yield increased with increase in the dose of applied nitrogen from 0 -45 kg/ha.

• The data indicated that application of phosphorus did not significantly influence the herb yield.

• In case of nitrogen also significant improvement in yield was noticed up to 45 kg/ha levels only.

• Herb yield obtained was higher at Namakkal compared to Pudukottai.
• Combined application of 45 kg N and 30 Kg P,0 resulted in higher herb yield beyond this level the differences observed were not significant.

• The increase in herb yield is due to increase in the dry matter production (total dry weight, g/plant) observed due to application of nitrogen.

• Uptake of nutrients like N, P, K, Ca, Mg, Fe, Mn and Zn with increase in the application of N and P. Increased nutrient availability and uptake resulted in higher dry matter production and in return increased the herb yield.

6.2.6. Influence of different inter and intra row spacings on the growth and herb yield of *P amarus*.

• The herb yield in *P amarus* varied significantly due to the influence of different inter and intra row spacings adopted as treatments.

• It can be inferred from the data that herb yield in treatments having 15 cm as inter row spacing were significantly low compared to other treatments compared to the system in which the intra row spacing adopted was 20 cm.
Among the inter row spacing adopting 30 cm space between the plants in a row resulted in higher herb yield.

Inter and intra row spacings play a dominant role in making the inputs available to the plants besides making the natural microenvironment ideal for plant growth. During this study, in case of P. amarus it was observed that following a spacing of 30x 20 cm is most ideal for obtaining higher herb yield.

At this spacing plants produced significantly higher total dry matter/ plant and the uptake of nutrients was also significantly higher at this spacing.

Favourable microenvironment created by adopting this spacing resulted in the plants expressing their potential, which ultimately resulted in higher herb yield.

It can be concluded that ex situ conservation of medicinal plants with community participation is an effective tool for conserving indigenous gene pool and save medicinal plants from genetic erosion. *Phyllanthus amarus* and *Andrographis paniculata* have responded well for cultivation to meet out the commercial demand.