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Review Article

CONSERVATION AND SUSTAINABILITY OF ASHWAGANDHA: A MEDICINAL PLANT

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ABSTRACT

Ayurveda become a globally popular healthcare system leading to constant rise in the demand for herbal medicines resulting in increased world herbal trade which stands at US$ 120 billion and is expected to reach US$ 7 trillion by 2050. As majority of Ayurvedic medicines are plant based, this demand has resulted in a huge pressure on the traditional sources of raw materials. Obviously, the wild sources are not able to meet the demand of raw materials. To overcome this situation alternate sources of raw materials like cultivated fields are look for supply. Dwindling forest cover, unscientific and exploitative collection leads to loss of supply source and threat to germplasm. Germplasm conservation and cultivation seems to be the best way forward for sustainable utilization of medicinal plants. Ashwagandha *(Withania somnifera* Dunal) is widely used, prioritised Ayurvedic herb having annual demand 7000 tonnes/yr but its actual production is 1500 tonnes/yr. It grows naturally in subtropical region and is collected from wild and fields. Its rampant collection has once leaded to critical pressure situation on its germplasm. This was noticed and a lot of effort was put in for its sustainable production. There is lot of evidence we will discuss in the various research field of Ashwagandha like Agronomic research, Phytochemical and Clinical research and Market Linkage. Ashwagndha due to such sustained and concerted multi-disciplinary effort has come near to a sustainable use mode. It is thus logical to extend the Ashwagandha model to other high demand medicinal plants and its feasibility.

Keywords: conservation, sustainable use, ashwagandha.

INTRODUCTION

The Indian System of Medicines, viz Ayurveda, has alone reported approximately 2000 medicinal plant species and Siddha, Unani, Homeopathy systems predominantly use plant based raw materials in most of their preparations and formulations. The Charaka Samhita an age-old written document on herbal therapy, reports on the production of 340 herbal drugs for curing various diseases. Modern pharmacopoeia also contain at least 25 % drugs derived from plants and many other which are synthetic analogues burn on prototype compounds isolated from plants. Medicinal plants occupied an important position in the socio-cultural, spiritual and medicinal arena of rural people of India the World Health Organisation (WHO) estimated that 80 % of the population of developing countries rely on traditional medicine mostly plant drugs, for their primary health care needs.[1]

Owing to the need and global resurge of herbal medicine creates huge pressure on the traditional sources of raw materials i.e. the forest for Ayurvedic medicines. Obviously, the wild sources are not able to meet the demand of raw material compelling the sector look for alternate sources like cultivated fields. Therefore, many of the high demand medicinal plants used in Ayurveda like Ashwagandha, Chitrak, Safed Musli are now being cultivated on a commercial basis. But, the unscientific and exploitative collection practices causes threat to germplasm of this species. This has rendered many medicinal plants as critically endangered and consequent ban on collection. In the area of endangered species NMPB implement the plan of conservation and sustainable use of medicinal plants.

Herbal market scenario

The domestic trade of Ayush industry is of the order of Rs.80-90 billion (1US$ = Rs 50). The Indian medicinal plants and their products account for exports in the range of Rs .10 billion dollar per annum. There is global resurgence in TSM resulting in increased world herbal trade which stands at US$ 120 billion and is expected to reach US$ 7 trillion by 2050. The domestic market is estimated to be around US$ 2 billion. Both the markets are annually growing at 15-20 %. The volume of demand of medicinal plants in India was 2700 tonnes in 2002 and has grown to 4400 tonnes in 2004-05 with an annual growth rate 21 %. Indian share in the world trade, at present, however, is quite low.[2]

Factors of threats to medicinal plant species

The great wealth of medicinal plants is under threats of various kind and orders. These threats originate from various biotic and abiotic factors/ pressures. They include:

- Over exploitation
- Unscientific exploitation
- Environmental degradation
- Human population
- Intensive cultivation
- Destructive harvesting
- Uncontrolled and unscientific grazing has also led to loss of some species

The most serious proximate threats generally are habitat loss, habitat degradation and over harvesting.

