

**ECONOMIC EVALUATION OF PMKSY-WD AND
KFW WATERSHED PROJECTS IN KOLAR
DISTRICT OF KARNATAKA**

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**DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE**

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*In partial fulfillment of the requirements for the
award of the degree*

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AFFECTIONATELY
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BETTERMENT OF SOCIETY



**DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE**

CERTIFICATE

This is to certify that the thesis entitled “**ECONOMIC EVALUATION OF PMKSY-WD AND KFW WATERSHED PROJECTS IN KOLAR DISTRICT OF KARNATAKA**” submitted by Ms. MEGHANA, J., PALB 8121 in partial fulfilment of the requirement for the degree of **MASTER OF SCIENCE (Agriculture) in AGRICULTURAL ECONOMICS** to the University of Agricultural Sciences, Bangalore, is a recorded of *bona-fide* research work done by her during the period of her study in this University under my guidance and supervision. The thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bengaluru
October, 2020

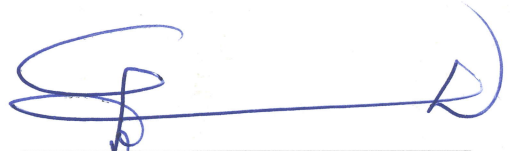


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(MEGHANA, J.)

ECONOMIC EVALUATION OF PMKSY-WD AND KFW WATERSHED PROJECTS IN KOLAR DISTRICT OF KARNATAKA

MEGHANA, J.

ABSTRACT

The study was undertaken in Srinivaspura taluk, Kolar district, Karnataka to analyse the economic benefits derived by watershed beneficiaries in Yeldur nala sub watershed project and Mudimadagu watershed project implemented under Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development (PMKSY-WD) and Credit Institute for Reconstruction-watershed project (KfW-WP), respectively. Primary data was collected from randomly selected 50 farmers from each project which includes 30 watershed beneficiaries and 20 non-beneficiaries. Data Collected was analysed using Simpson's index, cost and returns analysis and resource use efficiency tools. Higher crop diversity was found among beneficiaries of both PMKSY-WD and KfW watershed areas (WA) with Simpson's index values of 0.85 and 0.84, respectively compared to non-watershed area (NWA). Production, productivity and net returns of the major crops was higher in WA than in NWA. Annual income per farm was found higher in both PMKSY-WD and KfW-WP WA with Rs. 2,94,446 and Rs. 3,15,450 acre⁻¹ respectively than in NWA. Results of resource use efficiency depicted that inputs were efficiently used in WA compared to NWA. Lack of awareness about benefits of watershed technology among the beneficiary farmers and poor participation by the farmers during training programmes conducted by the implementing agencies were the major constraints faced during the implementation of watershed projects. Results have sufficiently indicated that the watershed activities benefited farmers by enhancing their yield, net returns and overall income. There is a need for formation of watershed farmers' associations for the maintenance of soil and water conservation structures by watershed development department.

October, 2020

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**ಕರ್ನಾಟಕದ ಕೋಲಾರ ಜಿಲ್ಲೆಯಲ್ಲಿ ಪಿಎಂಕೆಎಸ್‌ವೈ-ಡಬ್ಲ್ಯೂಡಿ ಮತ್ತು ಕೆಎಫ್‌ಡಬ್ಲ್ಯೂಪಿ
ಜಲಾನಯನ ಯೋಜನೆಗಳ ಆರ್ಥಿಕತೆಯ ಮೌಲ್ಯಮಾಪನ**

ಮೇಘನ, ಜಿ.

ಸಾರಾಂಶ

ಪ್ರಧಾನಮಂತ್ರಿ ಕೃಷಿ ಸಿಂಚಾಯಿ ಯೋಜನೆ-ಜಲಾನಯನ ಅಭಿವೃದ್ಧಿ (ಪಿಎಂಕೆಎಸ್‌ವೈ-ಡಬ್ಲ್ಯೂಡಿ) ಮತ್ತು ಕ್ರೆಡಿಟ್ ಇನ್‌ಸ್ಟಿಟ್ಯೂಟ್ ಫಾರ್ ರೀಕನ್‌ಸ್ಟ್ರಕ್ಷನ್-ಜಲಾನಯನ ಯೋಜನೆ (ಕೆಎಫ್‌ಡಬ್ಲ್ಯೂಪಿ ಡಬ್ಲ್ಯೂಪಿ) ಅಡಿಯಲ್ಲಿ ಯೆಲ್ದೂರ್ ನಾಲಾ ಉಪ ಜಲಾನಯನ ಯೋಜನೆ ಮತ್ತು ಮುದಿಮಡಗು ಜಲಾನಯನ ಯೋಜನೆಗಳನ್ನು ಕ್ರಮವಾಗಿ ಆಯ್ದುಕೊಳ್ಳಲಾಯಿತು. ಜಲಾನಯನದ ಫಲಾನುಭವಿಗಳು ಪಡೆದ ಆರ್ಥಿಕತೆಯ ಲಾಭಗಳನ್ನು ವಿಶ್ಲೇಷಿಸಲು ಕರ್ನಾಟಕದ ಕೋಲಾರ ಜಿಲ್ಲೆಯ ಶ್ರೀನಿವಾಸಪುರ ತಾಲ್ಲೂಕಿನಲ್ಲಿ ಈ ಅಧ್ಯಯನವನ್ನು ಕೈಗೊಳ್ಳಲಾಯಿತು. ಪ್ರತಿ ಯೋಜನೆಯಿಂದ ೩೦ ಜಲಾನಯನ ಫಲಾನುಭವಿಗಳು ಮತ್ತು ೨೦ ಫಲಾನುಭವಿಗಳಲ್ಲದ ಒಟ್ಟು ೫೦ ರೈತರನ್ನು ಯದ್ಯಚ್ಛಿಕೆ ಮಾದರಿ ಮೂಲಕ ಆಯ್ಕೆ ಮಾಡಿ ಪ್ರಾಥಮಿಕ ಮಾಹಿತಿಯನ್ನು ಸಂಗ್ರಹಿಸಲಾಯಿತು. ಸಿಂಪ್ಲನ್ ಸೂಚ್ಯಂಕ, ವೆಚ್ಚ ಮತ್ತು ಆದಾಯದ ವಿಶ್ಲೇಷಣೆ ಮತ್ತು ಸಂಪನ್ಮೂಲ ಬಳಕೆಯ ದಕ್ಷತೆಯ ವಿಶ್ಲೇಷಣೆ ಸಾಧನಗಳನ್ನು ಬಳಸಿಕೊಂಡು ಸಂಗ್ರಹಿಸಿದ ಮಾಹಿತಿಯನ್ನು ವಿಶ್ಲೇಷಿಸಲಾಗಿದೆ. ಪಿಎಂಕೆಎಸ್‌ವೈ-ಡಬ್ಲ್ಯೂಡಿ ಮತ್ತು ಕೆಎಫ್‌ಡಬ್ಲ್ಯೂಪಿ ಜಲಾನಯನ ಪ್ರದೇಶಗಳ (ಡಬ್ಲ್ಯೂಎ) ಫಲಾನುಭವಿಗಳಲ್ಲಿ ಸಿಂಪ್ಲನ್ ಸೂಚ್ಯಂಕ ಮೌಲ್ಯ ೦.೮೫ ಮತ್ತು ೦.೮೪ ಅನುಕ್ರಮವಾಗಿ ಕಂಡುಬಂದಿದ್ದು, ಬೆಳೆ ವೈವಿಧ್ಯತೆಯು ಜಲಾನಯನ ಅಲ್ಲದ ಪ್ರದೇಶಕ್ಕೆ (ಎನ್‌ಡಬ್ಲ್ಯೂಎ) (೦.೭೭ ಮತ್ತು ೦.೭೯ ಅನುಕ್ರಮವಾಗಿ) ಹೋಲಿಸಿದರೆ ಹೆಚ್ಚಾಗಿದೆ. ಪ್ರಮುಖ ಬೆಳೆಗಳ ಉತ್ಪಾದನೆ, ಉತ್ಪಾದಕತೆ, ಮತ್ತು ನಿವ್ವಳ ಆದಾಯವು ಎಕರೆಗೆ ರೂ. ೨,೯೪,೪೪೬ ಮತ್ತು ರೂ. ೩,೧೫,೪೫೦ ಪಿಎಂಕೆಎಸ್‌ವೈ-ಡಬ್ಲ್ಯೂಡಿ ಮತ್ತು ಕೆಎಫ್‌ಡಬ್ಲ್ಯೂಪಿ ಡಬ್ಲ್ಯೂಎದಲ್ಲಿ ಕ್ರಮವಾಗಿ ಬಂದಿದ್ದು, ಎನ್‌ಡಬ್ಲ್ಯೂಎ ಗೆ ಹೋಲಿಸಿದರೆ ಹೆಚ್ಚಾಗಿದೆ. ಫಲಾನುಭವಿ ರೈತರಲ್ಲಿ ಜಲಾನಯನ ತಂತ್ರಜ್ಞಾನದ ಪ್ರಯೋಜನಗಳ ಬಗ್ಗೆ ಅರಿವಿನ ಕೊರತೆ ಮತ್ತು ಅನುಷ್ಠಾನಗೊಳಿಸುವ ಏಜೆನ್ಸಿಯ ತರಬೇತಿ ಕಾರ್ಯಕ್ರಮಗಳಲ್ಲಿ ರೈತರ ಭಾಗವಹಿಸುವಿಕೆಯ ಕೊರತೆಯು ಜಲಾನಯನ ಯೋಜನೆಯ ಅನುಷ್ಠಾನದ ಸಮಯದಲ್ಲಿ ಎದುರಿಸಿದ ಪ್ರಮುಖ ಸಮಸ್ಯೆಗಳಾಗಿವೆ. ಫಲಿತಾಂಶಗಳು ಸೂಚಿಸುವಂತೆ ಜಲಾನಯನದ ಚಟುವಟಿಕೆಗಳು ರೈತರ ಬೆಳೆ ಇಳುವರಿ, ನಿವ್ವಳ ಆದಾಯ ಮತ್ತು ಒಟ್ಟಾರೆ ಆದಾಯ, ಇವುಗಳನ್ನು ಹೆಚ್ಚಿಸುವ ಮೂಲಕ ಪ್ರಯೋಜನಕಾರಿಯಾಗಿವೆ. ಫಲಾನುಭವಿಗಳಿಂದ ಮಣ್ಣು ಮತ್ತು ನೀರಿನ ಸಂರಕ್ಷಣಾ ನಿರ್ವಹಣೆ ಕೊರತೆ ಇರುವುದರಿಂದ, ಮಣ್ಣು ಮತ್ತು ಜಲ ಸಂರಕ್ಷಣಾ ರಚನೆಗಳ ನಿರ್ವಹಣೆಗಾಗಿ ಜಲಾನಯನ ರೈತರ ಸಂಘಗಳ ರಚಿಸುವ ಅವಶ್ಯಕತೆಯಿದೆ.

ಅಕ್ಟೋಬರ್ ೨೦೨೦

ಕೃಷಿ ಆರ್ಥಶಾಸ್ತ್ರ ವಿಭಾಗ,
ಕೃ.ವಿ.ವಿ., ಜಿ.ಕೆ.ವಿ.ಕೆ

ಜಿ. ಎಸ್. ಮಹದೇವಯ್ಯ
ಪ್ರಧಾನ ಸಲಹೆಗಾರರು

A Study on the Impact of Watershed Development Projects in Kolar District of Karnataka



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Introduction

- ❖ Agriculture is backbone of Indian economy and is highly dependent on natural resources like soil, water and vegetation. These natural resources are getting depleted day by day as they are in limited supply.
- ❖ Out of the total land (142 million ha) under cultivation in country 65 per cent (108 million ha) is under rainfed agriculture where water scarcity is major problem.
- ❖ The scarcity and volatility of rain fall and over exploitation of ground water has resulted in wide spread land degradation. Therefore, the conservation, up gradation and proper utilization of these natural resources on scientific principles is essential for the sustainability of rain fed agriculture.
- ❖ Initiating Watershed development projects has resulted in proper conservation and utilization of these natural resources and improves farming in rainfed areas.
- ❖ The present study assesses economic efficiency of two watershed projects Srinivaspur taluk of Kolar district.

Objective

To analyze the economic benefits derived from farmers in PMKSY-WD and KfW watershed projects

Methodology

Study area: The study has been conducted in Srinivaspur taluk of Kolar District, by selecting two watershed projects namely PMKSY-WD (Pradhan Mantri Krishi Sinchayee Yojana Watershed Development), and KfW-WP (Kreditanstalt für Wiederaufbau Watershed Project).



Kolar district

Sample size:

- ❖ 30 PMKSY-WD beneficiaries
- ❖ 30 KfW-WP beneficiaries
- ❖ 20 -PMKSY-WD non-beneficiaries
- ❖ 20 - KfW-WP non-beneficiaries.
- ❖ 100-Total sample size

Sampling frame work: Primary data is collected from randomly selected sample farmers by personal interview method. secondary data collected from both PMKSY-WD and KfW watershed project officials.

