ECONOMICS OF CULTIVATION OF SOME COMMERCIALLY IMPORTANT MEDICINAL PLANTS

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Introduction

India, with its vast biodiversity and potential for commercial cultivation of medicinal plants, could become a world leader in supply of raw material for medicinal plant sector. Majority of the demand of medicinal plant parts is met from the natural sources, forest being the prime source. This has put a great pressure on these resources and there has been a gross depletion of the natural population of a number of species. Such a situation has necessitated the augmentation of raw material sources by large-scale cultivation of medicinal plants.Past success in increasing the resources through cultivation of *Saussurea costus, Rauvolfia serpentina, Withania somnifera, and Gloriosa superba* has been reported by Sarin (2003). The introduction of medicinal plants into the cropping patterns of farming communities, and even in combination with tree crops such as Poplar and Eucalyptus on farm lands of northwest India could provide a strong thrust to this growing sector and will provide increased economic returns.

Agro-technologies for cultivation of a number of species have been developed but the large-scale cultivation of medicinal plants on farmlands is yet to begin. This state of affairs may be attributed to a number of reasons such as inability of farmers to adopt to high tech methodology; high cost of production; lack of knowledge on economics of cultivation; absence of buyback arrangement and lack of extension efforts. With this background, the present study was carried out on the selected farms of Haryana to understand the economics involved in cultivation of five selected medicinal plant species. The results are expected to be useful for the farmers who would like to undertake cultivation of medicinal plants.

Material and Methods

The study was carried out during the month of May 2004 on the selected farms of Haryana and species which are presently been grown there, viz, *Andrographis paniculata, Acorus calamus, Chlorophytum borivillianum, Withania somnifera* and *Spilenthes acmella* were selected for the study. The common names, crop duration including preparation of land, marketing and uses are given in Table A.

The study team visited the farms and interviewed the farmers of Karnal, Kaithal and Yamuna Nagar as per the well-structured questionnaire. The relevant

* Presently at . IGNFA, New Forest, Dehra Dun (Uttaranchal).

Table A

Common names, crop duration including preparation of land, marketing and uses of selected species of MAPs

Species	Common name	Crop duration (months)	Parts used	Uses
Andrographis paniculata	Kalmegh	9.0	Whole plant (above ground level only)	Treatment of dysentery, cholera, diabetes, influenza, itches and piles
Acorus calamus	Buch	11.0	Rhizomes	Dysentery, epilepsy, hysteria, & mental disorders
Chlorophytum borivillianum	Safed musli	10.5	Tubers	Aphrodisiac, general tonic & piles.
Withania somnifera	Ashwagandha	7.5	Roots	Treatment of leucoderma, constipation, insomnia & cough
Spilenthes acmella	Akarkara	9.0	Whole plant	Pyorrhea, nerve disorder, cough & gum related diseases

information on each and every activity including material and labour involved in relation to plantation, maintenance, harvesting, marketing costs etc., were recorded. Three observations were taken for each selected species and data is being reported on the basis of averages. The rental value of land @ Rs. 6000/- per acre was also taken into account for working out benefit cost ratios. The lands which were considered for the cultivation of medicinal plant species were generally not the best lands and accordingly rental value was estimated based on the discussions held with the farmers.

The costs incurred on planting, maintenance, harvesting, marketing and rental value and the benefits received for all the studied species were split into 45 days intervals and the discounting was carried out at 6%, 9% and 12% rates for the calculation of net present value (NPV), benefit cost (B/C) ratios and internal rate of return (IRR). The results on NPV at discount rate of 6% calculated for each crop were compared with the available reports on economics of cultivation. The literature consulted consisted of report on task force on conservation and sustainable use of medicinal plants (Anon., 2000); Cultivation techniques for medicinal plants in Haryana (Anon., 2002); Cultivation techniques of MAPs (Sharma, 2002); Cultivation practices of some commercially important medicinal plants (Anon., 2002) and financing medicinal and aromatic plants (Anon., 2003).

In order to ascertain the profitability of cultivation, sensitivity analysis were also performed on all the selected species by assuming the fall in price by 25%, 50%, 75%; increase in wage rate by 10%, 20%,

30% and increase in rental value of land by 20%, 40% & 60% or a combination of these factors, assuming price fall by 25%, wage rate rise by 10% and rental value of land increase by 20%.

