Economic assessment of Mahaneem (*Melia dubia*)- Mung bean (*Vigna radiata*) based agroforestry system in semi-arid regions of Bundelkhand

Abstract

In agroforestry, although a wide range of species are grown yet leguminous crops are mostly given importance due to the nitrogen fixation ability. Among various leguminous crops, Mung bean is one of the important crops which is traditionally grown in this region. The study was carried out at RLBCAU, Jhansi. Mung bean was grown under 2 growing conditions viz. under sole cropping in open field as well as under intercropping in Melia dubia based agroforestry system in 2 different spacings and distances from tree base. The cost of cultivation was calculated by taking into account the input prices that were in effect when different cultivation practices were used for crop cultivation as well as the establishment and management costs of plantations for various treatments. The cost of cultivation, which includes the cost of various agricultural operations and the labour rate, was computed locally, and the cost of other inputs, such as seeds, fertilizers, fungicides, pesticides, and herbicides, was determined by the actual amount used per hectare.

Keywords: Cost of cultivation, groundwater resources, irrigation, agroforestry

1. Introduction

The Bundelkhand region of central India is characterized by undulating and rugged topography, highly eroded soils with poor soil fertility, scarce groundwater resources and erratic rainfall with poor irrigation facilities leading to frequent droughts and crop failures (Gupta *et al.,* 2009). This region falls in semi-arid, subtropical climate, which receives an average annual rainfall of 867 mm, the maximum part of which (more than 90%) is received only during 3 months, *i.e.,* July to September (Tewari *et al.,* 2016).

Due to semi arid climate, crop failure is a major issue in this region. Hence, instead of sole cropping, agroforestry is gaining importance in this region due to additional benefits. In Bundelkhand numerous trees such as Teak (*Tectona grandis*), Babool (*Acacia nilotica*), Sissoo (*Dalbergia sissoo*), Palash (*Butea monosperma),* Tendu (*Dyospyros melanoxylon*), Harad (*Terminalia chebula*) and Bahera (*Terminalia bellirica*) etc. are predominant species under different agroforestry system. Nowadays, fast growing tree species are being promoted under agroforestry to sustain food security, livelihood security, environment security vis-a-vis developing a highly productive land use system to reduce the impact of climate change. *Melia dubia* Cav. (Meliaceae) is also an important fast growing agroforestry tree species of India, which is distributed naturally in tropical and sub-tropical regions. Its wood is utilized for making, furniture, pulp, plywood, packing cases, agricultural implements, pencils, splints etc. and as a source of bio-energy.

The demand of *Melia dubia* is increasing as an indigenous source for pulp, matchstick, pole and plywood industry in India. Due to wider adaptation ability, *Melia dubia* is suitable for plantation programmes under different agro-climatic conditions. Due to faster growth rate and industrial demand *Melia dubia* provides an alternative to traditional agroforestry tree species.

In agroforestry, although a wide range of species are grown yet leguminous crops are mostly given importance due to the nitrogen fixation ability. Among various leguminous crops, Mung bean is one of the important crops which is traditionally grown in this region.

The mung bean (*Vigna radiata* L.) known as green gram, mung, monggo, or munggo is a plant species that belongs to family Fabaceae or Leguminaceae and sub-family Papilionaceae. Mung bean has three subgroups, one of which is cultivated (*Vigna radiata* subsp. radiata) while the remaining two are wild (*Vigna radiata* subsp. sublobata and *Vigna radiata* subsp. glabra). Besides being two separate species, it is often confused with black gram (*Vigna mungo*) because of their similar appearances. Due to the mutualistic relationship between rhizobia and the roots of leguminous plant, mung bean enables it to fix atmospheric nitrogen (58–109 kg per ha). It may supply the soil with a lot of nitrogen (between 30 and 251 kg/ha) which may fulfil their own nitrogen requirement, as well as potential to fix nitrogen for future crops (Jat *et al.*, 2012).