Analytical tools:

1. Descriptive statistics
2. Cost and returns analysis

Results

Table 1: Productivity of major crops cultivated in PMKSY-WD and KfW-WP

Crop	PMKSY-WD			KfW-WP		
	Productivity (q/acre)	Per cent tage differe	Perce nce	Productivity (q/acre)	Perce nce	Perce nce
Ragi	10.22	6.73	34.15	10.34	7.00	32.30
Tomato	127.82	116.93	8.51	120.32	109.05	9.36
Horse gram	6.98	4.50	35.53	7.50	5.00	33.33
Mango	46.32	32.04	30.92	47.84	31.46	34.24

Note: WA: watershed area, NWA- Non-watershed area
PMKSY-WD :Pradhan Mantri Krishi Sinchayee Yojana Watershed Development, KfW-WP:(Kreditanstalt für Wiederaufbau Watershed Project).

Table 2: Cost and returns (per acre) of major crops cultivated in PMKSY-WD and KfW-WP

Crop	TC	Ragi	Tomato	Mango	
		TC	TC	TC	
PMKSY-WD	watershed area	NR	12417	114650	72406
	Non-watershed area	RE	1.44	2.57	2.70
KfW-WP	watershed area	NR	6712	65078	35040
	Non-watershed area	RE	1.27	1.93	1.85
KfW-WP	watershed area	NR	13485	113124	76610
	Non-watershed area	RE	1.47	2.66	2.70
KfW-WP	watershed area	NR	7638	71011	29858
	Non-watershed area	RE	1.24	1.88	1.73

Note: TC: Total cost, NR: Net Returns, RE: Returns per rupee of Expenditure, PMKSY-WD (Pradhan Mantri Krishi Sinchayee Yojana Watershed Development), KfW-WP (Kreditanstalt für Wiederaufbau Watershed Project)

Discussion

- ❖ Productivity of major crops in study area was higher in watershed area (WA) compared to non-watershed area (NWA) in both PMKSY-WD and KfW-WP because watershed activities enhanced soil health and water availability which increased yield of crops (Table1).
- ❖ Percentage increase in productivity of major crops in WA over NWA ranges from 8 per cent in tomato to 35 per cent in horse gram in PMKSY-WD, where as in KfW-WP percentage increase in productivity ranges from 9 per cent in tomato to 34 per cent in mango (Table1).
- ❖ Net returns per acre and returns per rupee of expenditure was higher in WA compared to NWA because of increased productivity of crops which further increased net returns from crop (Table 2 and Fig. 1).
- ❖ Annual income from farm and livestock was higher in WA compared to NWA in both PMKSY-WD and KfW-WP as soil and water conservation and livestock based watershed activities enhanced both farm and livestock income. Annual off-farm and non-farm income was higher in NWA than WA because in NWA the farm income is less hence people tends to do other work for their source of income. (Fig 2).

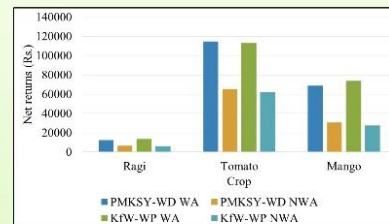


Fig. 1: Net returns of major crops cultivated by sample farmers in PMKSY-WD and KfW-WP

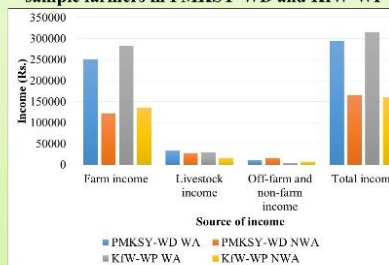


Fig. 2: Annual income of sample farmers in PMKSY-WD and KfW-WP

Summary

- ❖ The present study revealed that the productivity of major crops cultivated by sample farmer's was higher in watershed area compared to non-watershed area.
- ❖ Total cost of major crops was higher in watershed area than non-watershed area in both PMKSY-WD and KfW-WP.
- ❖ Net returns and returns per rupee of expenditure was higher in watershed area compared non-watershed area in both the watershed projects.
- ❖ Annual income of sample farmers in watershed area was higher than that of non-watershed area. Whereas off-farm and non-farm income was higher in NWA than WA in both PMKSY-WD and KfW-WP.

References:

NIRANKUSHA, S., 2015, Impact of watershed development (IWMP) on farm economy in Belagavi district. *M.Sc thesis (unpub.)*, Univ. Agric. Sci., Dharwad.

Advisory committee

Chairman: Dr. G. S. Mahadevaiah
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I INTRODUCTION

Agriculture is backbone of Indian economy and is highly dependent on natural resources like soil, water and vegetation. These natural resources are getting depleted day by day as they are in limited supply. Of these resources, water and land are the highly precious gift of nature and the base for existence of mankind. Water is a natural resource and is vital with multifarious uses. We need water for our life as well as food production. Indian agriculture is most vulnerable to climate change and water stress. Nearly three fourths of the cultivated land in India is depending on monsoon, which is contributing nearly 42 per cent to the agriculture production in India (Anonymous, 2012).

India receives annual precipitation of an average of 4,000 billion cubic meters. Annual rainfall in India is approximately 1183 mm, of which 75 per cent is received during monsoon (July to September) for a period of four months. Out of which, only 48 per cent is available in surface and groundwater entities of India (Anonymous, 2017). Lack of conservation practices, lack of sufficient infrastructure and insufficient management of water has created a situation where only 18-20 per cent of this water is actually used (Anonymous, 2017).

India's population is 1.35 billion which is expected to reach 1.6 billion by 2050, this rise in population creates increased demand for water, food, and energy. At the same time per capita availability of agricultural land among the developed nations is 1.4 ha per farmer, while in India it is merely 0.3 ha (Anonymous, 2016). Much of this land is also experiencing severe shortage of moisture and depleting groundwater levels. Out of the total land (142 million ha) under cultivation in country 65 per cent (108 million ha) is under rainfed agriculture (Anonymous, 2017). Rainfed agriculture contributes around 44 per cent of country's overall food grain production and accounts for the bulk of pulses, oil seeds, millets, coarse grains, commercial crops like cotton and groundnut etc. production. Therefore, rainfed agriculture has great prospects of improving food production in the countries, it is hard to achieve food security in the country unless production from these areas increases which is highly affected by water scarcity.

The scarcity and volatility of water availability has created pre and post production risk in Indian agriculture. Further, over exploitation of land to meet growing population has resulted in wide spread land degradation. Therefore, the conservation, up gradation and utilization of these two natural resources on scientific principles is essential for the sustainability of rainfed agriculture. This can be achieved by two alternative solutions, one is to bring all the rainfed areas under irrigation, which could not cover even 50 per cent of cultivated area. Second is improving crop production in rainfed area by promoting improved watershed technology.

A watershed is a hydrologically defined as any surface area from which runoff resulting from rainfall is collected and drained through a common point. In India the concept of Watershed Development Programmes (WDPs) was evolved in early 1980's with the aim of improving and sustaining productivity and the production potential of the dry and semiarid regions of the country through the adoption of appropriate production and conservation techniques. In WDPs the watershed is chosen as the appropriate unit area for development. It is a holistic approach to enhance and improve the economic and natural resource base of dry and semiarid regions.

Watershed development was created to balance conservation, regeneration and use of land and water resources by humans within a watershed. Popular benefits from successful watershed development programmes include improved farm yields and increased access to drinking water. The overall features of the watershed development approach, by and large, are three fold, *viz.* promoting rural economic development, employment generation, and restoring ecological balance (Anonymous, 2011).

Indian Government visualized and initiated watershed project in 1989 by Fr. Hermann Bacher of Social Centre, Ahmednagar, the guiding spirit behind the Programme. Most watersheds initiatives in India are implemented with the twin goals of soil and water conservation and improving the livelihoods of the rural poor (Anonymous, 2012). Different forms of treatment activities carried out in a watershed include soil and moisture conservation measures in agricultural lands (counter/field bunding and summer ploughing) drainage line treatment measures (loose boulder check dams, minor check dam, major

retaining walls), development / management of water resource (percolation pond, farm pond, and drip and sprinkler irrigation), crop demonstration, horticulture plantation and afforestation. Watershed development has become the major intervention for natural resource management. A total of 45.88 million hectares of land has been treated through various watershed development projects in India with an investment of ₹ 17,037 crores. The average annual expenditure during the tenth plan was around 2300 crores (Anonymous, 2011).

Karnataka State has the higher proportion (79 per cent) of drought prone area among all major states in the country and has the second largest dry land area in the country after Rajasthan in absolute terms. In addition, Karnataka also has the second lowest (154.2 M ha M/yr) replenishable ground water resources after Rajasthan among major States of India (Anonymous, 2016). Out of 19-million-hectare cultivable land of Karnataka 15 million hectare is dependent on rainfall. Hence, strategy to improve the rainfed agriculture is necessary for agriculture development in State.

Karnataka has implemented watershed Programme and created Department of Watershed Development to improve livelihoods in rainfed areas. The Watershed Development Department has prepared a strategic perspective plan to cover all the uncovered areas considering the areas covered earlier under different programmes through Integrated Watershed Management Programme. The area available for the treatment has been technically prioritized using like rainfall, slope, drought intensity, soil type and the extent of vulnerable groups, extent of irrigation etc. Suggested by the Department of Land Resources (DoLR). Based on this Prioritization, the critical ones will be treated on priority in the ensuing years for development projects across all the districts of the State through Integrated Watershed Management.

Kolar district is under rainfed zone with erratic and uneven rainfall. The area under rainfed crops ranged from 74 to 85 per cent of the cultivated area. The average annual rainfall is around 776 mm (ranging from 680 to 890) (Anonymous, 2018). Based on the prioritization many watershed projects were implemented in the district. Among them two watershed projects are considered for the study, one of them is Yeldur nala sub watershed

project implemented under PMKSY and the second is Mudimadagu watershed project implemented by NABARD under KfW watershed project in the Srinivaspur taluk of Kolar district.

Pradhan Mantri Krishi Sinchayi Yojana (PMKSY)

PMKSY is being implemented in the State since 2009-10 as per the Common Guidelines-2008 (Revised edition-2011) issued by Government of India. Desert Development Programme, Drought Prone Area Development Programme and Integrated Wasteland Development Programme have been brought under one umbrella with the nomenclature of Integrated Watershed Management Programme. It is a centrally sponsored scheme where the sharing pattern was 90:10 (centre and state) ratio up to 2014-15. From 2015-16 onwards IWMP is renamed as Pradhan Mantri Krishi Sinchayee Yojana-Watershed Development (PMKSY-WD) with a sharing pattern between Centre and State is in the ratio of 60:40 (Anonymous, 2015). The main objective of Pradhan Mantri Krishi Sinchayee Yojana are to conserve soil, moisture and nutrients, enhance recharge of ground water and agricultural productivity, provide livelihood activities for persons, encourage livestock production and income generation to farmers.

Indo-German Watershed Development Programme (KfW)

The Indo-German Watershed Development Programme (IGWDP) is an integrated programme for rehabilitation of watersheds for the regeneration of natural resources. The Indo-German Watershed Development Programme (IGWDP), implemented by the National Bank for Agriculture and Rural Development (NABARD) and leading Indian NGOs and supported by the German Government through KfW ((The KfW, formerly KfW Bankengruppe (banking group)), is a German state-owned development bank, based in Frankfurt. Its name originally comes from Kreditanstalt für Wiederaufbau ("Credit Institute for Reconstruction). KfW Development Bank works among sectors like, health, education, agriculture, forestry, solid waste management which was initiated on a small scale in 1992. Some of the objectives of the project are to create adequate and sustainable livelihood opportunities and sustainable economic development of farmers through watershed activities.

Scope of the study:

Water is the vital input to the agricultural production where the subsistence and sustenance of the farmers is completely dependent. Kolar being a water stressed area, was facing major problems like, Migration, Degradation of lands, Low productivity of farm lands, Depletion of ground water resources, Degraded soil, Marginal/small farmers and fragmented land holdings, and Less alternative income. In this regard, the rationale for watershed approach in rainfed agriculture areas is a way forward for the effective and efficient usage of natural resources by developing and managing them on a sustainable basis. This study sheds light on, how the selected watershed projects are designed to develop and harmonize the use of water, soil, forest and pasture resources in a participative manner by involving the local communication that help in conserving these resources. How these projects help in situ soil and moisture conservation and rain water harvesting to augment ground water resources, forest cover, livestock, fodder management, income-generation activities. What are measures that can be taken to reduce the poverty level, and improve the rainfed agriculture.

Kolar district is highly water stressed area where watershed approach plays a vital role on farmers livelihood, hence the present study “Economic Evaluation of PMKSY-WD and KfW Watershed Projects in Kolar District of Karnataka” undertook with the following specific objectives:

- 1) To document the activities taken up under PMKSY-WD and KfW watershed projects in the study area.
- 2) To analyse the economic benefits derived from PMKSY-WD and KfW watershed projects in the study area.
- 3) To identify the major Constraints faced by the implementing agency and beneficiaries during implementation of the watershed projects in the study area.