Results and Discussion

Tables 1-5 show the costs of different inputs required for cultivation of selected medicinal plant species, viz., Kalmegh, Buch, Safed musli, Ashwagandha and Akarkara respectively. Two methods of cultivation for Kalmegh, viz., by planting and sowing were included in the study and it was observed that an investment of Rs 19,170 and Rs. 18,100 per acre respectively was required to raise this crop by planting and sowing. The labour component however accounted for 34.85% for planting method and 25.41% by adopting sowing method (Table 1). Similarly, an investment of Rs. 43,660, Rs. 2,61,300, Rs. 15,960 and Rs. 25,880 per acre is required for cultivation of Buch, Safed musli Ashwagandha and Akarkara with labour component accounting for 20.89%, 14.11%, 27.32% and 40.49% respectively (Tables 2 to 5).

The species wise costs incurred under different operations for time intervals of 45 days are presented in Table 6. These costs are spread over different time periods depending on the crop duration, which varies from 7-11 months. The costs incurred and the benefits received from the cultivation of selected species along with cost effectiveness parameters, viz., Net benefits, B/C ratios along with IRR are shown in Table 7. Cultivation of Kalmegh by sowing method resulted into maximum benefit cost ratio of 2.07, which is followed by cultivation of same species by planting method (1.95) and Ashwagandha (1.59). Since these investments are for very short periods, net benefit on the investment can also be the criteria for profitability. Maximum net benefit is received in case of Safed musli, i.e., Rs 36,140 per acre, followed by Rs. 19,016 per acre for Kalmegh by sowing method. Maximum IRR on the cultivation of these crops is obtained in case of Kalmegh by sowing (416.4%) followed by Ashwagandha (370.7%) and Kalmegh by planting method (344.3%). The remaining two species gave a lower IRR compared to these species.

The comparison of the net benefits as calculated for the present study with the net benefits as reported in the available literature is presented in Table 8. It is clear from the table that vast differences on net benefits reported exist for each species. Maximum variation in net benefits per acre was observed in case of cultivation of Safed musli, which was between Rs. 17,200 and Rs. 3,02,000 against the benefits calculated to be Rs 36,140 calculated at 6% discount rate. This was followed by variations observed in case of Kalmegh by planting method, which were between Rs 13,200 and Rs 57,600 per acre. These differences could be attributed to variation in costs of cultivation as per location, quality of the product, difference in market prices etc. However, a casual estimation of yield or the market price assumed for these calculations cannot be ruled out.

Investment in medicinal plant cultivation is associated with risks and uncertainties on account of fluctuation in prices and other conditions influencing cultivation costs. The results of sensitivity

Table 1

Details of cost involved in cultivation of Kalmegh (Andrographis paniculata)
(Crop duration-9 months) (per acre)

Sr. No.	Items of cost	Material/ ploughing (Rs.)	Labour @ Rs. 80/ manday		Total cost	Material/ ploughing	Labour @ Rs. 80/		Total cost
			Man-days	Total cost			Man-days	Total cost	
		Planting				**Sowing**			
1.	Planting cost :								
i.	Soil working, ploughing, alignment etc.	1000	1.0	80	1080	1000	1.0	80	1080
ii.	Cost of fertilizer/ manure application	400	0.5	40	440	400	0.5	40	440
iii.	Cost of planting material and planting	3490	20.0	1600	5090	4000*	-	-	4000
iv.	Cost of pre sowing treatment	-	-	-	-	100	0.5	40	140
v.	Cost of ploughing** and broadcasting	-	-	-	-	400	0.5	40	440
2.	Maintenance :								
i.	Irrigation cost	1200	4.0	320	1520	1200	5.0	400	1600
ii.	Weeding and hoeing cost	-	20.0	1600	1600	-	12.0	960	960
3.	Harvesting and value addition :								
i.	Harvesting cost	-	17.0	1360	1360	-	17.0	1360	1360
ii.	Cleaning, drying & seed extraction cost	-	18.0	1440	1440	-	18.0	1440	1440
4.	Marketing :								
i.	Packaging, transportation loading & unloading	400	3	240	640	400	3.0	240	640
5	Rental value of land	6000	-	-	6000	6000	-	-	6000
	Grand total	12,490	83.5	6,680	19,170	13,500	57.5	4,600	18,100