Major sources of medicinal plants

Demand for medicinal plants is increasing in both developing and developed countries. At present, about 90 % of medicinal plants used by the industries are collected from the wild. While over 800 species are used in production by industry, less than 20 species of plants are under commercial cultivation. Over 70 % of the plant collections involve destructive harvesting causes many plants endangered or vulnerable or threatened. This poses a definite threat to the genetic stocks and to the diversity of medicinal plants if biodiversity is not sustainably used.[3] To strengthen the medicinal plant sector all over the country as well as to conserve the wild stock, the National Medicinal Plant Board (NMPB) was set up by the Government of India 15. on 24 Nov. 2000. The prime objective of setting up the board was to establish an agency which would be responsible for co-ordination of all matters with respect to the medicinal plants sector, including drawing up policies and strategies for in situ conservation, cultivation, harvesting, marketing and processing and drug development etc.[4]

Conservation of medicinal plants

In its broadest sense, conservation means to preserve from harm or decay or to protect from loss or consumption.

- Conservation is judicious use of medicinal plants
- Conservation rational exploitation of medicinal plants
- Conservation is wise use of medicinal plants

Measures for conservation and development of biodiversity in medicinal plants

Medicinal plants are potential renewable natural resources. Therefore, the conservation and sustainable utilization of medicinal plant must necessary involve a long term, integrated and scientifically oriented action programme. This should also involve the pertinent aspect of protection, preservation, maintenance, exploitation, and sustainable utilization. A holistic system will be a more desirable one. There are two broad lines of conservation i.e. in-situ and Ex-situ conservation.[5]

In-situ conservation

In-situ conservation involves conservation of species in its natural habitat - in places where the species normally occurs. The natural surroundings or the entire ecosystem is protected and maintained so that all the constituent species, known or unknown to us are conserved and benefitted. This has two aims:

- To maintain economic production
- To replant the ecosystem with local sources of propagule.

Ex-situ conservation

Maintenance of species away from their normal ecosystem/habitat is known as ex-situ or off-site conservation. It is slowly becoming more popular as a back-up and sometimes a temporary replacement for in-situ conservation. This can be followed for both wild plants and domesticated crops. Ex-situ conservation has several purposes

- Rescue threatened germplasm
- Produce material for conservation biology research
- Supply material for various purposes to remove or reduce pressure from wild collecting
- Make available material for conservation education and display Produce material for reintroduction, reinforcement, habitat restoration and management[5].

Drawbacks of wild collection

- Lack of identification of particular species causes adulteration.
- The plant part is collected without paying attention to the stage of maturity, dried haphazardly and stored for long periods under unsuitable conditions.

The quality of medicinal plants depends on the geographical origin, time and stage of growth when collection has been done and post harvest handling. The collections in most cases are done by villager's tribal's residing in the vicinity of forest in their spare time. The quality of collected material, as such is often degraded.

Cultivation of Medicinal Plants

The other main source of medicinal plant is from cultivation. Given the demands of the market for a continuous and uniform supply of raw materials, and the increasing depletion of the forest resource base, expanding the number of medicinal plants in cultivation appears to be an important strategy for research and development. However, according to one estimate, of more than 400 plant species used for production of medicines by Indian Industry, less than 20 are currently under the cultivation in the country. Cultivation is clearly a sustainable alternative to collection of medicinal plants from the wild. Therefore, it is important to conserve the extensively traded medicinal plants in its natural environment or cultivate it in favourable environments.[6]

Advantages of cultivation over wild collection

As compared to the traditional crops, the cultivation of medicinal crops has many advantages. These include:

- Medicinal crops provide better returns than traditional crops
- Have very high domestic and export demand
- Fetch better prices in the market with lower price fluctuations
- Could be stored for a long time, and sold at a time when better prices prevail in the market

Given these advantages the cultivation of medicinal crops has been picking up in some regions. However, the spread is not so large to meet the demand of the industry. Owing to short supply, prices of some medicinal crops have increased substantially in the recent past. Systematic cultivation of many medicinal plants needs specific cultural practices and agronomical requirements. These are species-specific and are dependent on soil, water and climatic conditions. Hence research and development work has to be done to formulate good agricultural practices which will include appropriate selection and identification, propagation methods, cultivation techniques, harvesting, stepwise quality control of raw material up to processing stage, post-harvest treatment, storage and safety. These aspects have to be incorporated into protocols for the cultivation of medicinal plants.[7] Organic farming is another practice that is gaining wide acceptance as world demand particularly in developed countries for organically grown crops is rapidly on the increase. Farmers have to be trained in all aspects of organic farming of medicinal

plants including obtaining certification from associations that do the monitoring starting from cultivation to final harvesting.[7]