The first objective is to document the activities, funding and implementation of both the PMKSY-WD and KfW watershed projects in study area. Second objective estimates the economic benefits derived by farmers. Third objective identifies constraint

faced by beneficiaries and implementers during the implementation of project in the study area.

Hypothesis

1. The watershed interventions have positive impact on land use and cropping pattern.
2. The watershed interventions have positive impact on asset creation in the watershed area.
3. Production and Productivity of major crops cultivated under watershed area are higher than non-watershed area.
4. Net returns of major crops under cultivation is higher in watershed area than non-watershed area.
5. Annual income derived from watershed beneficiaries is higher than non-beneficiary.
6. Lack of awareness about the watershed technology and obstruction for cultural operation by soil and water conservation structures are the major constraints faced by beneficiaries during watershed project implementation.
7. Poor participation by the farmers in training programs is the major constraint faced by the implementing agency during implementation of the watershed project

Limitation of the study:

Ragi occupies lion's share in the total cropped area in the watershed area, even though many other vegetables and pulses are cultivated, their share in terms of area and production, is meager. Hence, the study has not been completely successful in capturing the contribution of such minor crops. Scattered and irregular in rainfall over the years has damaged some water structures, hence it was difficult in capturing actual benefits from water harvesting structures. As this study is the part of master's degree programme due to limitation of time, the sample size of the farmers is restricted to the 100, hence generalizations may not be suitable to all areas and further studies can be proceeded with large sample size.

Presentation of the study:

The thesis is divided into a total of six chapters. First chapter covers a brief introduction of the study, specific objectives, its scope and limitations. Second chapter contains review of previous studies conducted on the related subject. Third chapter includes brief description of the study area, sample selections, statistical techniques used for data analysis. Presentation and interpretation of the results are presented in chapter four. Brief summary of the study, conclusions drawn based on the results and policy recommendations suggested are presented in chapter five. In the sixth chapter references of the cited studies are listed.

II REVIEW OF LITERATURE

Review of literature is the comprehensive summary of previous research done in related field which helps to fill the gap in conceptual and methodological issues relevant to the proposed study. This will enable the researcher to get an inward look into previous analysis so as to draw meaningful interpretations. It provides clues and guidance throughout the research process. Steady efforts were made to compile research findings of the research studies possessing more or less similar characteristics. Therefore, studies related watershed management programme were reviewed comprehensively under the following sub-headings.

- 2.1 Impact of watershed on production, productivity, cropping pattern, land use pattern and cropping intensity
- 2.2 Impact of watershed on income generation
- 2.3 Impact of watershed on livestock income
- 2.4 Resource use efficiency of crops
- 2.5 Constraints faced by farmer beneficiaries and implementing agencies in implementing watershed project

2.1 Impact of watershed on production, productivity, cropping pattern, land use pattern and cropping intensity

Rambhai (2000) concluded from his study “A study on the consequences of adoption of watershed management technology by beneficiary farmers in watershed area of Kheda district of Gujarat state” that the soil and water conservation measures increase the irrigation facilities to the farmers and increase ground water table in watershed area, this further increases cropping area and yield of farmers, where majority (70.05 per cent) of the respondents observed increase in cropping intensity from 106 per cent to 150 per cent.

Govind Babu (2004) in his study on “Socio-economic Impact of Watershed Development in Kanpur” evaluated 'before and after' condition of watershed program and

revealed that the Gross cropped area in the command area increased from 157 to 204 hectares. The productivity of most of the crops has also increased. On an average, the wheat yield increased from 7.49 quintals/ha during the pre-watershed period to 16.18 quintals/ha during the post-watershed period. Yield of mustard almost doubled, and those of Pigeon pea and sorghum increased by 1.5-times.

Sreedevi *et al.* (2004) concluded from her study “Adarsha watershed in Kothapally: understanding the drivers of higher impact” that the area under maize and pigeon pea increased more than three-fold from 60 to 200 ha and 50 to 180 ha, respectively within four years after implementation of watershed project. The area under chickpea also increased two-fold during the same period. The integrated nutrient management (INM) approach was adopted to enable good crop growth with conserved soil and water amendments with B (Boron), S (Sulphur) and B+S provided under watershed project resulted in 13 to 29 per cent increase in sorghum grain yield and 20 to 39 per cent increase in maize grain yield.

Sreedevi *et al.* (2006) in their study on “On-site and Off-site Impact of Watershed Development: A Case Study of Rajasamadhiyala, Gujarat, India” found that the overall production was 6.5 kg m⁻³ of storage capacity of water with an average yield of 5124 kg ha⁻¹ was observed, which is about 33 per cent increase in production (kg) per unit storage capacity (m³), and 15 per cent increase in yield (kg) per unit area irrigated (ha) in 2004 over 1995 i.e. post and pre watershed period.

Sulbha Khanna (2008) took up study on “Effectiveness of contour bunds and gully plugs as tools for watershed treatment” in Khabji Village of Bharuch District of Gujarat and reported that total crop production has increased in two ways: first due to the improvement of soil quality and second due to availability of more area for cultivation after implementation of counter bunds and gully plugs. Increase in agriculture production was also seen (36 %) it leads to more availability of fodder (20 %), which resulted in improved health of animals which in turn increase milk yield.

Palinisami and Suresh Kumar (2009) from their study “Impacts of Watershed Development Programmes: Experiences and Evidences from Tamil Nadu” reported that

the area under high water-consuming crops increased by 25.3 per cent in first crop period and 29.4 per cent in second crop period. Similarly, the evidence shows that the cropping intensity has increased from 120 per cent to 146.88 per cent in Kattampatti watershed and 102.14 per cent to 112.08 per cent in Kodangipalayam watershed. And it was observed that the yield rate of all the crops had increased with an annual CGR of 3.94 to 16.40 per cent after implementation of watershed project.

Sahu and Santosh (2009) observed from their study “Cost Benefit Analysis of Participatory Natural Resource Management: A study of watershed development initiative in Indian village” that in case of the Bichhiwada watershed the number of crops under cultivation rose to 16 compared to 14 crops per year. The mean production of Sorghum was 34.40 kilograms and rose to 47.40 kilograms in the post watershed period. The mean production of Maize has recorded 76.40 kilograms compared to 38.40 kilograms in the pre watershed period and also observed that Tomato and Radish are the new crops cultivated in the period.

Anonymous (2011) in the report “Impact of Watershed Management Under PMKSY-WD, (Erstwhile IMWP, Karnataka) Batch I” recorded increase in yields in case of ragi by 230 to 420 kg/ha and in case of maize the yield improvement varied from 300 kg/ha to 2000 kg/ha in watershed project area and such yield improvements increased net returns ranging from ₹ 5700/- to ₹ 13,188/- per ha. The total yield in the total watershed area also increased by 66.5 to 1656 tonnes across the watersheds. The rise in productivity per ha ranges from 8.5 per cent in the case of green gram to 88 per cent in the case of chickpea.

Palanisami *et al.* (2011) in their study on “Impact of watershed projects in India: Application of various approaches and methods” found that the change in yield due to watershed intervention across crops varied from 31 per cent in maize to 36 per cent in pulses. The analysis also revealed increase in net cropped area, gross cropped area, and cropping intensity in the watersheds, the cropping intensity worked out to be 146.88 per cent in the watershed village, which was higher than in the control village (123.33 %). Net

cost reduction in production varied from 32 per cent in vegetables to 59.8 per cent in sorghum.

Erin and Arjuna (2013) in their paper on “Watershed development in India: economic valuation and adaptation considerations” in Kumbharwadi watershed project in Maharashtra reported that there was increase in cropped area from 457 ha before project to 566 ha after the project, variety of crops grown also increased from 4 to 25 different crops after watershed project.

Gourav (2013) in his study “Impact evaluation of watershed development in kota district of Rajasthan” revealed that per cent of area under Rabi crops to gross cropped area was higher in case of beneficiaries (43.09 %) as compared to non-beneficiaries (39.17 %) this shows change in cropping pattern because of watershed development activities. Due to availability of water production also increased and it was observed highest in wheat (51.09 %), followed by soybean (13.15 %) and mustard (9.47 %).

Kadam *et al.* (2013) conducted study on “Impact of watershed project on farmers’ economy in Nagpur district” and revealed that the cropping pattern changed due to increased availability of water, where the area of soybean, wheat, chickpea was increased by 52.57 per cent 49.29 per cent 85.93 per cent, respectively in watershed area and it was also observed that an incremental change in productivity of pigeon pea (5.73 %) soybean (11.68 %) cotton (32.23 %) chickpea (33.23 %) and wheat (36.52 %) after implementing watershed project.

Prabhakar *et al.* (2013) from their study “Multiple Impact of Integrated Watershed Management in Low Rainfall Semi-Arid Region: A Case Study from Eastern Rajasthan, India” concluded that increased availability of surface and groundwater changed the land use pattern in the watershed area. The total irrigated area increased by 66 per cent (207 to 343 ha) in the study area. It was also seen that the area under rainfed crops declined by 36 per cent (327 to 209 ha) and increase in the cultivation of high value crops *viz.* vegetable (11 to 22 ha) and horticultural crops (nil to 35 ha). The per capita availability of cereals

increased from 90 to 140 kg (56 %), while the availability of pulses increased from 30 to 40 kg (33 %) per annum after the implementation of watershed program.

Painuli *et al.* (2014) reported from their study “Impact Evaluation of Watershed Programs in Jaisalmer District of Rajasthan” that the impact of watershed was quite significant on the availability of additional agricultural land, about 24.67 per cent respondents told that farm land under cultivation increased and an additional area of 269.67 ha was brought under cultivation with introduction of micro-watershed activities in watershed project area.

Thakur *et al.* (2014) in their study “Impact analysis of integrated watershed project in Swan catchment, Una district of Himachal Pradesh” analyzed the impact of Integrated watershed project and found that on an average production of different crops was found to be increased from 37.51 to 50.95q (35.83 %) per household after the implementation of project. The productivity also found to be increased, in case of cereals which ranged between 5.88 per cent in case HYV paddy to 33.26 per cent in case of HYV wheat. In oilseeds it was increased by 11 and 12 per cent of soybean and mustard respectively. Among different field crops the increase in the productivity was found to be highest in case vegetables especially in cabbage (43.26 per cent).

Rasmi Ranjan and Lakshmipriya (2015) in their study on “Impact and effectiveness of watershed development programmes on education and health in Keonjhar District of Odisha: A critical analysis” found that in the study area where watershed programme was implemented has increased surface and groundwater availability, increased cropping system, land use system, livestock population, horticulture, and vegetable production along with reduced skilled labour migration as well as the migration of the general tribal population to the urban city area.

Mani (2016) reported from his study “Impact analysis of sujala watershed project in Kolar district of Karnataka” that improved soil and water harvesting structures increased the availability of Green fodder (42.50 % to 69.16 %) and dry fodder (59.16 % to 75.83 %)

after implementation of the project. It was also found that average yield of green fodder increased from 7.53 t/ha to 22.16t/ha and dry fodder from 4.22 t/acre to 7.11 t/acre.

Birhanu Zemadim *et al.* (2018) took up study on “A watershed approach to managing rainfed agriculture in the semiarid region of southern Mali: integrated research on water and land use” and reported that with the implementation of contour bunding technique as an Soil and Water Conserving (SWC) practice, runoff volume and soil erosion were significantly reduced and resulted in cropland expansion. It was also observed that significant yield improvement (58 % for millet and 72 % for sorghum) in farmers’ fields with contour bunding in southern Mali. The net returns with the use of contour bunding were higher by 20 per cent and the willingness of farmers to pay ₹ 5000 per hectare to have a contour bunding in their farm land to a local NGO makes the investment socially viable.

Ranjit Basha *et al.* (2019) in their study “Impact of batch-I (2009-10) PMKSY – watersheds programme on cropping pattern, crop yields and household income in Srikakulam district of Andhra Pradesh” opined that Watershed programmes have shown positive impact on cropping pattern, crop productivity and household income levels. Total area under different crops in kharif in the pre project period was 10157 ha and in the post project it increased to 11842 ha (16.59 %). In rabi it was 1236 ha and increased to 1548 ha. Maize productivity increased from 2866 kg ha⁻¹ to 3578 kg ha⁻¹ (25 %), whereas, rice productivity increased from 3744 kg ha⁻¹ to 4413 kg ha⁻¹ (21 %), green gram increased from 321 kg ha⁻¹ to 408 kg ha⁻¹ (27 %), black gram increased from 326 kg ha⁻¹ to 400 kg ha⁻¹, an increase of 23 per cent during the project period.

From the reviews quoted above we can infer that gross cropped area, crop diversification, cropping intensity were observed more in watershed area as compared to non-watershed area. Production and productivity of crops cultivated in watershed area was also seen more as compared to non-watershed area, hence it can be said that, farmers situated in watershed area are more benefited in almost all aspects than non-watershed area.