* Cost of seed @ Rs. 2000/ kg ** Second ploughing just before broadcasting of seed

Table 2

Details of cost involved in cultivation of Buch (Acorus calamus)
(Crop duration-11 months) (per acre)

Sr. No.	Items of cost	Material/ ploughing (Rs.)	Labour @ Rs. 80/manday		Total cost (Rs.)
			Mandays (Rs.)	Total (Rs.)	
1.	Planting cost :				
i.	Soil working, ploughing, alignment etc..	1000	1	80	1080
ii.	Cost of fertilizer/ manure application	4000	2	160	4160
iii.	Cost of planting material and planting	18000	26	2080	20080
2.	Maintenance :				
i.	Irrigation cost	5200	13	1040	6240
ii.	Weeding and hoeing cost	-	20	1600	1600
3.	Harvesting and value addition :				
i.	Harvesting cost of roots	-	30	2400	2400
ii.	Cleaning & drying	-	20	1600	1600
4.	Marketing :				
i.	Packaging, transportation, loading & unloading cost	340	2	160	500
5.	Rental value of land :	6000	-	-	6000
	Grand total	34,540	114	9,120	43,660

analysis for the assessment of profitability of cultivation under adverse conditions of price fall, increase in wage rate and rental value of land has shown that all the species were quite sensitive to the price fall so much so that a price fall of 50% resulted into negative net benefits except for Kalmegh by sowing method. (Table 9). The affect of increasing wage rates or rental values of land when considered independently was observed to be marginal in the species, which gave higher net benefit values, i.e., Kalmegh, Safed musli and Ashwagandha. Buch and Akarkara were significantly affected by increasing wages rates and rental values of land owing to their lower net benefits calculated during the study (Figs. 3, 4 and 5).

The simultaneous effect of all the three assumed adverse factors was observed to be most significant in Buch where the net benefit decreased by 324.48%, which was followed by Akarkara where the net benefits declined by 274.10% and Safed musli with 216.35%. Kalmegh by planting and sowing methods and Ashwagandha were observed to be resilient to these adverse conditions and showed a fall in net benefits of 61.35%, 56.83% and 84.86% respectively and the resultant net benefits still remained positive.

Conclusions and Recommendations

On the basis of above results the

Table 3

Details of cost involved in cultivation of Safed musli (Chlorophytum borivillianum)
(Crop duration-10.5 months) (per acre)

Sr. No.	Items of cost	Material/ ploughing (Rs.)	Labour @ Rs. 80/manday		Total cost (Rs.)
			Mandays (Rs.)	Total (Rs)	
1.	Planting cost :				
i.	Soil working, ploughing, alignment etc..	2400	2	160	2560
ii.	Cost of fertilizer/ manure application	8000	4	320	8320
iii.	Mixing of Neem khali	2800	1	80	2880
iv.	Cost of planting material and planting	200000	42	3360	203360
2.	Maintenance :				
i.	Irrigation cost	3200	16	1280	4480
ii.	Weeding and hoeing cost	-	50	4000	4000
iii.	Spray of fungicide (Trichoderma)	1500	10	800	2300
3.	Harvesting and value addition :				
i.	Harvesting cost of tubers	-	50	4000	4000
ii.	Cleaning & drying	-	280	22400	22400
4.	Marketing :				
i.	Packaging, transportation, loading & unloading cost	520	6	480	1000
5.	Rental value of land	6000	-	-	6000
	Grand total	2,24,420	461	36,880	2,61,300

cultivation of Kalmegh and Ashwagandha may be recommended on account of their maximum resilience to the adverse conditions of sudden price fall, rise in wage rate or the rental value of land. Moreover the cultivation of these species require lesser investments and can be taken up by the small farmers. The cultivation of Buch, Safed musli and Akarkara is, however, recommended for large farmers who can afford more risk. This is also because of higher initial investments involved in these species and lesser resilience to the adverse factors as described above.