Ashwagandha

NMPB includes Ashwagandha in 32 prioritized medicinal plants.[3] Ashwagandha (*Withania somnifera* Dunal) is also known as Indian ginseng and winter cherry. It is widely used, Ayurvedic herb it appears in WHO monographs on selected medicinal plants and an American herbal Pharmacopoeia is also forthcoming.[8] It is a cosmopolitian plant and grows throughout the drier and subtropical parts of India, Srilanka, Mediterranean regions and south Africa. Ashwagandha is hardy and drought tolerant plant. Botanically it is a small, erect, branched, evergreen, tomen-tose woody shrub that grows up to 150-170 cm tall. Roots are stout, fleshy and whitish brown in colour. Leaves simple, petiolate, elliptic-ovate to broadly ovate, entire, exstipulate, cunate or oblique, glabrous, up to 10 cm long, those in the floral region are smaller and opposite. Flowers are inconspicuous, greenish or lubrid-yellow, pedicellate, 4-6 mm in diameter, axillary, umbel-late cymes occurring in 5-25 clusters. Berries are small, globose, bright orange-red when mature, 5 mm in diameter, enclosed in the persistent calyx containing numerous seeds. Seeds are small, smooth, yellow, reniform, 2 mm long, 1.5-2 mm wide and 0.5 mm thick.[9] Different parts of the Ashwagandha contain a number of chemical com-pounds. Such as alkaloid (somniferine, withanine, withananine), steroidal compounds (ergostane), Steroidal lactones (withaferin A, withanolides A-Y), Pyrazole derivatives (pseudowithanine and ashwagandhine).[10] More than 200 Ayurvedic formulations use Ashwgandha as main ingredient. The roots of the plant are categorized as rasayanas, which are reputed to promote health and longevity by augmenting defense against disease, arresting the ageing process, revitalizing the body in debilitated conditions, increasing the capability of the individual to resist adverse environmental factors and by creating a sense of mental well-being and act as memory enhancer. The plant has been used as an antioxidant, anti-tumor, adaptogenic, aphrodisiac, liver tonic, anti-inflammatory agent, astringent and more recently to treat ulcers, bacterial infections, venom toxins and senile dementia.[11] Its annual demand is 7000 tonnes but its actual production is 1500 tonnes per year.[12] The demand of ashwagandha in herbal market was estimated to be 9127.5 tonnes per annum in the year 2004-05[13] based on the trend, the current demand of aswagandha per annum would be around 12500 tonnes. Due to increasing demand and low production rates causes pressure on its wild germplasm. To overcome this cultivates Ashwagandha in commercial manner.

Opportunities for cultivation

The global interest in this plant and the high demand for its roots provide ample scope to cultivate this plant on commercial scale. Other opportunities for cultivation include: Present price for roots is attractive, crop gives economically remunerative returns in comparison to traditional crops, ease of cultivation under rainfed condition, the crop can be integrated with traditional crops through crop sequencing, opportunities for marketing leaf and seed exist, bye-products can be profitably be utilized, value addition can in-crease profits, however, current exports are limited and large scale exports of roots and value added products need to be explored.

Various Researches on Aswagandha

The following works has been done.

Agronomic Research

Cultivation practices for Ashwagandha

In India Ashwagandha is commercially cultivated in Madhya Pradesha, Gujrat, Maharashtra, Rajasthana, Hariyana, Punjab, Karnataka and Uttar Pradesh are the main producing states of this crop. In MP Neemuch and Mandsaur alone cultivated as in more than 5000 ha and in India it is cultivated under 10768 ha land.[14]

Available sources of (WS) technologies

Its cultivation, harvesting, pre and post harvest care, conservation and value addition is available with following research centers.

- Central Institute of Medicinal Aromatic Plants, Lucknow, India
- Regional Research Laboratory, Jammu, India
- Jawahar Lal Krishi Vishwa Vidyalaya Indore and Mandsaur (M. P.), India
- Gujarat Agriculture University, Anand, India
- Haryana Agriculture University, Hissar, India
- Rajasthan Agriculture University, Udaipur, India

Varieties

The major varieties under cultivation are

- WS-20(JA-20) and WS-22 developed by Jawahar Lal Nehru Krishi Vishawavidhalaya, Mandsore, India
- WSR by RRL, Jammu, India
- Rakshita and Poshita by CIMAP Lucknow, India
- In addition Regional Research Laboratory, Jammu, India has also developed a complete Protocol for the micro propagation of *Withania somnifera*.
- Nagori is a local variety with starchy roots botanically it is *Wthania* ashwagandha kaul.
- The Central Institute of Medicinal Aromatic Plants, Lucknow, India has developed complete agro-technology for cultivation of *Withania somnifera*.