2.2 Impact of watershed on income generation

Arunkumar (1998) in his study on “Economic evaluation of watershed development: A case study of Kuthanagere Micro-watershed in Karnataka” and found that the average net returns from a hectare of dry land crops was 93.20 per cent higher in watershed area (₹ 6159) than in non-watershed area (₹ 3188). It was also observed that Watershed farmers had higher income (₹ 27411) compared to non-watershed farmers income of ₹ 17277.

Lokesh (2004) in his study on “Economic impact assessment of watershed development programme: A case study of Kallambella watershed, Karnataka” evaluated economic value of Kallambella watershed project and found that the total economic value of the project was ₹ 20375 per acre, in which contribution from groundwater irrigation was 49 per cent, and contribution from rainfed field crops, agri-horticulture, agro-forestry and silvi-pasture was 46 per cent. Net return per acre of dry land field crops (ragi and groundnut) in watershed area was ₹ 1437, which was ₹ 719 in non-watershed project area. Due to recharge of groundwater, gross irrigated area per irrigation well increased by 53 per cent (by 2.4 acres).

Nanag Ram (2009) concluded from his research “An economic analysis of watershed development project in Jaipur district of Rajasthan” that maximum per cent increase in net income was observed in marginal beneficiaries (36.7 %), followed by small (27.23 %), medium (7.94), and large (7.48 %) farmers in watershed development project Jaipur. The maximum net income increase was observed in small farmers (₹ 3167), followed by marginal farmers (₹ 2065), large farmers (₹ 1910) and medium farmers (₹ 1054). Also observed the absolute and per cent increase in annual employment in watershed project area, the maximum per cent increase in employment was observed for marginal farmers (36.25 %) followed by small (25.82 %), medium (2.36 %) and large (2.64 %) farmers.

Sahu and Santosh (2009) in their study on “Cost Benefit Analysis of Participatory Natural Resource Management: A study of watershed development initiative in Indian village” found that the mean income of a household was calculated to be rupees 1024.00

before the project implementation which was increased to rupees 1683.50 per month in the post implementation period.

Anonymous (2011) concluded from their study “Impact of Watershed Management Under PMKSY-WD, (Erstwhile IMWP, Karnataka) Batch I” that the per capita income from the watershed areas varied from 18 to 122 %. The average annual per capita income from all sources which was ₹ 74672/- before the launch of the watershed project rose to ₹ 112692/- (51 %) after the launch.

Prem Singh *et al.* (2011) from their study ‘Impact and effectiveness of “watershed development programmes” in India resulted positive changes in agriculture, horticulture and livestock production in watershed area have helped better income generation and debt reduction. In Uttar Pradesh debt position reduced in 54 watersheds out of 87 sample watersheds, in remaining 33 watersheds debt position did not reduce. The income generating activities carried out under the project in Assam helped the poor people in getting some regular income. The overall poverty level was reduced from 45 per cent to 36 per cent in the project area. Andhra Pradesh reported 50-75 per cent reduction in debt due to improvement in economic condition by WDP.

Prabhakar *et al.* (2012) reported from their study on “Multiple Impact of Integrated Watershed Management in Low Rainfall Semi-Arid Region: A Case Study from Eastern Rajasthan, India” that the selected poverty indicators evaluated during the pre and post watershed program that the farmers belonging to marginal and small land holdings got relatively higher benefits from the watershed development activities and their head count ratio (which is proportion of population below poverty line) in case of marginal and small farmers fell from 0.13 to 0.006, and 0.09 to 0.04, respectively.

Sandeep (2012) estimated benefits derived by beneficiaries from his research “Impact of watershed programme on beneficiaries in Shivpuri district of Madhya Pradesh” watershed project, where farmers obtained ₹ 28152 gross income followed by ₹ 15317 net income, ₹ 18358 family labour income, and ₹ 20671 farm business income per hectare respectively in 2010-11 (after project year) compared to ₹ 24230 gross income, ₹ 11575

net income, ₹ 14507 family labour income and ₹ 16648 farm business income respectively in 2004-05 (pre project period).

Gourav (2013) concluded from his study “Impact evaluation of watershed development in kota district of Rajasthan” that all the categories of beneficiary farmers of watershed programme recorded absolute increase in net returns. The maximum net return per hectare was observed in marginal farmers (₹ 16305.89) followed by medium farmers (₹ 10544.02), large farmers (₹ 6340.18) and small farmers (₹ 4562.46).

Kadam *et al.* (2013) conducted study on “Impact of watershed project on farmers’ economy in Nagpur district” found that the per household total income of farmer increased to ₹ 121929.80 from ₹ 90322.47 and share of Income from agriculture of total income also increased to ₹ 108390.58 (88.89 %) from ₹ 79553.68 (88.09 %) after implementing watershed program.

Painuli *et al.* (2014) in their study “Impact Evaluation of Watershed Programs in Jaisalmer District of Rajasthan” found that through micro-watershed activities the sample households generated income by livestock and crop production to the extent of +32.73 per cent over the pre-project period average income. The pre-project average annual income was ₹ 38,153 which in post-project had increased to ₹ 50,641.

Satish (2014) took up study on “Impact of watershed development programme on agricultural upliftment of tribal – a statistical study” and evaluated various development benefits from watershed *viz.* Technological benefits, Economic benefits, Social and Environmental benefits. In technology benefits increase in production and productivity with mean score 3.59 and better use of available resources (3.39) were major benefits reported by beneficiaries. In economic benefits improvement in overall living condition (4.36), access to credit (4.14) and poverty alleviation (4.12) were major benefits. In social benefits good linkage established with officials (4.31) and more consciousness of people (4.25) and in environmental benefits conservation of natural resources (4.20) and increase in water table (4.20) were identified as major benefits by beneficiaries of watershed project.

Thakur *et al.* (2014) reported from their study “Impact analysis of integrated watershed project in Swan catchment, Una district of Himachal Pradesh” that the per household increase in farm income (Agricultural Crops) was observed from ₹ 48363 to ₹ 69034/household on an average in watershed project area. The labour use per household has increased from 103 to 108 man days in all categories of farms. The annual per farm labour employment in horticulture increased from 219 to 699 Man days, 151 to 249 Man days in livestock, registering an increase of 213 and 65 per cent, respectively on overall farm households.

Ranjan *et al.* (2016) conducted Macro-level evaluation of 636 micro-watersheds (100 to 1000 ha area) through meta-analysis and reported the benefits of watershed programmes as augmented income, increased rural employment generation (151 person days ha⁻¹), increased crop yields and cropping intensity (36 %), decreased runoff (45 %) and soil loss (1.1 t ha⁻¹ year⁻¹), augmented ground-water and decreased poverty after implementation of watershed projects.

Ranjit Basha *et al.* (2019) in their study “Impact of batch-I (2009-10) PMKSY – watersheds programme on cropping pattern, crop yields and household income in Srikakulam district of Andhra Pradesh” found that in the pre-project period in Srikakulam district, the number of households with income more than ₹ 10,000/- per month were 317 and in post project the number of households increased to 348 indicating positive impact of PMKSY watershed programme.

Above studies revealed that, beneficiaries of watershed project had more net returns, returns per rupee of expenditure, income than that of non-beneficiary under watershed project. It can also be noted that, watershed projects generated more employment by both construction activities and farm activities and also enhanced livelihood of rural poor.

2.3 Impact of watershed on livestock income

Singh and Jain (2004) conducted study on “Long term impact evaluation of watershed development projects in Punjab” in Kandi Watershed and Area Development

Project (KWADP) of Punjab and showed that cultivated area increased from 19.4 to 55.3 per cent, cropping intensity increased from 113.7 to 143.1 per cent and productivity of Maize, Wheat and milk were increased from 1017 kg per ha, 1084 kg per ha, 2574 kg and 928 liters per milch cattle to 1879 kg per ha, 2574 kg per ha, 1233 liters per milch cattle respectively after watershed project.

Sharada *et al.* (2005) reported from her study “Participatory watershed management programmes for sustainable development: Experiences from IWDP” the improvement in cow, bullock and goat population in watershed project, where 71.46 per cent of households had shown increase in cattle to 96.6 per cent after implementation of project. There was increase of 35.26 per cent of household’s number having own cattle.

Jain (2008) revealed in his study on “Impact of organizational instruments on livestock activities in watershed development project” that increase in livestock population varying from 68 to 83 per cent in cows, 57.5 to 73 per cent in buffaloes, and 63 to 149 per cent in sheep and goats across the watersheds. The milk yield improved by 84.5, 62.7 and 73.2 per cent and number of milking days increased by 20, 10 and 20 in NGO, Government organization and research organization managed watershed respectively. By this improved milk yield improved incomes of landless increased by 155 to 168 per cent across watersheds.

Silori *et al.* (2008) from their study on “Social cost–benefit analysis of Karnataka Watershed Development (KAWAD) project, Karnataka, India” reported increase in number of cows and buffaloes in MM Halli, from 46 to 75 after the Karnataka Watershed Development (KAWAD) project, with a significant increase of 17 improved breed cows after the project. Similarly, in K B Hatti, in the last year there has been an increase of 50 cows and 20 buffaloes in the village.

Anonymous (2011) reported from “Impact of Watershed Management Under PMKSY-WD, (Erstwhile IMWP, Karnataka) Batch I” that Animal health camps are the most successful programme in watersheds in Karnataka. The F&M disease was controlled in the watershed villages by 55 to 60 per cent in animals, suitable treatment has lowered

mortality of sheep by 60 per cent, Treatment to the mastitis affected cattle, has lowered this disease by over 62 to 65 per cent after watershed activities. Fodder enrichment and distribution of fodder minikits has increased milk yield by 20 per cent.

Anonymous (2013), in the report on “Impact Assessment Study of Kalyanpura Watershed Project, Bhilwara District, Rajasthan” observed that nearly 70 per cent farmers reporting to be increase of cows (3-4 nos.) & buffalo (4-5 nos.). This increase in livestock was a result of increased income and also increased availability of fodder and sufficient water from watershed development programme.

Prabhakar *et al.* (2013) in their study on “Multiple Impact of Integrated Watershed Management in Low Rainfall Semi-Arid Region: A Case Study from Eastern Rajasthan, India” revealed that Substantial increase was noticed in the number of cows with marginal farmers (44 %) and small (77 %) farmers in watershed area in Rajasthan. Small farmers owning buffaloes had seen 41 per cent rise, followed by 27 per cent rise in case of medium holding farmers. A substantial increase in daily milk production from 2.5 to 4.0 liters per animal was achieved under the watershed project. In the case of other animals like goat and sheep, a satisfactory increase (9 % to 17 %) was recorded in all categories of farmers.

Painuli *et al.* (2014) reported from their study “Impact Evaluation of Watershed Programs in Jaisalmer District of Rajasthan” that with introduction of watershed, majority of the respondents resulted an increase in availability of fodder, fuel, and rise in water table which further increased number of animals to 911, including cattle, buffaloes, camel, sheep and goat etc. in post-project period.

Thakur *et al.* (2014) conducted study on “Impact analysis of integrated watershed project in Swan catchment, Una district of Himachal Pradesh” and reported that the impact of intervention by watershed project increased in livestock unit from 1.62 animal/house to 2.71 animal/house, registering an increase of 67 per cent. The annual average income from livestock component has been increased from ₹ 86,286 (before project) to 1, 33,875 (after project) per household, registering an increase of 55 per cent.

Mani (2016) in his study on “Impact analysis of sujala watershed project in Kolar district of Karnataka” reported that due to increased availability of fodder and drinking water increasing trend in number of local cows from 141 (before) to 179 after project implementation, in case of local buffaloes increased from 158 to 198, in cross breed cows and improved buffaloes increased from 96 to 163 and 37 to 54 was observed respectively. Increase in average milk yield was also observed in local cows, local buffaloes, crossbreed cows and improved buffaloes from 0.97 lit/day (before) to 1.02 lit/day (after), 1.25 lit/day to 1.50 lit/day, 16.03 lit/day to 18.01 lit/day and 3.27 lit/day to 3.40 lit/day respectively.

Above studies revealed that farmers in watershed area reported higher number of animals, milk yield and income from livestock than non-watershed area farmers. This can be attributed by increased water availability and fodder for livestock.

2.4 Resource use efficiency of crops

Taru *et al.* (2008) estimated the Economic efficiency of resources use in groundnut production was determined using the ratios of their Marginal Value Product (MVPs) to the Marginal Factor Cost (MFC). Comparison of the ratio of the MVP to MFC indicates that two resulting ratio were greater than unity; labour and seed, indicating that the inputs were under used or being under utilized on the farms during the cropping season hence increasing their rate of use will increase output and profit level. Similarly, two resulting ratios were less than unity; fertilizer and agrochemical indicating that the inputs were excessively used or over utilized hence decreasing quantity of the inputs use will increase output and profit level.