The large-scale adoption of medicinal plant cultivation by the farmers of Haryana will depend on the profitability of these efforts in comparison to agriculture options. Generally the farmers take two crops a year whereas the crop duration of medicinal plants studied in the present case varied between 7 to 11 months. The net benefits reported by different authors for cultivation of paddy and wheat at 6% discount rate were as 1158/- and Rs 7605/- per acre and when both crops considered together, the benefits rose to Rs 8579/- per acre on yearly basis. (Anon., 1999; Anon., 2004 and Kumar *et al.*, 2004). Compared to these benefits,

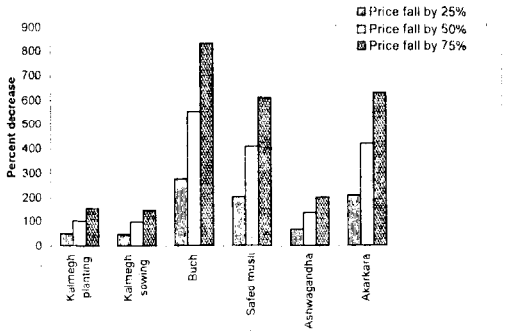
Table 4

Details of cost involved in cultivation of Ashwagandha (Withania somnifera)
(Crop duration-7.5 months) (per acre)

Sr. No.	Items of cost	Material/ ploughing (Rs.)	Labour @ Rs. 80/manday		Total cost (Rs.)
			Mandays (Rs.)	Total (Rs.)	
1.	Planting :				
i.	Soil working, ploughing, alignment etc.	1000	1.0	80	1080
ii.	Cost of seeds	2000	-	-	2000
iii.	Cost of ploughing, sowing or broadcasting	300	0.5	40	340
2.	Maintenance :				
i.	Irrigation cost	1600	4.0	320	1920
ii.	Weeding and hoeing cost	-	10.0	800	800
3.	Harvesting and value addition :				
i.	Seed extraction cost	-	2.0	160	160
ii.	Harvesting cost of roots	-	20.0	1600	1600
iii.	Cleaning & drying	-	15.0	1200	1200
4.	Marketing :				
i.	Packaging, transportation, loading & unloading cost	700	2.0	160	860
5.	Rental value of land	6000	-	-	6000
	Grand total	*11,600*	*54.5*	*4,360*	*15,960*

the cultivation of Kalmegh, Safed Musli and Ashwagandha appear to be better options for the farmers. The cultivation of Kalmegh and Ashwagandha is recommended for the small farmers on account of low investments required and greater resilience to adverse market conditions. However, the sustainability of these options is very difficult to predict because of continuous volatility in market for these medicinal plant parts.

Fig. 3



Per cent decrease in net benefits in response to price fall

Table 5

Details of cost involved in cultivation of Akarkara (Spilenthes acmella)
(Crop duration-9 months) (per acre)

Sr. No.	Items of cost	Material/ ploughing (Rs.)	Labour @ Rs. 80/manday		Total cost (Rs.)
			Mandays (Rs.)	Total (Rs.)	
1.	Planting :				
i.	Soil working, ploughing, alignment etc.	1200	1	80	1280
ii.	Cost of fertilizer/ manure application	2000	12	960	2960
iii.	Cost of planting material and planting	2000	4	320	2320
2.	Maintenance :				
i.	Irrigation cost	3200	8	640	3840
ii.	Weeding and hoeing cost	-	30	2400	2400
3.	Harvesting and value addition :				
i.	Harvesting cost of whole plant	-	60	4800	4800
ii.	Cleaning & drying	-	15	1200	1200
4.	Marketing :				
i.	Packaging, transportation, loading & unloading cost	1000	1	80	1080
5.	Rental value of land	6000	-	-	6000
	Grand total	15,400	131	10,480	25,880

Table 6

Species wise per acre costs incurred under different time intervals of 45 days.

Species	Time intervals of 45 days								
	0-45	46-90	91-135	136-180	181-225	226-270	271-315	316-360	Total (Rs.)
Kalmegh (planting)	10,810	1600	320	-	2800	3640	-	-	19,170
Kalmegh (sowing)	9,580	1760	320	-	2800	3640	-	-	18,100
Buch	30,800	1360	2160	480	480	880	4000	3500	43,660
Safed Musli	2,23,620	1260	1260	3640	1120	-	30400	-	2,61,300
Aswagandha	7,380	1360	-	400	6820	-	-	-	15,960
Akarkara	12,600	1600	1600	-	-	10080	-	-	25,880

* 50% land rent (Rs.3000/-) taken as initial cost and rest at the harvest of crop.