It has also carried out organic cultivation and processing of Ashwagandha root with certification from the international organic certification agency ESCOCERT S.A.[15]

Cultivation Practices

Soil and climate

In India, it is distributed from 230 N-330 N, from 180-1700 m above mean sea level. The semi-arid tropical areas receiving 500-750 mm rainfall are suitable for cultivation of this crop. It requires dry season during its growing period. One or two late winter rains are conducive for proper development of roots. The crop grows well in well-drained sandy, sandy loam or light textured red/black soils having a pH of 7.5-8.0. [16]

Seed rate and germination

The rainfed crop is generally sown by broadcasting the seeds (15-25 kg/ha) mixed with sand. Irrigated crop is sown in rows 20 cm apart maintaining 5-10 cm plant-to-plant distance (5-10 lakh plants/ha). Seeds germinate in 6-10 days after sowing, but some-times the germination may be erratic. Treating the seeds with nitrogen salts improves germination, seedling vigour and root yield.[16]

Sowing time

This crop is sown late in the rainy season (Late Kharif) in the month of August in Madhya Pradesh, India. Seeds are sown when soil moisture is sufficient for good germination. A long break in the monsoon or heavy rains adversely affects germination.[12]

Seed treatment

Seeds are treated with fungicides (Mancozeb or Thiram at 3 g/kg seed) prior to seeding to protect the seedlings from seed borne diseases[12]

Thinning and weeding

Seedlings are thinned 25-30 days after planting if required and are manually weeded once. Well-grown crop can effectively suppress weeds by smothering them.[12]

Fertilizer application

Organically grown medicinal plants are commanding a good demand both in national and international markets. Therefore, application of 10-15 t/ha of farmyard manure or 3-5 t/ha of vermicom-post along with bio fertilizers such as phosphorus solubilizing bacteria is recommended for harvesting high root yields on a sustain-able basis. Alternatively 65 kg urea, 200 kg single superphosphate and 50 kg muriate of potash/ha may be applied; P and K at sowing and N in 2 splits at 30 and 60 days after sowing.[12]

Irrigation

It is generally raised as a rainfed crop. However, where irrigation facilities exist, light irrigations once in 15-20 days encourage good crop growth and produce high root yield.[12]

Pests and diseases

A number of leaf eating pests (mites, aphids, beetles) and diseases (seedling blight, leaf blight, die back etc.) are reported on Ashwagandha. A combination of 0.5 % Malathion and 0.3 % Kelthane foliar sprays at 15 days intervals controls the pests. Similarly, seed treatment with Thiram/Mancozeb and spraying of 0.3 % Mancozeb or Copperoxychloride controls the fungal diseases. Organically grown plants are sprayed with botanical pesticides such as neem products, custard apple leaf decoction, cow urine, garlic + chillies extract etc. as a prophylactic measure to protect the crop from pests and diseases.[12]

Harvesting

The crop is ready for harvest 180-210 days after planting. In some regions 150-180 days old crop is harvested. Particularly at Feb end or March First week. Signs of maturity of plant is drying out of lower leaves and reddening of berries judge the maturity of the crop. The entire plant is pulled out and cutting the stem 1-2 cm above the crown, separates the roots. The roots are cleaned and either cut into 7-10 cm long pieces and dried or dried as a whole in the sun and stored. Berries are hand plucked, dried, threshed and the seeds are stored for the next crop.[12]

Grading of roots

The dried roots are beaten with a club to remove adhering soil and to break off thin, brittle, lateral rootlets. Lateral branches, root crown and stem remains are carefully trimmed with a knife. Root pieces are then sorted out into following grades.[12]

A grade

Root pieces up to 7 cm in length, 1-1.5 cm in diameter, solid cylindrical with smooth external surface and pure white from inside.

B grade

Root pieces up to 5 cm in length, 1 cm or less in diameter, solid, brittle and white from inside.

C grade

Solid root pieces up to 3-4 cm in length, 1 cm or less in diameter

D grade

Small root pieces, semisolid or hollow, very thin, yellowish inside and < 1 cm in diameter.