Ibitoy *et al.* (2015) from their study on “Analysis of Resource Use Efficiency in Tomato (*Solanum lycopersicum*) Production in Kogi State, Nigeria” analysed resource use efficiency in tomato production using OLS regression result revealed that pesticide, quantity of seed, and kg of fertilizer has ratios that are less than unity. This means that these variable inputs in tomato production were over-utilized and increase in the supply of these resources will increase tomato output. inputs such as labour and farm size have an efficiency ratio of 1.2 and 15.2 respectively. This means that these inputs were under-

utilized in tomato production in the area and a decrease in the supply of these resources will increase the output of tomato produced in the State.

Tanvir Ahmed *et al.* (2015) conducted research on “Cost-effectiveness and resource use efficiency of sweet potato in Bangladesh” and revealed resource use efficiency in sweet potato using four factors which are vine/planting materials, land preparation, fertilizer and labor. The resource efficiency ratio for given resources is greater than 1, hence all the resources were underutilized. That means the sample farmers used less inputs than the optimal. There is scope for the farmer to increase the use of all selected resources to maximize gross return.

Rohith *et al.* (2018) in their study estimated the resource use efficiency of crops using Cobb- Douglas production function. The result shows that the ratio of MVP to MFC was away from one, in most of the crops highlighting the inefficiency in resource use. Resources were not economic optimally utilized in most of the crops. There is great scope for use of human labour (MVP to MFC ratio was 2.13) and nitrogen (10.39) in rainfed cotton, human labour (1.79) and groundwater (8.93) irrigation in cotton crop irrigated with groundwater. The human labour (0.945) was optimally utilized and there is great scope to use of machine labour (8.57) in canal paddy. There is scope for use of human labour (2.09), bullock labour (3.28), machine labour (4.44), nitrogen (0.29) and capital cost (2.51) in rainfed redgram.

Sakamma *et al.* (2018) in their research on “Resource use efficiency and externality associated with banana production in Karnataka, (India)” assessed the resource use efficiency in banana and its competing crops production using Cobb-Douglas type of production function (per hectare) and found that Resource use efficiency in banana production was high in case of chemical fertilizer (4.32) followed by sucker (3.25), FYM (2.47) and irrigation (1.93), indicating considerable scope to increase banana production by increasing the level of these inputs. The resources were over utilized in case of competing crops (paddy and ginger). Thus, farmers can reduce the wastage of resources by cultivating banana crop.

Kanitoli Chishi and Amod Sharma (2019) from their study on “Resource Use Efficiency on Different Farm Size Groups of Integrated Watershed Development Programmes Beneficiaries in Nagaland” and computed the ratio of MVP to its factor cost and was observed that ratio of all inputs were found to be positive and negative both values. Positive values indicate that the farmers can incurred more investment on those inputs for getting better returns, while the negative values indicates either excess use of inputs and adverse response towards the gross return, which needs to be curtailed immediately and further investment of such inputs must be shifted towards the higher results inputs which will provide the positive contribution to the gross return.

Above reviews shown that resource use efficiency is higher in crops where projects have been implemented compared to non-project area.

2.5 Constraints faced by farmers and implementing agencies in implementing watershed project

Ramanna and Chandrakanth (2000) from their study on “Constraints on participation as perceived by the watershed beneficiaries” on watershed activities implemented by the government and found that lack of knowledge about programme (62 %), uneven distribution of incentives (58 %), supply of poor inputs and materials (52 %), groupism and politics at the village level (48 %), poor quality of work (42 %), improper location of soil and water conservation structures (21 %) and planning was not based on felt needs (13 %) were major constraints faced by beneficiaries in implementation of project.

Rambhai (2000) conducted study on “A study on the consequences of adoption of watershed management technology by beneficiary farmers in watershed area of Kheda district of Gujarat state” and observed that majority (79.26 per cent) of the beneficiary farmer stated that high cost on construction of bunds, farm pond and leveling of land was their main constraint in adoption of soil and water conservation methods in watershed area, followed by lack of finance for carrying out soil and water conservation work was another important constraint (74.85 per cent) of the respondents followed by lack of technical guidance (73.33 per cent), land waste in bund and channels (63.19 per cent),

fragmentation of land in unconventional shape and size (55.30 per cent), lack of cooperation of neighbor farmers (48.10 per cent) and lack of knowledge about utility of soil and conservation (39.17 per cent) respectively.

Manoj kumar (2006) from his study “Impact analysis of National Watershed Development Programme for Rainfed area” identified the constraints faced by functionaries in implementing National Watershed Development Programme (NWDP), where constraints were made four parts constraints related to planning and organization, financial constraint, technical constraint and transfer of technology constraint. Noninvolvement of farmers in watershed planning and no provision of incentives for excellence field functionaries were reported major constraint under planning and organization constraints, lack of sufficient fund for activities and problem of recovery of loans from watershed beneficiaries, small and fragmented land holding is not suitable for treatment and lack of area specific, proven and viable technology and farmers are more interested to get free input than in the technical knowhow and lack of adequate trained field staff were reported major constraints under financial, technical and transfer of technology constraints respectively.

Jesy Thomas *et al.* (2009) in their study on “Watershed-based Development for Rural Prosperity — Evidences from Kerala” found that the major constraint for watershed project implementation were non-availability of irrigation water, followed by availability of inputs and subsidy on time, inadequacy of sanctioned amount, lack of awareness about the beneficial programme, lack of supervision and follow-up, and lack of technical guidance reported by beneficiaries of watershed project.

Anil *et al.* (2010) from their study “Adoption of Watershed Technologies by the Farmers in Morena District of Madhya Pradesh” reported the constraints in adoption of watershed technologies Kheri nala watershed as perceived by respondents and resulted that illiteracy (57 farmers), lack of capital (52), complexity of loan procedures (50), high cost of fertilizer and seed (49), lack of training (46), lack of transport facilities (37) and lack of irrigation facilities (34) lack of active workers (27), uncertainty of forthcoming fund (24),

unavailability of fertilizer at proper time (22) and distant training center (19) were perceived as major constraints in adoption of watershed technologies

Shambulingappa (2011) in his study on “Impact of SUJALA watershed development programme in Dharwad district of Karnataka” reported constraints experienced by farmer beneficiaries in adoption of soil and water conservation practices where 60 per cent of beneficiary farmers expressed obstruction for cultural operation as the major constraint followed by water stagnation near bunded area (57.50 %), fragmentation of land into unconventional shape and size (55.00 %), loss of cultivable area (49.17 %) and financial constraints as major problem (42.50 %) respectively.

Rai *et al.* (2012) resulted from their study “Constraints and suggestions perceived by beneficiaries of Participatory Irrigation Management (PIM) programme” that out of all constraints faced by respondents in implementation of watershed, the higher irrigation charges recovered by the implementing agency (88.00 %) was reported as major constraint by the beneficiaries followed by biasness in distribution of irrigation water by some committee members (81.00 %) inadequate supply of irrigation water to the tail enders (79.00 %) encroachment in share of water by dominant farmers (71.00 %), poor maintenance of field channels (69.50 %), improper guidance by implementing agency for getting maximum benefits from the programme (54.50 %), time schedule for irrigation was not proper (52.00 %), lack of finance (47.00 %), and improper motivation for increasing participation (42.50 %) was the least responded.

Satish (2014) reported from his study “Impact of watershed development programme on agricultural upliftment of tribal’s – a statistical analysis” the constraints faced by implementers in implementation of watershed activities and major constraint faced by implementers were no permanent approach to each programme followed by insufficient demonstration, implementation not done in full knowledge of everybody, well arrangement of inputs not done, no role specification of different institutions and no flexibility in implementation were listed as major problem faced by implementers in adoption of watershed activities.

Pandey *et al.* (2014) in their study on “Constraints analysis of watershed development programme perceived by respondents” documented the constraints of different nature *viz.*, social, economic, supervision and guidance, constraints related to supply of field worker of watershed in Raipurani block of Haryana state. And reported that financial problem in programme 216 respondents (90 %), Lack of technical supervision in the operation of occupation 217 (90.41), Inadequate and untimely supply of inputs 240 (100 %), Political interference 209 (87.08 %), Caste structure of the village discouraged the execution some activities, 215 (89.58 %) were the major constraints under different nature respectively.

Nirankusha (2015) in his study on “Impact of watershed development (IWMP) on farm economy in Belagavi district” identified various constraints using Garrett score, majority of the farmers mentioned limitation of capital for adoption of watershed activities as major constraint with Garrett score 78.80 followed by lack of suitable guidance on various dry land agriculture technology (GS:68.43), non-availability of labour (GS: 59.23), lack of motivation and encouragement from institutes (GS:53.00), groupism among villagers and local politics (GS: 47.25), poor quality of work by implementing agency (GS:32.04), and improper location of soil and water conservation structures (GS: 20.93).

Author also identified constraints faced by implementers of watershed. inadequate fund availability for implementation of projects with highest garret score of about 74.80 followed by lack of availability of technical staff (GS:68.13), lack of involvement of farmers in Implementation of watershed development activities (GS:60.86), delay in distribution of sanctioned amount (GS:47.10), uneven distribution of incentives (GS:35.90), lack of communication with farmers (GS:31.40), and political interference (GS:20.40) were the major constraints reported by implementers in implementing watershed project.

Mani (2016) took up study on “Impact analysis of sujala watershed project in Kolar district of Karnataka” identified the major constraints experienced by farmers in implementation of Sujala watershed project were uneven rain fall (69.16 %), lack of number of out let in nala bunds (50.83 %) ,improper placement of soil and water

conservation structures without farmer knowledge (48.33 %), less area coverage under watershed programme (46.60 %), in adequate number of soil and water conserving structure (30.00 %), big farmer derived more benefits than small farmers (23.33 %), less subsidy (10.83 %), lengthy bunding (9.16 %), and more fragmentation of land due to soil and water conserving measures (6.66 %).

Vaidyanath (2016) in his study on “A study on peoples participation, benefits and constraints in Integrated Watershed Management Programme (IWMP) in Medak district of Telangana state” reported the major problem faced by beneficiaries of Integrated Watershed Management Project (IWMP), where low levels of the farmers to meet the cost of repairs to the water harvesting structures (91.66 %) reported major problem faced by farmer beneficiary followed by poor technical knowledge of watershed among farmers (87.50 %), lack of team spirit among farmers (85.30 %), small and marginal land holding (81.66 %), lack of coordination among various concerned department (80.00 %), poor knowledge on finance management (62.50 %), lack of adequate support from IWMP for the farmers in maintaining water harvesting structures (60.00 %), and poor follow up action by the officials of IWMP (54.16 %) were the problems faced by farmer beneficiaries.

Ashok Kumar Jatwer (2017), reported from his study on “A study on people’s participation in integrated watershed management programme in Mungeli district of Chhattisgarh” and showed that about 62.5 per cent of respondents faced problem of the poor knowledge and finance management ,followed by 56.67 per cent respondents had faced lack of exposure to successful watershed ventures, 54.17 per cent of respondents had unfavorable attitude of officials due to frequent transfer and short term engagements , 48.33 per cent of respondents said Lack of proper supervision by the technical staff/ higher officials, about 35.83 per cent respondents reported most important works like bundings etc. are not prioritized, about 29.17 per cent of respondents said funds were not released well in time, 26.67 per cent respondents faced problem in lack of adequate support and follow up from IWMP officials in maintaining of water harvesting structures in study area.

From the reviews quoted above we can infer that lack of knowledge about programme, illiteracy, financial constraints as major problem faced by beneficiary in implementing watershed projects. Whereas lack of involvement of farmers in Implementation of watershed development activities, insufficient fund were major problems faced by implementers in implementation of project.

III METHODOLOGY

This chapter mainly depicts the general characteristics of the study area, the sampling procedure adopted, the sources and nature of data, and the various statistical tools and techniques employed in analyzing the data. The methodology followed for the study has been presented under the following headings.

3.1 Description of the study area

3.2 Sampling framework

3.3 Nature and source of data

3.4 Analytical tools and techniques

3.1 Description of the study area

India is identified as one of the most vulnerable countries to climate change. Among the different sectors, climate-dependent agriculture is relatively more vulnerable. The pattern of droughts and floods are becoming more unpredictable. Rural livelihoods which mainly dependent on agriculture are largely affected by the adverse effects of water stress. Among, the different Indian states, nearly 49 per cent (9.40 M ha) of the total geographical area of Karnataka, the seventh largest state of the country, is affected by water erosion ($> 10 \text{ Mg ha}^{-1} \text{ yr}^{-1}$), placing it fifth among the Indian states (Anonymous, 2012).

Karnataka state is located between $11^{\circ} 3'$ and $18^{\circ} 3'$ N latitudes and $74^{\circ} 15'$ and $78^{\circ} 30'$ - E longitudes covering an area of 1,91,790 sq.km with 300km coast line on the west. It is contributing about 7.4 per cent to the nation's Gross State Domestic Product (GSDP) ranking it fifth among the Indian states (Anonymous, 2016). The state is third in terms of the area affected by land degradation (about 41 % of the total geographical area) and has a net sown area of about 105.23 lakh ha as per the 2010-11 census, of which 70.3 lakh ha (67 %) is rainfed. Karnataka had a total - 6.87 crores population where 62 per cent population resides in rural and 38 per cent resides in urban area. Population destiny of state was 319 persons per sq. km (2011 census) and has 15.67 per cent average growth rate per decade. Further, around 62.8 per cent of the rural population is dependent on agriculture.

