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Women Empowerment Through the Namo Drone Didi Scheme

Bhavana K. S*[1], Sahana S[2], Ganesh Prasad T. S.[3] and Kiran Kumar R. Patil[4]

[1] P. G. Scholar, Department of Agricultural Extension Education, KSNUAHS, College of Agriculture, School of Post Graduation Studies, Main Campus, Iruvakki, Shivamogga - 577 412, Karnataka, India
[2] Professor and Head, Department of Agricultural Extension Education, KSNUAHS, College of Agriculture, School of Post Graduation Studies, Main Campus, Iruvakki, Shivamogga - 577 412, Karnataka, India
[3] Assistant Professor, College of Forestry, Ponnampet, Karnataka, India
[4] Assistant Professor, Department of Agricultural Economics, KSNUAHS, College of Agriculture, School of Post Graduation Studies, Main Campus, Iruvakki, Shivamogga - 577 412, Karnataka, India

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Abstract

Drone technology has emerged as a transforming tool in agriculture, offering significant benefits in improving efficiency, reducing input costs and enhancing crop productivity. In this context, the present study attempts to examine women empowerment through the flagship Central Government initiative Namo Drone Didi, implemented in the year 2023. The study was conducted by considering ten Self-Help Groups (SHGs) effectively functioning in various districts of Karnataka that have availed Namo Drone Didi. Women empowerment was assessed in economic terms by estimating the profitability accrued to Drone Didi's through renting drones for the application of plant protection chemicals (PPCs) to growers in Karnataka. In addition, an attempt was also made to estimate the economic worthiness of using drones for PPC application. Enterprise budgeting and partial budgeting techniques were employed to ascertain the economic feasibility of drone usage. The results indicated that the selected Drone Didi's widely used drones for the application of plant protection chemicals to control pests and diseases, predominantly in red gram fields, followed by maize. The Drone Didi's used drones for pest and disease control over an area of about 350 acres per year, incurred total cost of Rs. 1,22,500.00 and earned a profit over variable cost at Rs. 94,500.00. The net profit accrued was Rs.17,500.00, which was substantial and contributed significantly to the empowerment of women functioning as Drone Didi's. The economic worthiness of chemical application through drones ranged from Rs. 1165.74 per acre in Maize to Rs. 3426.68 per acre in Red gram. This income has made the women to become economically empowered and encouraged them to take up this as an entrepreneurial activity to have social recognition.

***Key words*:** Women empowerment, Self-help groups, Namo drone Didi

Agriculture plays a crucial role in the Indian economy by supporting livelihoods, employment and food security, engaging nearly 45.00 to 50.00 per cent of the workforce [1]. Women form a significant part of this sector, constituting about 33.00 per cent of cultivators and 47.00 per cent of agricultural labourers and actively participate in major farm operations such as sowing, weeding, harvesting and post-harvest activities [2]. Despite their substantial contribution, women face persistent challenges including limited access to land, modern machinery, institutional credit, extension services and skill-oriented training, which restrict their decision-making power and economic empowerment.

The emergence of drone technology offers new opportunities to enhance agricultural productivity and sustainability through precision spraying, crop monitoring and input optimization. Drone-based operations can reduce chemical usage by 20.00 to 30.00 per cent, save 30.00 to 40.00 per cent in labour cost and significantly increase operational efficiency compared to conventional methods [3]. In India, the rapid growth of the agricultural drone sector has been supported by policy initiatives such as the Drone Rules, 2021 and the Sub-Mission on Agricultural Mechanization [4]. Recognizing the dual potential of drone technology for agricultural transformation and women empowerment, the Government of India launched the Namo Drone Didi Scheme in 2023 to provide drones and training to women Self Help Groups (SHGs). The scheme enables women, known as Drone Didis, to offer drone-based agricultural services on a rental basis, generating new livelihood opportunities while reducing health risks associated with manual pesticide application [5].