Yield and profits

The crop produces 400-1200 kg/ha dried roots and 200-500 kg seeds/ha. Good quality roots are selling at a price of Rs.100-150/kg and seeds at Rs. 40-100/kg. The cost of cultivation works out to Rs. 15000-25000/ha. The net profit ranges from Rs. 25000-155000/ha. Additional returns can be earned by selling seeds and leaves.[16]

Phytochemical Research

All the plant parts are credited with medicinal properties. This plant is attracting the attention of researchers from different parts of the globe some researches has been done to increase its phytochemicals these are…

Hari Yogendra Shukla *et al* (Sept.2012)

Reported that when two crop seasons of 2005-06 and 2006-07 in split plot design using cultivar viz. cv. poshita and Ja-20 as main plot having two planting distances 30 x 30 cm^2 as subplot. Plant raised in nursery bed and transferred after 30 days of sowing. After 30, 60, 90 days of transplanting the plants were sprayed with IAA 100 ppm, IAA 200 ppm, GA 50 ppm, GA 100 ppm, CCC 2000 ppm, CCC 3000 ppm solution; where as in control they were sprayed with distilled water. Observations were suggested the best combination of plant growth regulators and stand geometry for higher yield and alkaloid content was CCC 3000 ppm with 30 x 20 cm^2 for cultivar JA-20 and poshita; whereas cv. Poshita appeared to be most suitable cultivar of Ashwagandha for cultivation as compare to JA-20.[17]

Rai and Singh (1996)

Conducted field experiments to study the efficacy of some insecticides/acaricides against the infestation of carmine spider mite on Ashwagandha. Triazophos (0.05 %) was least effective and Dicofol (0.03 %) was found to be the best among all the tested chemicals. Insecticidal treatment with Dimethoate 1.5 ml/l and Chlorpyriphos 2 ml/l for the control of Epilachna beetle and mealybug in Ashwagandha indicated that the highest yield of 519.2 kg dried roots/ha was recorded.[18]

Santhil R *et al* (August 2010)

Elucidate that the relationship between soil tests and response of ashwagandha to applied fertilizers on its chemical constituents under Integrated Plant Nutrition System (STCR-IPNS), a field experiment was conducted on Vertic Ustropept soils of Tamil Nadu (Southern India) during 2008-09 following Ramamoorthy's Inductive cum targeted yield model. Using the data on dry root yield, initial soil test values on available NPK, doses of fertilizers and farm yard manure (FYM) applied and NPK uptake, the basic parameters viz., nutrient requirement, contribution from soil, fertilizers and FYM were computed. It was found that 77.6, 31.7 and 113.3 kg of N, P_2O_5 and K_2O respectively were required for producing one tonne dry root of ashwagandha. The percent contribution of nutrients from soil, fertilizer and FYM were 19.03, 31.30 and 23.14 for N; 20.26, 17.30 and 6.38 for P_2O_5; 11.08, 62.53 and 30.39 for K_2O respectively. Making use of these basic parameters, fertilizer prescription equations were developed for ashwagandha (var. JA 20) and an estimate of fertilizer doses formulated for a range of soil test values and desired yield targets under NPK alone and IPNS (NPK plus FYM).[19]

Panwar N.L. *et al* 2009

Reported that adoption of green house technology can improve yield and productivity of medicinal crop in off season cultivation; the study was conducted with *Withania somnifera* to evaluate cultivation performance and compare with field condition. The experimental results shows that mean plant height of *Withania somnifera* in greenhouse condition was 78.9 cm whereas it was 2802 cm in field condition respectively. The collar diameter for *Withania somnifera* was 9.8 mm and 5.68 mm for greenhouse and field condition respectively. Total dry matter from *Withania somnifera* inside the greenhouse was 92.9 g per plant whereas it was 25.8 g per plant at field conditions. The above experimental results shows that off season cultivation of medicinal plants under greenhouse condition will increase the production of these high value medicinal plant and permit round year production of these crop.[20]

Clinical Research

Bone K. *et al* (1996)

Reported that Anti-Aging effect of ashwagandha in a double-blind clinical trial, ashwagandha were tested in a group of 101 healthy males, 50-59 years old, at a dosage of 3 grams daily for one year. A significant improvement in hemoglobin, red blood cell count, hair melanin and seated stature was observed. Serum cholesterol decreased and nail calcium was preserved. Erythrocyte sedimentation rate decreased significantly and 71.4 percent reported improvement in sexual performance.[21]