Though the average annual rainfall is 1192 mm received over 55 days, about 66 per cent of the geographical area receives less than 750 mm rainfall with a climatic condition varying from semiarid to arid making agriculture a gamble (Anonymous, 2015).

The present study was conducted in Srinivaspur taluk of Kolar district of Karnataka state. Kolar district is a semi-arid drought-prone region that lies between 77° 21' to 78° 35' east longitude and 20° 46' to 13° 58' north latitude. District lies in southern region of the state and is an eastern-most district of the state. The district is surrounded by the Bangalore rural district on the west, Chikkaballapur district on the north, the Chitoor district of Andhra Pradesh on the east and the Krishnagiri and Vellore districts of Tamil Nadu on the south. The district comprises five taluks *viz*, Kolar, Malur, Srinivaspur, Bangarpet and Mulbagal. According to 2011 census district has population of 15.40 lakhs of which 7,76,396 are male and 7,60,005 females with the sex ratio of 953 females per 1000 male. Out of the total population of the district 89.25 per cent (13,74,768) were in rural areas and rest of population resides in semi urban and urban area. District has literacy rate of 75.4 per cent which comprises of 82.5 and 68.1 per cent male and female literacy respectively (Anonymous, 2015).

The district is having undulating to plain topography and has pleasant and moderate climate with maximum temperature of 36 °C in -May and minimum temperature of 15 °C in December. District has 65 per cent of average humidity. The total geographical area of district is 3.75 lakh ha where 2.33 lakh ha (46.13 %) area is under cultivation. Kolar district falls under 'eastern dry zone (zone 5)' of the agro-climatic zones. The average rainfall in the district is 743-mm with 52 average annual number of rainy days. It was observed that, there was a wide variation in pattern and distribution of rainfall over the years.

The district comprises of major soil types of red sandy, red loamy and mixed red soils. Major field crops cultivated in district were ragi, groundnut, paddy, red gram, etc. which cover 95.83 thousand ha of land under cultivation. Ragi occupies about 26 per cent (52, 491 ha) of total cultivated area. Horticulture crops like mango, banana, sapota, guava and vegetables such as tomato, potato, brinjal etc. covers 42.50 thousand ha area.

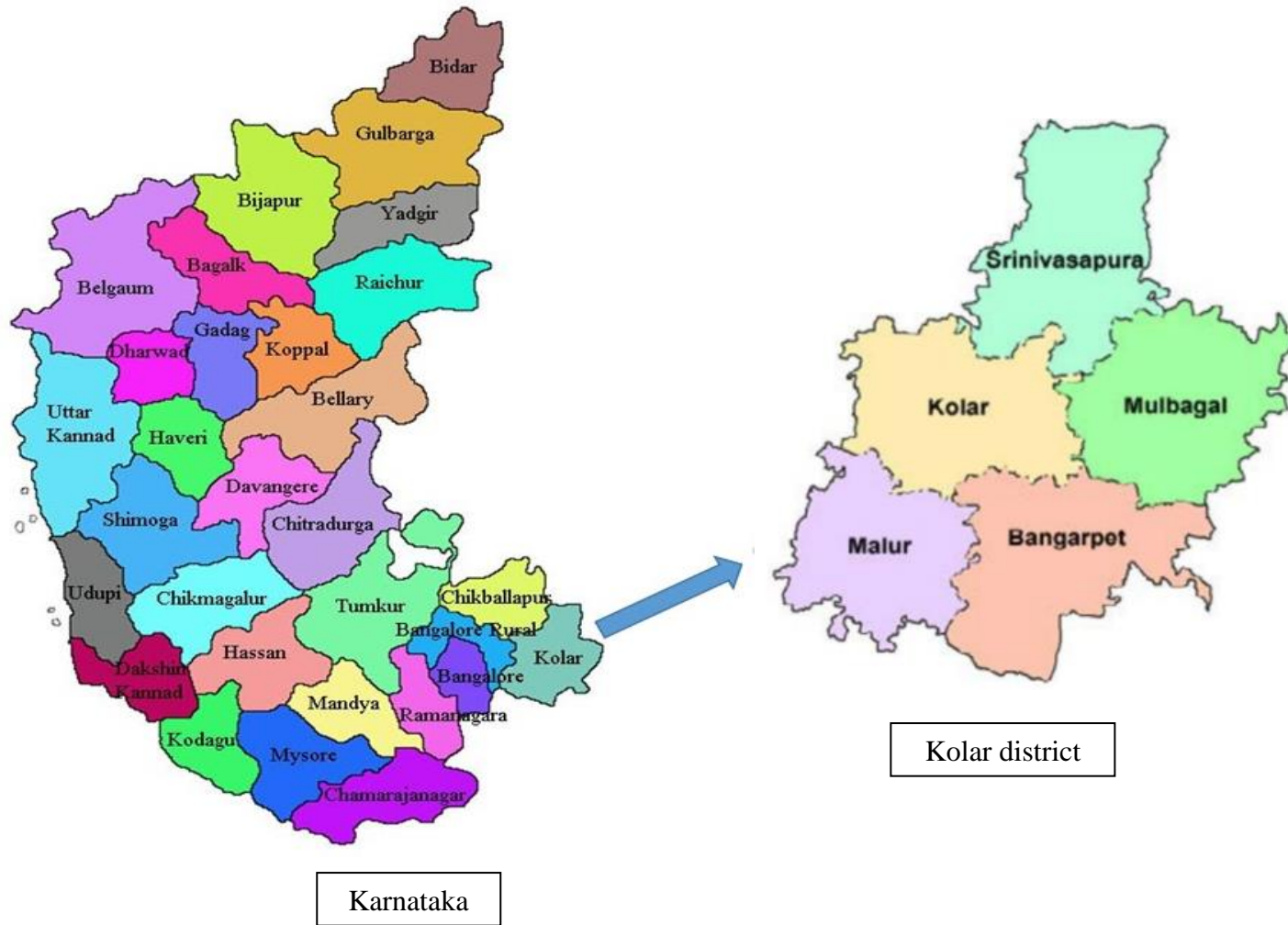


Fig. 3.1: Map of study area

Table 3.1: General information of study area

Sl. No.	Particulars	Kolar district	Srinivaspur taluk
1	Temperature	38 °C (Max) 18 °C (Min)	37 °C (Max) 19 °C (Min)
2	Average Humidity (%)	79 (Max) 45 (Min)	77 (Max) 48 (Min)
3	Average Annual Rainfall (mm)	743	722
4	Geographical Area (sq km)	3979	860
5	Villages (number)	1798	347
6	Hoblies	27	5
7	Population (number)	1536401	202304
8	Population density (per sq. km)	384	235.23
9	Rural Population (number)	1056328	175511
10	Urban Population (number)	480073	26793
11	Male Population (number)	7,76,396	102075
12	Female Population (number)	7,60,005	100229
13	Agriculturists (number)	209591	37,466
14	Agricultural Labors (number)	160961	24,040
15	Non- workers (number)	752685	17,858
16	Sex ratio (female per 1000 male)	979	982
17	Literacy rate (per centage)	76.54	76.12
18	Total area reported (hectare)	2,50,670	42,329
19	Forest land (hectare)	20620	9547
20	Current Fallow (hectare)	74547	17855
21	Net sown area (hectare)	1,97,666	39,335
22	Gross cropped area (hectare)	2,33,675	43630
23	Cropping intensity [GCA/NSA] (%)	118.21	113.14
24	Total District GDP (₹ crores)	6182	
25	Agriculture and Allied (Agriculture, Animal husbandry, Forestry, Fishing) (₹ crores)	2030	
26	Gross irrigated area (hectare)	26,144	3568
27	Net irrigated area (hectare)	17,135	2892
28	Area irrigated by Other sources	1,50,531	
29	Area Treated so far under various Watershed Schemes (ha)	148645.23	33812.58

Source: Kolar district at a glance (2014-15) and District irrigation plan (2016) Government of Karnataka

Out of these fruit crops mango has major share with 27.8 thousand ha (65.41 % of horticulture area). Among the vegetables tomato is standing first in production (5,47,753 MT) followed by potato (1,07,928.20 MT) and brinjal (39,520 MT). Apart from agriculture another major occupation found in district -is sericulture -where the mulberry is cultivated in 19 thousand ha (Anonymous, 2015).

Srinivaspura taluk is one among the five taluks of Kolar district is 24 km away from the district headquarters and is 90 km away from Bangalore. Taluk lies between 78° 6' 40" and 78° 24' 26" longitude and 13° 12' 57" and 13° 35' 43" latitude. The taluk is surrounded by Kolar, Mulbagal and Chintamani taluks of Kolar district and Chithoor district of Andhra Pradesh.

The geographical area of taluk is 85824 hectares; -the district has 9547 hectares of forest area which is 13.5 per cent of total forest area in the district. The taluk has 39335 hectares of net sown area which is about 11 per cent of total net sown area of district and has 4 per cent of total geographical area under irrigation.

The average rainfall of the taluk is 722 mm with on an average 55 rainy days in a year and has dry and hot climate during summer. Taluk has gravelly soil region which is most suitable for growing mango, groundnut, ragi and pulses. There are two agricultural seasons namely Kharif (June - October) and Rabi season (Mid October – Mid February). Major crops cultivated in the taluk are paddy, maize, ragi, ground nut, field bean tur and vegetables. Mango plantations are the major perennial crop grown in the taluk.

3.2 Sampling framework

A purposive sampling procedure was employed for the selection of study area. At the first level Kolar district was selected based on Rainfed Area Prioritization Index (RAPI). Next level in consonance with the objectives of the study and consultation with PMKSY-WD (Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development) and NABARD (National Bank for Agriculture and Rural Development) officials, Yeldur nala sub watershed under PMKSY-WD and Mudimadagu Watershed under NABARD in Srinivaspura taluk of Kolar district has been selected purposively for this study, as most of

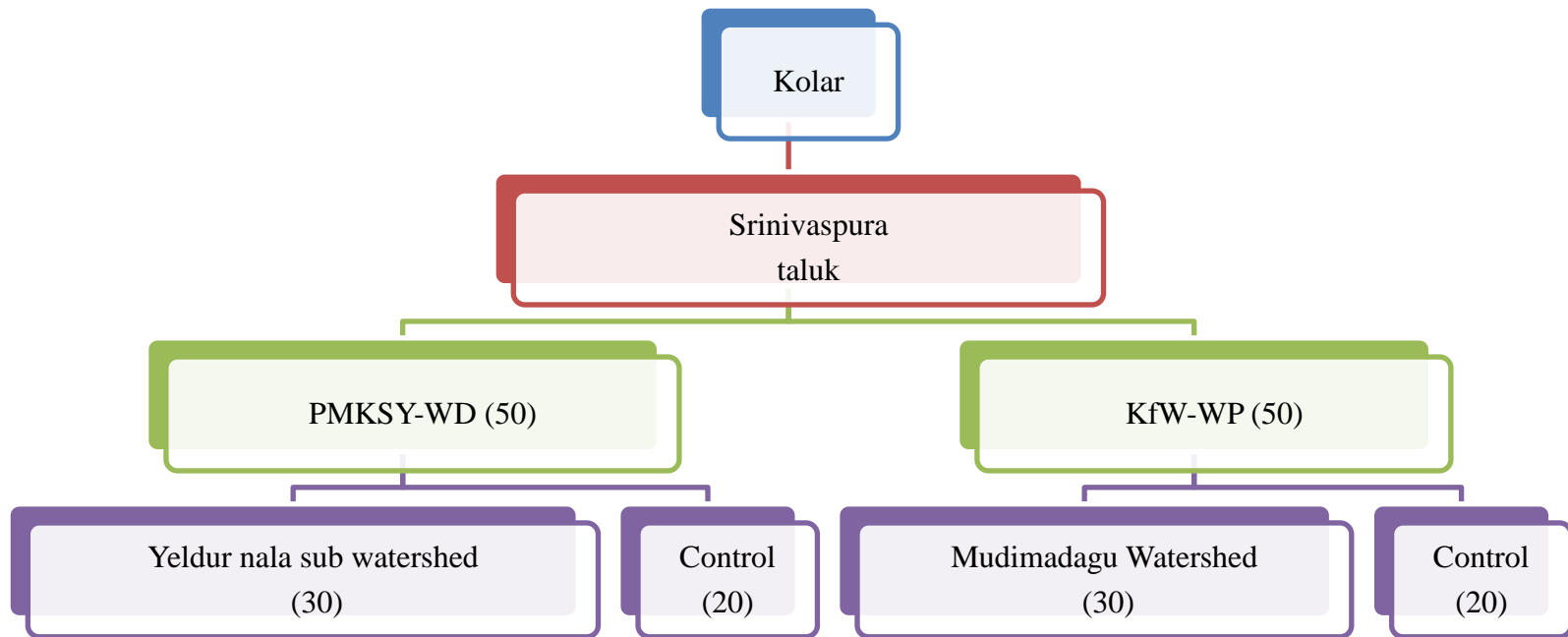


Fig. 3.2: Sampling framework of study area

the watershed activities were completed in these watershed areas. In the final stage, 50 sample farmers were randomly selected from each PMKSY-WD and KfW watershed projects. Under Yeldur nala sub watershed project Out of 50 sample respondents 30 respondents who are beneficiaries from watershed were randomly selected from villages Yedur and Beeraganahalli and 20 sample respondents who are non-beneficiaries (control) of watershed activity selected randomly from village Thimmasandra. For Mudimadagu Watershed project 30 sample respondents who were beneficiaries from KfW watershed activity were randomly selected from Paturagudda Yarlampalli, Bhonepalli, Anepalli, and M thumanapalli villages of watershed project and 20 sample respondents who were non-beneficiaries (control) were selected randomly from Guntapalli village which was selected randomly beside watershed area thus forming a total sample size of 100 (Fig.2).