The Namo Drone Didi Scheme contributes directly to several Sustainable Development Goals (SDGs) by integrating women empowerment with technological advancement in agriculture. By creating income-generating opportunities for women SHG members through drone-based services, the scheme supports SDG 1 (No Poverty) and SDG 8 (Decent Work and Economic Growth) by enhancing livelihoods and promoting rural entrepreneurship. The active involvement of women as trained drone operators strengthens SDG 5 (Gender Equality) by improving women's access to productive

***Correspondence to:** K. S. Bhavana, E-mail: bks97556@gmail.com; Tel: +91 98803 64748

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resources, skill development, leadership roles and decision-making power. The use of drone technology for precision spraying and efficient input use promotes SDG 2 (Zero Hunger) by improving agricultural productivity and SDG 12 (Responsible Consumption and Production) through reduced chemical usage and optimized resource management. Further, by minimizing manual exposure to pesticides, the scheme contributes to SDG 3 (Good Health and Well-Being), while the adoption of advanced agricultural technologies aligns with SDG 9 (Industry, Innovation and Infrastructure). Thus, the Namo Drone Didi Scheme represents a sustainable development intervention that simultaneously advances agricultural efficiency, women empowerment and national commitments towards achieving the SDGs [6].

From an empowerment perspective, the scheme contributes to women's economic, social, and psychological empowerment by enhancing income, promoting entrepreneurship, strengthening leadership roles and building confidence through advanced skill acquisition [7]. Karnataka, with its strong SHG networks and increasing technological adoption in agriculture, provides a suitable context to assess these impacts. In this context, the present study examines the role of the Namo Drone Didi Scheme in promoting women empowerment and improving agricultural efficiency, with a focus on income generation, employment creation and empowerment outcomes among women SHG members.

MATERIALS AND METHODS

The present study was undertaken to examine women empowerment through the Namo Drone Didi Scheme and is based entirely on primary data collected from women Self Help Groups (SHGs) benefiting under the scheme. The data was collected from total of 10 women SHGs that received agricultural drones and actively engaged in providing drone-based agricultural services using purposive sampling.

Data were collected directly from SHG members and trained as Drone Didi, through personal interviews using a pre-tested structured interview schedule. Information was gathered on the profile characteristics of SHGs, including year of establishment, number of members, savings, bank linkage, loan availed and year of initiation of drone services. In addition, data on income generated from drone services for one year were collected to assess the earning potential of SHGs under the scheme. Table 1 shows the profile and income characteristics of women SHGs benefiting under Namo Drone Didi Scheme.

Further, data were collected on the operational aspects of drone-based agricultural services, such as area covered, quantity of chemicals used, number of sprays taken, labour requirement, operational costs, and crop yield levels in major crops like red gram and maize. The returns and profit from drone-based agricultural operations were estimated using the enterprise budgeting technique, while the economic worthiness and incremental income resulting from drone usage were assessed using the partial budgeting technique. The collected data were analyzed and presented in tabular form to facilitate clear understanding and interpretation of the results.

Analytical techniques employed

Enterprise budgeting

Enterprise budgeting is the summary of costs, returns and profit associated with an enterprise [8]. This technique was employed to assess the profitability of drone-based agricultural services undertaken by Drone Didis under the Namo Drone Didi Scheme. It was explicitly used to work out the costs incurred in operating and maintaining agricultural drones on an annual basis and to estimate the economic benefits accrued through providing drone-based plant protection services to farmers. To estimate the economic benefits of adoption of drone technology in agriculture under the Namo Drone Didi Scheme, the cost of operation and maintenance of drones by Drone Didis was estimated on an annual basis using the enterprise budgeting technique. The major cost and return components influencing the productivity and profitability of drone-based plant protection services were identified and classified into variable and fixed costs. Variable costs included expenditure on electricity for battery charging, human labour involved in drone operation, annual operation and maintenance expenses of the drone. Fixed costs comprised depreciation of the drone assuming a useful life of 10 years and interest on fixed capital invested on the drone calculated at the rate of interest of 12 per cent per annum. Returns were estimated based on income generated by Drone Didis through renting out of drone-based plant protection services to farmers, and profitability was assessed by estimating profit over variable cost and profit over total cost.