Table 7

Details of cost incurred, net benefits, B/C ratios and IRR.
(per acre)

Species	Yield (dry wt.), Selling rate (Rs.)	Benefits (Rs.)	Total costs (Rs.)	Net Benefit (Rs.)			B/C Ratio			IRR (%)
				6	9	12	6	9	12	
Kalmegh (planting)	12 qt, 1200/ 20kg, 1200[1]	38,400	19,170	17952	17361	16799	1.95	1.93	1.91	344.30
Kalmegh (sowing)	12 qt, 1200/ 20kg, 1200[1]	38,400	18,100	19016	18422	17856	2.07	2.05	2.03	416.40
Buch	20 qt, 2500[2]	50,000	43,660	4265	3779	2428	1.10	1.09	1.06	21.15
Safed musli	3.2 qt, 85,000/ 1.5 qt, 25,000[3]	3,09,500	2,61,300	36140	30603	25362	1.14	1.12	1.10	29.19
Ashwagandha	4.5 qt, 5,500/ 20 kg, 50[4]	25,750	15,960	9198	8922	8659	1.59	1.58	1.56	370.70
Akarkara	2.0 qt, 15,000[5]	30,000	25,880	3417	3093	2785	1.14	1.12	1.11	48.26

[1] 12 qt of whole plant (above ground) @ Rs 1,200 per qt and 20 kg seed @ Rs. 1,200 per kg
[2] 20 qt of rhizome @ Rs 2,500 per qt.
[3] 3.2 qt of tubers @ Rs 85,000 per qt and 1.5 qt propagules @ Rs 25,000 per qt.
[4] 4.5 qt of root @ Rs. 5,500 per qt and 20 kg seed @ Rs. 50 per kg.
[5] 2.0 qt of whole plant @ Rs 15,000 per qt.

Table 8

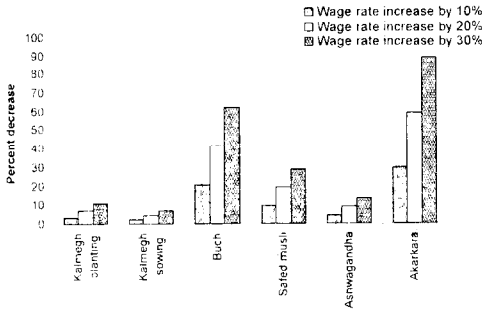
Comparison of net benefits with the available reports

(per acre)

Species	Net benefits calculated at 6%	Net benefits reported in literature				
		Planning Commission Document	Haryana Forest Deptt.	Dr. Ravindra Sharma	NMPB	NABARD
Kalmegh (planting)	17,952	13,200	-	57,600	13,200	7,300
Kalmegh (sowing)	19,016	-	25,000	-	-	-
Buch	4,265	10,816	-	16,000	-	37,500
Safed musli	36,140	17,200	1,65,000	3,02,000	2,80,000	1,15,000
Ashwagandha	9,198	720	13,500	12,320	9,600	12,500
Akarkara	3,417	-	15,000-20,000	-	-	-

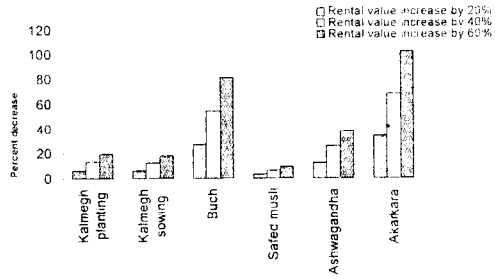
(-): Not available

Fig. 4



Per cent decrease in net benefits in response to increase in wage rate

Fig. 5



Per cent decrease in net benefits in response to increase in rental value

Table 9

Cost effectiveness in response to sensitivity analysis at 6% discount rate

Species	Net benefits calculated (at 6%)	Net benefits at 6% discount rate when									Net benefits when price fall by 25%, wage rate rise by 10% and rental value increase by 20%
		Price fall by (%)			Wage rate increase by (%)			Rental value increase by (%)			
		25	50	75	10	20	30	20	40	60	
Kalmegh (planting)	17952	8763	-427	-9616	17299	16646	15992	16782	15612	14442	6939*
Kalmegh (sowing)	19016	9826	637	-8552	18569	18122	17675	17845	16675	15506	8209*
Buch	4265	-7527	-19319	-31112	3380	2494	1609	3103	1942	780	-9574
Safed musli	36140	-37389	-110918	-184447	32649	29152	25658	34973	33808	32642	-42049
Ashwagandha	9198	2990	-3217	-9425	8775	8352	7930	8023	6849	5675	1393*
Akarkara	3417	-3761	-10941	-18120	2400	1383	366	2247	1077	-92	-5949