3.3 Nature and source of data

In order to address the objectives of the study, data were collected from both primary and secondary sources.

Primary data: Data on socio-economic features, cropping pattern, allied activities, economic impact of the major interventions undertaken through PMKSY-WD and KfW projects collected from the sample farmers through pre-tested schedule.

Secondary data: Secondary data on activities taken up under PMKSY-WD and KfW-WP projects and implementation of project were collected from respective project officials.

3.4 Analytical tools and techniques

To fulfill the objectives of the study, data collected were analyzed by following tools and techniques.

3.4.1 Descriptive statistics

3.4.2 Economics of farm enterprises

3.4.3 Crop diversification Index

3.4.4 Statistical significance test

3.4.5 Resource use efficiency

3.4.6 Garrett's Ranking

3.4.1 Descriptive statistics

The technique of tabular analysis was employed for analyzing data related to socio-economic characteristics of sample farmers, costs and returns and income details using mean, average and percentage.

3.4.2 Economics of farm enterprises

To study the economics of major crops and enterprises, mean, averages and percentages were used. Different costs and returns concepts used in the study are presented in below. In the present study, all calculations pertaining to the economics of major crops were made on per acre basis.

3.4.2.1 Inputs and cost concepts

- a. Variable Costs
- b. Fixed Costs
- c. Marketing Costs
- d. Cost of cultivation
- e. Total cost

a. Variable costs: the variable costs include cost of seeds, fertilizers, pesticides, wages of human and bullock labour and interest on capital.

i. Labour Cost

The cost of hired labour for men and women was calculated by multiplying the man-days and woman days with existing wage rate per day (8 hour). The cost of family labour was imputed considering wage rate prevailing in the study area. The bullock labour was hired in pair days and the cost incurred was estimated by multiplying pair days with

prevailing wage rate. Machine labour was measured in hours and valued at existing hourly rates in the area for different operations performed by machines, mainly the tractors.

ii. Cost of material and inputs

Cost of various inputs such as seeds, fertilizers, Farm Yard Manure (FYM), plant protection chemicals and others are considered in this category and were valued at their actual purchase price. While the value of owned farm inputs was imputed at current prices.

b. Fixed costs: Fixed costs are costs incurred even if no output is produced. These include Depreciation on farm implements and machinery, Interest on fixed capital, and Rental value of land.

i. Rental value of Land: the practice of leasing in and leasing out was quite common in the study area. Hence, the existing lease rate of the area was considered as rental value of land in the present study.

ii. Depreciation: Depreciation of each farm implements used in the cultivation of crop in study area was worked out by straight line method of computing depreciation

$$\text{Depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Average life of an asset}}$$

iii. Interest on fixed capital: Interest on fixed capital was calculated at the rate of 9 per cent, as the fixed deposits in commercial banks would give this rate of interest. Farm implements and machinery are the items considered under fixed capital. Interest was considered on the value of these assets after deducting the depreciation for the year.

iv. Land revenue: land revenue which was levied by the government and paid by farmer in the study area considered.

c. Marketing costs: marketing costs include cost of transportation, loading and unloading, packing, labour charges and commission charges. Actual cost incurred by farmer producer in study area for marketing of produce was considered.

d. Cost of cultivation: refers to the total expenses incurred in cultivating one acre of crop. Calculated by adding fixed costs, variable costs and marketing cost and expressed in per unit basis.

e. Total cost: it is the sum of total variable cost and total fixed cost

$$\text{Total cost of cultivation} = \text{Total variable Cost} + \text{Total fixed cost.}$$

f. Amortized cost of establishment: Amortization is an accounting technique that reduces cumulative establishment cost at a discount rate over the economic life of the plantation. To arrive at amortized establishment cost, the following formula was used: Amortization was calculated by using formula:

$$A = P \frac{r(1+r)^n}{(1+r)^n - 1}$$

Where,

A = Annual amortized cost

P = Establishment cost

n = Economic life of mango orchard (taken as 50 years)

r = interest rate (2 %)

g. Establishment Cost: Cost incurred by the farmers till the crop start bearing the yield generates income. The costs incurred under this comprises land preparation, digging of pits, manure and silt application, planting and filling of pits, fertilizer application, pruning, plant protection chemicals application, staking, weeding, etc.

h. Annual Maintenance Cost: After the establishment of the crop, the cost incurred by the farmer to maintain the crop annually. This include both variable and fixed costs.

3.4.2.2 Returns

a) Gross Returns: Gross return is the value of main product and the by-product imputed on the basis of post-harvest prices prevailing in the study area.

$$\text{Gross Returns} = \text{yield} \times \text{price}$$

b) Net Returns: Net returns were estimated by subtracting the cost of cultivation from gross returns and also, the returns per rupee of cost were calculated by dividing gross returns by total cost of cultivation.

$$\text{Net Returns} = \text{Gross Returns} - (\text{TVC} + \text{TFC})$$

$$\text{Returns per rupee of investment} = \frac{\text{Total cost}}{\text{Gross Returns}} \quad \dots (1)$$

3.4.3. Crop diversification Index

Simpson Index (SI) is the most widely used index for measuring diversification of crops in a particular geographical region and is employed to calculate crop diversification in study area using – the formula given below

$$SI = 1 - \sum_{i=1}^N P_i^2$$

Where, $P_i = A_i / \sum A_i$ is the proportion of the i th activity in acreage.

A near to zero Simpson index value, indicates that the region is near to the specialization in growing of a particular crop and if it is near to one, then the region is fully diversified in terms of crops.

3.4.2 Statistical significance test

Different statistical tests were employed in this study to examine the significant difference between the transacts with respect to socio economic characteristics, The test employed is as follows,

Chi-square independent test

This is a most frequently used non-parametric statistical test in social sciences as it can be used for any levels of measurement in general and nominal variable in particular. Chi-square test of independence was used to evaluate group differences when the dependent variable is nominal, dichotomous, ordinal, or grouped interval. The Chi square test of independence allows the researcher to determine whether variables are independent

of each other or whether there is a pattern of dependence between them. If there is dependence, the researcher can claim that the two variables have a statistical relationship with each other.

This approach consists of four steps:

- (1) State the null and alternative hypotheses
- (2) Formulate an analysis plan
- (3) Analyze the sample data
- (4) Interpretation of results

Step 1: Null Hypothesis (H0): Two variables are independent

Alternative hypothesis (H1): Two variables are not independent.

Step 2: This deals with the use of the data to accept or reject the null hypothesis. In this stage researcher also needs to set up the significance level. Often, researchers choose significance levels equal to 0.01, 0.05, or 0.10.

Step 3: Using sample data from the contingency tables, find the degrees of freedom, expected frequency counts, test statistic, and the P-value associated with the test statistic. The formula used to find out the Chi square statistic is as follows

$$\text{Follows } \chi^2 ((r-1) \times (c-1) \text{ df})$$

Where,

O_{ij} is the observed number of cases with respect to i th factor in j th district,

E_{ij} the expected number of cases with respect to i th factor in j th district.

N is the total number of observations, r is number of rows, c is number of columns and df is the degrees of freedom $((r-1) \times (c-1))$

The expected value of the each category can be calculated as follows

$$\text{Expected number of } ij\text{th case} = \{(\text{ith row total} \times \text{jth column total}) / \text{grand total}\}$$

This Chi square statistic is obtained by calculating the difference between the observed number of cases and the expected number of cases in each category. Chi square correction factor subtracted from Chi square statistic as expected value of single cell was less than five. This difference is squared and divided by the expected number of cases in that category. These values are then added for all the categories, and the total is referred to as the Chi squared value. Since the test statistic is a Chi-square, use the Chi-Square distribution calculator to assess the probability associated with the test statistic using the degrees of freedom computed above.

Step 4: Reject the null hypothesis if the probability of test statistic is less than or equal to alpha (0.05)

In the present study this test was employed to know the relationship between socio-economic characteristics of the respondents across transacts.

3.4.4 Resource Use Efficiency (RUE)

Cobb-Douglas production function was used to assess the resource use efficiency in the production of the ragi among the beneficiaries and non-beneficiaries of watershed project, as ragi is major crop in study area and cultivated by farmers in both watershed and non-watershed area.

The specification of the equation for production of principle crops is given in the equation 1.

$$Y_i = aX_1^{b^1}X_2^{b^2}X_3^{b^3}X_4^{b^4}X_5^{b^5}X_6^{b^6}e^u \dots\dots\dots(1)$$

- Where, Y_i = yield of crop
- X_1 = Area (acres) under crop
- X_2 = Seed (Kg) for crop
- X_3 = Fertilizer (kg) in the production of crop
- X_4 = Human labour (man days) in the production of crop
- X_5 = FYM (tons) in the production of crop
- X_6 = Machine labour (hours) in the production of crop

a = Constant

e^u = random error.

b_1 to b_6 indicate regression coefficients of respective inputs and implicitly represents the elasticity of production of respective inputs.

The Cobb-Douglas production function was converted into natural log linear form. The log linear form of equation was

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + u \ln e \dots (2)$$

Keeping technology as constant, farm is said to be efficient when resources are allocated efficiently according to market prices. To decide whether a particular input is used efficiently or not, its marginal value products were computed. If the marginal value product of an input just covers its acquisition cost it is said to be used efficiently.

Marginal Value Product (MVP): The estimated coefficients were used to compute the MVP. We can assess the relative importance of factors of production by studying the marginal value product. Marginal Value Product of X_i , i.e. for the i^{th} input, it is estimated by the following formula,

$$MVP = b_i \times \frac{G.M.(Y)}{G.M.(X_i)} \times P_y$$

G.M. (Y) and G.M. (X_i) represent the geometric means of output and input respectively, b_i is the regression co-efficient of i^{th} input and P_y is price of output.

The model was estimated as follows,

$$r = MVP/MFC$$

Where, r = efficiency ratio MVP = Marginal value product of variable input
MFC = Marginal factor cost (price per unit input)

As all the variables are taken in physical terms, MFC will be per unit input cost. Based on economic theory, a firm maximizes profits with regards to resource use when the ratio of the marginal return to the opportunity cost is one. The values are interpreted thus,

If $r < 1$; resource is excessively used or over utilized (no scope to increase) hence, decreasing the quantity of resource increases profits.

If $r > 1$; resource is under used or being underutilized (there is a scope to increase) hence, increasing its use will increase profit level.

If $r = 1$; it shows the resource is efficiently used, that is optimum utilization of resource, hence the point of profit maximization.

3.4.6 Garrett's Ranking

Garret's ranking technique gives the changes in orders of constraints and advantage into numerical score. Garrett's ranking technique was used to rank the constraints faced by beneficiaries and implementing agency in implementing watershed activities in study area. Constraints for the study area were listed by taking opinions of the sample farmers and with regard to the various studies undertaken in the similar field. Totally six constraints were listed for beneficiaries: Lack of awareness about benefits of watershed technology, Obstruction for cultural operation by soil and water conservation structure, High Maintenance cost of water harvesting structures, Uncertain rainfall, Small and fragmented nature of holdings and Groupism and village politics. Constraints faced by implementing agency were listed as Poor participation by the farmers during training programmes, Political interference, Failure to recognize advantages of watershed activities by farmers, Small and fragmented nature of holdings, Limited availability of labour and Delay in releasing the sanctioned amount, these were ranked by PMKSY-WD and KfW officials. For constraints faced by beneficiaries each of the sample farmer was asked to rank the listed six constraints from rank one to rank six. In this analysis, rank one meant most important factor and rank six meant least important factor. Rank assigned to each constraint by each individual was converted into per cent position using the following formula,

$$\text{Per cent position} = 100 * (R_{ij} - 0.50) / N_j$$

Where,

R_{ij} stands for rank given for the i th factor ($i = 1, 2, \dots, 6$) by the j th individual ($j = 1, 2, \dots, 50$)

N_j stands for number of factors ranked by j th individual.