Partial budgeting analysis

Partial budgeting is one of the most widely used techniques to understand the profitability because of the change in the existing technology [9]. Partial budgeting analysis was employed to assess the economic worthiness of drone-based pesticide application in comparison with the conventional manual spraying method. The analysis focused only on those costs and returns that changed due to the adoption of drone technology. The credit side of the partial budget included added returns obtained due to improved crop protection and yield enhancement, as well as reduced costs resulting from savings in chemical usage and labour requirement. The debit side included added costs incurred due to drone operation, such as pilot and co-pilot charges, depreciation on the drone, interest on fixed capital invested, electricity charges for battery charging, and annual operation and maintenance expenses apportioned per acre. Economic worthiness was estimated as the difference between total credit and total debit, which helped in determining the profitability of drone-based plant protection measures in red gram and maize compared to manual spraying.

RESULTS AND DISCUSSION

The profile of SHGs in (Table 1) indicated that the selected SHGs were established in the time frame of 2014 to 2022. The average number of members were 15 which was optimum as per the requirement of SHG for bank linkage. The savings per month per member was Rs. 100 serving as a source of internal lending inculcating the habit of thrift among women folk. The SHG bank linkage took place among selected SHGs in time frame of 2014 to 2022. The average of total loan advanced from SHG came to Rs. 1091000. The loan advanced per individual worked out to Rs. 121600.

Drone Didi availed drones from 2023 to 2024 across selected SHGs. The average of income generated from renting of drone across SHGs was Rs. 140000. The enterprise budgeting analysis of drone-based agricultural services provided by Drone Didi under the Namo Drone Didi Scheme indicated that on an average, Drone Didi rented drone for 350 acres per year and incurred total cost of Rs.1,22,500. Out of the total cost, fixed cost constituted the major share at Rs.77,000, followed by variable cost at Rs.45,500. Within the variable cost, annual operation and maintenance of the drone formed the major chunk, followed by expenditure on human labour and

electricity charges, indicating that operational expenses played a significant role in provision of drone service. The dominance of fixed costs was mainly due to interest on fixed capital and depreciation, reflecting the capital-intensive nature of drone technology. Despite the higher fixed cost component, the Drone rentals generated returns of Rs.1,40,000, resulting in a profit of Rs.94,500 over variable cost and Rs.17,500 over total cost, indicating the economic viability of drone-based services. The positive net returns demonstrate that the drone enterprise is economically viable and provides direct income generation for women SHG members, thereby enhancing their individual economic empowerment under the Namo Drone Didi Scheme.

Table 1 Profile of SHGs practicing drone Didi Scheme

Name of SHG	Year of establishment	No. of members	Savings per month	Year of SHG bank linkage	Total loan advanced	Avg. loan per person	Year from which drones were given	Income generated from drones
Gnana SHG, Koppal	2020	20.00	100.00	2020	10,00,000	50,000	2023	1,50,000
Bhagyajyothi Swasahaya Sangha, Belagaum	2005	15.00	100.00	2005	15,00,000	1,00,000	2023	30,000
Annapoorneshwari Swasahaya Sangha, Hassan	2015	20.00	100.00	2015	11,20,000	56,000	2023	80,000
Sri Anjaneyasahakara Sangha, Gulbarga	2022	12.00	100.00	2022	6,00,000	50,000	2024	50,000
Mahalakshmi Streeshakti Sangha, Tumkur	2019	15.00	100.00	2019	7,50,000	50,000	2024	2,40,000
Bhoomika Raitha Mahila Sangha, Gadag	2016	16.00	100.00	2016	16,00,000	1,00,000	2024	1,20,000
Bhagiratha SHG, Vijayanagar	2021	11.00	100.00	2021	11,00,000	1,00,000	2023	80,000
Pathreshwara Mahila Sangha, Raichur	2023	12.00	100.00	2023	6,00,000	50,000	2024	1,50,000
Eshwaramma Sangha, Hassan	2014	18.00	100.00	2014	18,00,000	1,00,000	2024	1,00,000
Ananya Sahakara Sangha, Mandya	2018	15.00	100.00	2018	8,40,000	5,60,000	2024	4,00,000
Average			100.00		10,91,000	121600		1,40,000