2. Methodology

The following study was carried out at RLBCAU, Jhansi. Mung bean was grown under 2 growing conditions viz. under sole cropping in open field as well as under intercropping in *Melia dubia* based agroforestry system in 2 different spacings and distances from tree base. The growth and yield parameters was assessed at 3 different time interval viz. 25 DAS, 45 days after sowing and 65 DAS. At the end of harvest, the economic parameters were also assessed. This research paper assesses the economics of Mahaneem (*Melia dubia)*- Mung Bean (*Vigna radiata*) based agroforestry system. The Mung bean harvested at the end of the study was sold at Market price and different economic parameters were also assessed.

Various economic parameters were assessed using standard formulas as depicted below.

2.1 Cost of cultivation

The cost of cultivation was calculated by taking into account the input prices that were in effect when different cultivation practices were used for crop cultivation as well as the establishment and management costs of plantations for various treatments. The cost of cultivation, which includes the cost of various agricultural operations and the labour rate, was computed locally, and the cost of other inputs, such as seeds, fertilizers, fungicides, pesticides,and herbicides, was determined by the actual amount used per hectare.

2.2 Gross returns

The total financial returns from the system were computed by summing the total financial returns from the system's intercrop and tree components, taking into a gross return in rupees per hectare using the current local market pricing.

Net Return

Net returns were calculated by deducting total costs from the gross returns.

Net return = Gross return – Total Cost of cultivation

Benefit to Cost Ratio

Benefit to Cost Ratio = Gross Return (Rs/Ha) / Total cost of Cultivation (Rs/Ha)

Land Equivalent Ratio

The land equivalent ratio was estimated using the following formula

Land Equivalent Ratio = Crop A (Tree) yield in mixture/ Crop A (Tree) yield in Monoculture + Crop B yield in mixture/ Crop B yield in Monoculture

Result and Discussion

Table 1 : Gross and Net return analysis

Sl. No	Treatment	Total cost of cultivation(Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit-Cost ratio	LER
1.	T1 - *Vigna radiata* sole crop	37,284	75,386	42,100	2.02	0.96
2.	T2 - *Melia dubia* sole tree (5 m × 3 m)	83,340	241,425	162,085	2.90	1.28
3.	T3 - *Melia dubia* sole tree (5 m × 4 m)	64,300	151,250	90,200	2.35	1.16
4.	T4 - *Melia dubia* sole tree (5 m × 5 m)	53,160	99,000	48,640	1.86	1.03
5.	T5 - *Melia dubia* (5 m × 3 m) + *Vigna radiata*	120,624	378,566	265,940	3.14	2.19
6.	T6 - *Melia dubia* (5 m × 4 m) + *Vigna radiata*	101,584	246,723	153,387	2.43	2.10
7.	T7 - *Melia dubia* (5 m × 5 m) + *Vigna radiata*	90,444	175,359	91,714	1.94	2.00

When the growing environments were compared, the mung bean cultivated under tree spacing T5 produced greater B:C ratios, land equivalent ratios (LER), net returns, and gross returns. This is consistent with previous research by Dalvi et al. (2020), Mevada et al. (2022) in an agroforestry system based on Teak and Okra, Patil et al. (2020) in an agroforestry system based on Teak and Sapota, Dash et al. (2024) in a system based on poplar and turmeric, and Garima et al. (2021), which found that agri-silviculture systems yielded higher net returns than sole cropping. Similarly, Yadav et al. (2017) and Sravan (2017) observed greater net returns from growing potatoes and rice Hanif et al. (2010) studied okra under the *Litchi chinensis* agroforestry system; Panwar and Wani (2014) studied wheat under the *Ipomea batata-Populus deltoides* agroforestry system; Rajalingam et al. (2016) studied vegetables under the *Ailanthus excelsa* agroforestry system; and Kazi et al. (2016) studied Colocassia under the *Borasus flabelliar* agroforestry system and reported similar results.

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