Shrinivas K Kulkarni (July 2008)

Reported Anxiolytic effect of Ashwagandha in this study the effect of fluoxetine, citalopram (SSRI'S) gabapentin (Antiepileptic drugs), Venlafexine (SNRI), clozapine and resperidone (Atypical Antipsychotics) and a herbal preparation Ashwagandha on elevated zero maze 7 elevated plus maze paradigms was examined, Anti-anxiety potentials of these drugs were compared with Diazepam. The drugs tested that is fluoxetine (10 mg/kg), Citalopram (10 mg/kg), Clozapine (0.25, 0.5, 1 mg/kg, resperidone (0.51 mg/kg), Venalafaxine (4.8, 10 mg/kg), Citalopram (10 mg/kg), fluoxetine (10 mg/kg), gabapentin (10, 20 mg/kg) and Ashwagandha (100, 200 mg/kg significantly increased the number of open arm entries and time spent in open arm. These drugs also decreased the latency to enter in open arm as compared to control in both the paradigms[22].

Kaur *et al*, (2004)

Reported Anti neoplastic effects both *in vivo* and *in vitro* research attest to the cytotoxic and antitumor potential of *Withania somnifera*. *In vitro* research has been conducted primarily using powdered *Withania somnifera* leaf extract. osteogenic sarcoma and breast carcinoma cell lines were treated with 3-24 µg/mL aqueous leaf powder extract of *Withania somnifera*. Cells treated with *Withania somnifera* showed reduced proliferation compared to controls and assumed morphology more closely related to senescent cells. Osteogenic sarcoma and breast carcinoma cells exposed to high oxidative stress via a high-glucose medium or exposure to H_2O_2 were actually more susceptible to the effects of oxidative damage after treatment with the *Withania somnifera* extract. This suggests *Withania somnifera* has an anti-proliferative effect, but not an antioxidant effect, on human tumor cells.[23]

Shouma Paul Nandi *et al* (2011)

Reported the antioxidant and antibacterial activity of aqueous root extract of *W. somnifera* against methicillin resistant *Staphylococcus aureus* (MRSA). Aqueous root extract of the plant was found to possess strong antibacterial activity against MRSA as revealed by the *in vitro* agar well diffusion assay. The separation of the bioactive compounds from the plant extract was carried out using two dimensional thin layer chromatography (TLC) and contact bio-autography. Two TLC spots were found to be bioactive against the pathogen with minimum inhibitory concentrations of 2.3 µg/µl and 5.2 µg/µl respectively. One spot was of alkaloids and the other one was a mixture of essential oil and phenolics. The antioxidant activity was estimated to be Trolox Equivalent Antioxidant Capacity of 9.83 mg/g of dry weight of extract and reducing power was 0.11 mg/g of dry weight of extract using ascorbic acid as standard. Our study suggests that the bioactive fractions separated from aqueous extract of *W. somnifera* are a potential source of antibacterial compounds with antioxidant property.[24]

These researches have proven that the Ashwagandha clinically used in various diseased conditions.

Market Linkage of Ashwagandha

The Neemuch and Mandsaur markets of Madhya Pradesh, India are popular world over for Ashwagandha. Importers, buyers within the country, processors, traditional practitioners, Ayurvedic and Siddha Drug manufacturers visit these markets for procurement of Ashwagandha roots every year. Other trade

centers are Mumbai, Delhi and Amritsar, India. The annual domestic demand for Ashwagandha roots as stated earlier is about 7000 t. As the production is much less (around 1500 tonnes) in India, the internal market itself is having high potential.

DISCUSSION

The success of Ashwagandha cultivation sector mainly depends on the awareness and interest of the farmers as well as its other stakeholders, supportive government policies, availability of assured markets, profitable price levels, and assess to simple and appropriate agro-techniques. The successful establishments of Ashwagandha in Indian herbal market may help in raising rural employment, boost commerce, and contribute to the health of millions.

Ashwagandha is one such plant which has a steady market demand, whose cultivation technologies are well established, whose marketing channels are fairly established. This has made the use of Ashwagandha sustainable despite having a huge demand and depleting wild population.

CONCLUSION

Ashwagandha is a success story in sustainable use of medicinal plant and this model can be replicated for other medicinal plants.

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