Table 2 Economics of usage of drone-to-drone Didi

S. No.	Variable cost	Value (Rs. / Year)
a)	Electricity	3,500
b)	Human Labour	7000
c)	Annual operation and management of drone	35,000
	Total variable cost	45,500
a)	Interest on fixed capital @12 per cent per annum	42,000
b)	Depreciation assuming life as 10 years	35,000
	Total fixed cost	77,000
	Total cost	1,22,500
	Returns	1,40,000
	Profit over variable cost	94,500
	Profit over total cost	17,500

Table 3 Incremental income from application of pesticide in red gram using drone

S. No.	Credit	Value (Rs./acre)	Debit	Value (Rs./acre)
	Added Returns		Reduced Returns	
1.	Added returns due to timely and effective control of pod borer and sterility mosaic through drone spray compared to manual spray	3,180	Nill	
	Total Added Returns	3,180	Total Reduced Returns	
	Reduced Cost		Added Cost	
2.	Savings on account of chemical through drone spray compared to manual spray	630	Rental charges of Rs. 100 per day with two labour can spray within a day, so per acre wages came to Rs. 700.	2,400
3.	Savings on account of human labour requires to operate drone compared to manual spray	2,100	Added cost on account of Depreciation of Drone assuming lifespan as 10 years apportioned on per acre basis	116.66
			Interest on fixed capital invested in Drone @ 12 per cent per acre	140
			Electricity charges for charging battery per acre	10
			Annual operation and management of Drone to cover 300 acres of land costs Rs.35000 per annum	116.66
	Total Reduced Cost	3,030	Total Added Cost	2,483.32
	Total credit	5,910	Total Debit	2,483.32
	Economic Worthiness = Total Credit -Total Debit		3426.68	

Partial budgeting analysis was employed to assess incremental income from drone-based plant protection measures in comparison with conventional manual spraying in Red gram. Timely and effective management of vectors responsible for sterility mosaic virus through drone application of thiamethoxam @ 40 g per acre for three sprays resulted in an increase in yield by 0.34 quintals per acre, while efficient control of pod borer causing pod deformation through drone spraying of copper oxychloride 50 WP @ 3 g per litre of water for three sprays increased yield by 0.11 quintals per acre over manual spraying. The combined yield advantage resulted in added returns of Rs. 3,180 per acre. In addition, significant cost savings were observed due to reduced chemical usage under drone spraying. Manual spraying of thiamethoxam required 360 g of chemical for three sprays, whereas drone spraying required only 60 g, resulting in a saving of 300 g valued at Rs. 69 at Rs. 0.23 per gram. Similarly, manual spraying of copper oxychloride required 1,080 g for three sprays, while drone spraying required only 60 g, resulting in a saving of 1,020 g valued at Rs. 561 at Rs. 0.55 per gram. Labour requirement was also lower under drone spraying, as spraying was carried out using one pilot charges Rs. 350 per spray, amounting to Rs. 2,100 for three sprays for spraying two chemicals separately, which was lower than manual spraying cost and hence considered as reduced cost. Thus, the total reduced cost amounted to Rs. 3,030 per acre and, together with added returns of Rs. 3,180, the total credit under partial budgeting was Rs. 5,910 per acre. On the debit side, savings on account of human labour required to operate drone compared to manual spray is Rs. 2,400, depreciation on drone at Rs. 116.66 per acre assuming a useful life of 10 years, interest on fixed capital invested in the drone at 12 per cent amounting to Rs. 140 per acre, electricity charges of Rs. 10 per acre for battery charging, and annual operation and management cost of Rs. 35,000 apportioned over 300 acres resulting in Rs. 116.66 per acre, together accounting for a total added cost of Rs. 2,483.32 per acre. Consequently, the economic worthiness, calculated as the difference between total credit and total debit, was Rs. 3,426.68 per acre, clearly indicating that drone-based pesticide application is economically superior to manual spraying due to timely pest control, substantial savings in chemical use, reduced labour requirement, and higher yield realization [10].