* Recommended for small farmers

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SUMMARY

Agro technologies for cultivation of a number of medicinal plant species have been developed but large-scale cultivation on farmlands is yet to begin. Amongst other causes for this gap, lack of reasonably correct information on economics of cultivation of these species is one important cause. The economics of cultivation of five medicinal plant species, viz., Kalmegh, Buch, Safed musli, Ashwagandha and Akarkara was studied on farmer's field in Haryana. The net benefits calculated for each species were also subjected to sensitivity analysis in relation to fall in price by 25%, 50%, 75% increase in wage rate by 10%, 20%, 30% and increase in rental value of land by 20%, 40% & 60%. The results showed that maximum net benefits of Rs 36,140 and Rs. 19,016 per acre could be received by cultivation of Safed musli and Kalmegh respectively. The cultivation of Kalmegh and Ashwagandha were observed to be more resilient to the adverse factors of price fall, increase in wage rate and rental value of land, compared to other species. On the basis of initial investment involved and resilience to adverse market conditions, the cultivation of Kalmegh and Ashwagandha is recommended for small farmers. The large farmers who can afford greater risk may cultivate Buch and Safed musli and Akarkara for higher returns.

व्यापारिक महत्व वाले कुछ औषध पादपों की खेती करने का अर्थशास्त्र

मोहित गेरा, महेन्द्रसिंह गुसांई, एम०वाई० अंसारी व एन०एस० बिष्ट

सारांश

अनेक औषध पादप जातियों की खेती करने की कृषि प्रौद्योगिकी का विकास तो किया जा चुका है किन्तु बड़े-बड़े खेतों पर उनकी बहुत परिमाण पर खेती करना शुरू होना बाकी है । इस कमी के अन्य कारणों मे से एक महत्वपूर्ण कारण इन जातियों की खेती करने विषयक अर्थशास्त्र सम्बन्धी पर्याप्त सही-सही जानकारी का न मिलना भी है । इनमे से पांच औषध पादप जातियों अर्थात् कालमेध, बच सफेद मसूली अश्वगंधा और अकरकरा की खेती करने के अर्थशास्त्र का अध्ययन हरियाणा में किसानों के खेतों पर किया गया । इनमें से प्रत्येक से मिलने वाले शुद्ध लाभ की गणना की गई तथा कीमतों में 25%, 50% और 75% गिरावट आने, मजदूरी दरों में 10%, 20% और 30% वृद्धि हो जाने तथा जमीन के किराए में 20%, 40% और 60% बढ़त हो जाने के आधार पर उनका प्रभविष्णुता विश्लेषण भी किया गया । इस तरह मिले परिणामों ने दिखाया है कि सफेद मसूली और कालमेघ की खेती करने से क्रमशः 36,140/- रू० और 19,016/- रू० प्रति एकड़ का अधिकतम शुद्ध लाभ प्राप्त किया जा सकता है । कालमेघ और अश्वगंधा की खेती कीमतों मे गिरावट, मजदूरी दरों में वृद्धि और जमीन के किराये मे बढ़त हो जाने जैसे प्रतिकूल कारकों के प्रति अन्य पादप जातियों की तुलना में कहीं ज्यादा लचीली रहती देखी गई । आरम्भ में किए जाने वाले धननिवेश और प्रतिकूल बाज़ारी दशाओं के प्रति लचीलेपन को आधारस्वरूप लेते हुए हम छोटे किसानों के लिए कालमेध और अश्वगंधा की खेती करना अभिस्तावित करते हैं । बड़े किसान जो उनसे कहीं ज्यादा जोखिम उढ़ाने की स्थिति में हों, वे बच, सफेद मूसली और अकरकरा की खेती भी अधिक प्रत्याय प्राप्त करने के लिए करा सकते हैं ।

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Fig. 1

Kalmegh growing on farmer's field

Fig. 2

Buch growing on farmer's field

Plate 1

Cassia fistula

Plate 2

Asparagus racemosus

Plate 3a

Sida cordifolia

Plate 3b

Sida cordifolia (Seed and Panchang)