Table 4 Incremental income from application of pesticide in maize using drone

S. No.	Credit	Value (Rs./acre)	Debit	Value (Rs./acre)
	Added Returns		Reduced Returns	
1.	Added returns due to timely and effective control of downy mildew and dead heart symptom through drone spray compared to manual spray	800	Nill	
	Total Added Returns	800	Total Reduced Returns	
	Reduced Cost		Added cost	
2.	Savings on account of chemical through drone spray compared to manual spray	1222.4	Rental charges of Rs. 100 per day with two labour can spray within a day, so per acre wages came to Rs. 400.	900
3.	Savings on account of human labour requires to operate drone compared to manual spray	800	Added cost on account of Depreciation of Drone assuming lifespan as 10 years apportioned on per acre basis	233.33
4.			Interest on fixed capital invested in Drone @ 12 per cent per acre	280
5.			Electricity charges for charging battery per acre	10
6.			Annual operation and management of Drone to cover 150 acres of land costs Rs.35000	233.33
	Total Reduced Cost	2022.40	Total Added Cost	1656.66
	Total credit	2822.40	Total Debit	1656.66
	Economic Worthiness=Total Credit-Total Debit		1165.74	

The partial budgeting technique was employed to estimate the incremental income from drone-based chemicals application in maize by comparing it with the existing manual spraying practice. Timely and effective management of downy mildew and shoot borer causing dead heart symptom through drone application spraying Coragen @ 0.4 ml per litre and Emamectin benzoate @ 0.5 g per litre of water for two times increased yield by 0.3 quintals per acre over manual spraying, together generating an added return of Rs. 800 per acre. In addition, drone spraying significantly reduced chemical consumption due to lower spray volume requirement. Manual spraying of Coragen consumed 96 ml for two sprays, whereas drone spraying required only 16 ml, resulting in a saving of 80 ml valued at Rs. 1,066.40 at Rs. 13.33 per ml, while Emamectin benzoate usage was reduced by 100 g, valued at Rs. 156 at Rs. 1.56 per gram. Labour requirement was also reduced under drone spraying, as spraying was completed using one pilot charges Rs. 400 per acre, amounting to Rs. 800 for two sprays, which was lower than manual spraying cost and hence considered as reduced cost. Thus, the total reduced cost was Rs. 2,022.40, and together with added return of Rs. 800, the total credit under partial budgeting was Rs. 2,822.40 per acre. On the debit side, Savings on account of human labour requires to operate drone compared to manual spray is Rs. 900 for two sprays, depreciation on drone at Rs. 233.33 per acre assuming a lifespan of 10 years, interest on fixed capital invested in the drone at 12 per cent amounting to Rs. 280 per acre, electricity charges of Rs. 10 per acre for battery charging, and annual operation and management cost of Rs. 35,000 distributed over 150 acres resulting in Rs. 233.33 per acre, together accounting for a total added cost of Rs. 1,656.66 per acre. The economic worthiness, calculated as the difference between total credit and total debit, was Rs. 1,165.74 per acre, indicating that drone-based pesticide application in maize is economically superior to manual spraying due to timely pest and disease control, reduced chemical usage, lower labour requirement, and higher yield realization. The positive net gain of Rs. 1,165.74 per acre demonstrates the economic feasibility and potential of drone-

based pesticide application as a cost-effective and resource-efficient alternative to conventional manual spraying in maize.

CONCLUSION

Through capacity building programme non drone using farmers in the region should be educated about the economic benefits of using drone for control of pests and diseases. Thereby rentals of drone can be improved and profits from drone rentals could be increased. The study concluded that drone-based plant protection services under the Namo Drone Didi Scheme have significantly enhanced incremental income and economic viability among women Self Help Groups members in Karnataka. Drone spraying enabled timely and precise pest and disease management, resulting in higher yields and improved crop protection efficiency in red gram and maize. The partial budgeting analysis revealed substantial economic worthiness of drone-based spraying over conventional manual methods due to reduced chemical usage and labour requirement. Enterprise budgeting results further confirmed the profitability of drone-based services despite their capital-intensive nature. The income generated through drone operations contributed directly to the economic empowerment and entrepreneurial development of women beneficiaries. At present, the Namo Drone Didi Scheme covers a limited number of SHGs and crops. The findings indicate that expanding the scheme to additional crops and regions could further enhance farm income and resource-use efficiency. Strengthening training, institutional support, and access to credit would facilitate wider adoption. Promoting drone-based services can address labour scarcity and rising input costs in agriculture. The scheme represents a sustainable and inclusive technological intervention. It integrates income generation, women empowerment, and agricultural modernization effectively.

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