The per cent position of each rank was converted to scores by referring to table given in Garret and Woodsworth (1969). Then for each constraint the scores of individual respondents were added together and divided by the total number of respondents from whom scores were added. Finally, overall ranking of the six constraints was done by assigning rank 1, 2, 3,.....6 in the descending order of the mean scores.

Terms and concepts used

Crop production: it is the quantity of output produced from given area.

Crop productivity: crop productivity is the quantitative measure of crop yield in given measured area or field.

Gross Cropped Area (GCA)- the total area sown once as well as more than once in a particular year. When the crop is sown on a piece of land for twice, the area is counted twice in GCA.

Net cropped area: - the total area sown with crops and orchards. It represents an area in which total crops are grown only once in a year.

Cropping intensity: refers to raising of a number of crops from the same field during one agricultural year; it is estimated using below formula.

$$\text{Cropping Intensity} = \frac{\text{Gross Cropped Area}}{\text{Net Sown Area}} \times 100$$

IV RESULTS AND DISCUSSION

The results and discussion of the study “Economic Evaluation of PMKSY-WD and Watershed Projects in Kolar District of Karnataka” in accordance with the objectives formulated, analyzed using various statistical tools and technique are presented below under the following heads.

- 4.1 Watershed activities extended to sample farmers under watershed projects
- 4.2 Socio-Economic characters
- 4.3 Cropping pattern of sample farmers under both the watershed projects
- 4.4 Production, and productivity of major crops under both the watershed projects
- 4.5 Cost, returns and income of sample farmers under both the watershed projects
- 4.6 Resource use efficiency in ragi production in the project area
- 4.7 Constraints faced by implementing agency and beneficiaries in the implementation of watershed project

4.1 Watershed activities extended to sample farmers under watershed projects

To conserve the soil and water in the field, some of the structures were constructed in sample farmer’s field. In PMKSY-WD farm pond, field bund and trench cum bund were constructed for eight, one and twenty nine farmers respectively, out of which seven farmers maintained farm pond and only eleven farmers maintained trench cum bund (Table 4.2)

Of the total sample farmers under KfW-WP, ten farmers were benefited by farm pond whereas field bund and boulder bund were constructed in two sample farmers each and trench cum bund constructed in seven farmers field out of which only four farmers maintained the structures.

Farm ponds constructed under watershed projects were efficiently maintained by farmers compared to other water harvesting structures, this was because farm pond benefits the farmer by holding more rain water compared to trench cum bund and field bund and it was very difficult to manage trench cum bund and field bund as weed growth on these bunds is a major problem.

Table 4.1: Soil and water conservation activities undertaken in the sample farmer's fields (number)

Sl. No.	Structures	PMKSY-WD			KfW-WP		
		Beneficiaries	Managed asset	Not managed asset	Beneficiaries	Managed asset	Not managed asset
1	Farm ponds	8	7	1	10	9	1
2	Field bunds	1	0	1	2	0	2
3	Trench cum bund	29	18	11	7	4	3
4	Boulder bund	0	0	0	2	1	1

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP- Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Table 4.2: Watershed intervention activities extended to sample farmers in the study area (number)

Sl. No.	Activities	PMKSY-WD	KfW-WP
		Number of beneficiaries	Number of beneficiaries
1	Dry land horticulture (Mango seedling)	17 (56.67)	10 (33.33)
2	Agro forestry (Silver oak seedlings)	14 (46.67)	0 (NA)
3	Fodder production promotion	13 (43.33)	29 (96.67)
4	Participation in the animal health camp	17 (56.67)	0 (NA)
5	Annual and Perennial fodder minikits	3 (10.00)	0 (NA)
6	Tank slit application	0 (NA)	11 (36.67)
7	Vermi compost pits	0 (NA)	2 (6.67)
8	Compost pit	0 (NA)	3 (10.00)
9	Jeevamrutha and Panchagavya	0 (NA)	6 (20.00)
10	Sheep rearing	0 (NA)	8 (26.67)
11	Backyard poultry	0 (NA)	20 (66.67)
12	Backyard poultry shed	0 (NA)	10 (33.33)
13	Ragi seeds distribution	0 (NA)	28 (93.33)
14	Training and income Generation activity for SHG members	4 (13.33)	0 (NA)

Note: Figures in the parenthesis indicates per cent to total sample NA: Not Available PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW- Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project



Plate 4.1: Farm pond constructed under KfW Watershed project in the study area



Plate 4.2: Check dam constructed under PMKSY-WD in the study area



Plate 4.3: Cattle pond constructed under KfW watershed project in the study area



Plate 4.4: Trench cum bund constructed under PMKSY-WD in the study area



Plate 4.5: Farm pond constructed under PMKSY-WD in the study area



Plate 4.6: Dry land horticulture (mango cultivation) and agro forestry (silver oak plantation) under PMKSY-WD in the study area



Plate 4.7: Poultry birds and poultry cage provided under KfW watershed projects in the study area



Plate 4.8: Primary data collection in the study area

Out of the total sample farmers 56.67 per cent of them were benefited from Dry land horticulture i.e. provided with mango seedlings, 46.67 per cent were benefited by Agro forestry i.e. provided with silver oak seedling under PMKSY-WD, along with these 43.33 and 56.67 per cent of farmers participated in Fodder production promotion and animal health camp respectively. Around 13.33 per cent of farmers were SHG members had undergone training of income generation activity conducted by implementing agency (Table 4.2).

In KfW watershed project, 33.33 per cent of sample farmers were benefited with mango seedlings under dry land horticulture watershed activity, 96.67 per cent farmers participated in fodder production programme, 36.67 per cent farmers incorporated tank silt application, 66.67 per cent of farmers were provided with Backyard poultry and 26.67 per cent of sample farmers were provided with Sheep rearing. Improved high yielding drought tolerant seeds of ragi were also given to 93.33 of samples farmers respectively under KfW watershed activities. When compared to PMKSY-WD and KfW WP, KfW WP has taken more diversified activities and concentrated more on income generating activities whereas PMKSY-WD focused more on soil and water conservation methods, dry land horticulture and agroforestry activities (Table 4.2).

4.2 Socio-Economic characteristics

4.2.1 Socio-Economic characteristics of watershed and non-watershed area sample farmers

A total of 100 sample-farmers were selected from the two watershed projects Yeldur nala sub watershed project implemented under PMKSY-WD and Mudimadagu watershed project implemented under KfW-WP. Under Yeldur nala sub watershed project (PMKSY- WD), Out of 50 selected sample respondents, 30 respondents -were beneficiary from watershed and 20 sample respondents were non beneficiaries (non-watershed area.) From Mudimadagu Watershed project (KfW-WP) 30 sample respondents were beneficiaries and 20 sample respondents were non-beneficiaries.

The comparative analysis of general characteristics of the sample watershed and non-watershed farmers would help to know their influence on watershed activities and the

results are presented in Table 4.3 The characteristics included demographic features like age, education, family size, the details of these characteristics are analyzed below.

4.2.1.1 Socio-Economic- characteristics of sample farmers in Yeldur nala sub watershed project (PMKSY-WD)

The general characteristics of the sample farmers indicated that under PMKSY – WD majority of farmers belonged to old age group (>50 years) i.e. 63.33 per cent of sample farmers followed by middle (35-50 years) age group 33.33 per cent and young age (18-35 years) group 3.33 per cent. In non-watershed area, majority of farmers belonged to old age group (>50 years) i.e. 55 per cent followed by middle age (35-45 years) group 45 per cent. The average age of the watershed beneficiary is found to be 56.00 years whereas, it was 51.55 years in the case of non-beneficiary and there was no significant difference in the age groups of both the category of sample farmers. It was observed that participation of young age in farming was very less in the both sample categories because young age went in search of job as Bangalore city is near to them. The results are in accordance with findings of (Vaidyanath, 2016) where middle age and old age of farmers were practicing farming while youths were preferring more remunerative and less risky profession (Table 4.3).

Out of 30 sample farmers in watershed area, 6.67 per cent of them were illiterate, the remaining majority of 93.33 per cent were educated. Out of educated respondents 53.33 per cent attained primary education, 33.33 per cent had high school education, 3.33 per cent pre university course (PUC) and 3.33 per cent of them possessed post-graduation. Similarly, in non-watershed area 5 per cent of the sample farmers were illiterate and the remaining 95 per cent were literates. Out of the literates, 40 per cent attained primary education, 25 per cent possessed high school education, 20 per cent received pre university and only 10 per cent obtained graduation level education. There was no significant difference in the education level of both the category of sample farmers (Table 4.3).

The classification of farmers based on their family type shows that in the watershed area joint families were higher with 60.00 per cent of sample farms, and nuclear family with 40.00 per cent whose family size consists of less than four members.

Table 4.3: Socio-economic characteristics of sample farmers in the study area

Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiaries (n = 30)	Non – Beneficiaries (N =20)	Beneficiaries (N = 30)	Non– Beneficiaries (N =20)
I	Age				
1	Young (18-35 years)	1 (3.33)	0 (0.00)	2 (6.66)	5 (25.00)
2	Middle (35-50)	10 (33.33)	9 (45.00)	12 (40.00)	7 (35.00)
3	Old (> 50)	19 (63.33)	11 (55.00)	16 (53.33)	8 (40.00)
	Chi square value	0.37 ^{NS}		3.40 ^{NS}	
II	Education				
1	Illiterate	2 (6.67)	1 (5.00)	2 (6.67)	2 (10.00)
2	Primary	16 (53.33)	8 (40.00)	14 (46.67)	7 (35.00)
3	High school	10 (33.33)	5 (25.00)	7 (23.33)	6 (30.00)
4	PUC	1 (3.33)	4 (20.00)	4 (13.33)	3 (15.00)
5	Degree	0 (0.00)	2 (10.00)	3 (10.00)	1 (5.00)
6	Post-graduation	1 (3.33)	0 (0.00)	0 (0.00)	1 (5.00)
	Chi square value	2.41 ^{NS}		0.75 ^{NS}	
III	Family type				
1	Nuclear	12(40.00)	14(70.00)	21(70.00)	13(65.00)
2	Joint	18(60.00)	6(30.00)	9(30.00)	7.00(35)
	Chi square value	0.43 ^{NS}		0.13 ^{NS}	
IV	Land holdings(ha)				
1	marginal land (less than 1 ha)	9 (30.00)	14 (70.00)	21 (70.00)	15 (75.00)
2	small land holding (Between 1 to 2 ha)	9 (30.00)	6 (30.00)	7 (23.33)	5 (25.00)
3	medium land holding (Between 2 to 10 ha)	10 (33.33)	0 (0.00)	2 (6.67)	0 (0.00)
4	large land holding (more than 10 ha)	2 (6.66)	0 (0.00)	0 (0.00)	0 (0.00)
	Chi square value	4.20 ^{NS}		6.25 ^{NS}	
V	Average land under cultivation				
1	Rainfed land(acre)	1.15(21.28)	1.62(79.13)	0.71(38.39)	1.05(75.00)
2	Irrigated land(acre)	2.65 (78.72)	0.4(20.87)	1.15(61.61)	0.35(25.00)
	Total land	3.36 (100.00)	2.00 (100.00)	1.86 (100.00)	1.40 (100.00)
	t test value	6.35 ^S		4.30 ^S	

Note: 1. PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW-WP- Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project 2. Figures in parentheses indicate percentage to total sample.

3.NS: Non significant S: Significant

Whereas the nuclear families were higher with 70.00 per cent, and joint family with 30.00 per cent in non-watershed area. There was no significant difference in the family types of both the category of sample farmers. More number of nuclear families were observed in non-watershed area due to youths migrate to cities in search of non-farming job due to non-availability of water and uncertainty of agriculture. These results are in line with the study of Mani and Govind Gowda, (2016). (Table 4.3).

Majority of farmers in watershed area belonged to medium land holding category (Between 2 to 10 ha) with 33.33 per cent of total sample farmers, followed by marginal and small land holding farmers with 30 per cent, only few farmers were having large land holding with 6.66 per cent. Similarly, in non-Watershed Area Majority of farms are marginal which 70 per cent followed by small farms with 30 per cent. There was no significant difference in the land holdings of both the category of sample farmers (Table 4.3). Similar results were seen in the study by Vaidyanath (2016) where due to sub division and fragmentation of land, the farm size was decreasing there by more small and marginal farmers in the study area.

With respect to average land holding, the average land holding was higher in the watershed area with 3.36 acres which comprises of rainfed and irrigated area of 2.65 and 1.15 acre, respectively. The corresponding total land owned by non-watershed farmers was 2.00 acres comprising rainfed and irrigated areas of 1.62 and 0.4 acres respectively, this was because adoption of watershed activity like farm pond, check dam in study area increased irrigated land and even some farmers have reported increased water yield from their bore well and hence increased area under irrigation (Table 4.3).

4.2.1.2 Socio-Economic - characteristics of Mudimadagu Watershed project (KfW-WP)

The majority of KfW watershed beneficiary sample farmers belonged to old age group i.e. 53.33 per cent followed by middle age group 40 per cent and young age group 6.66 per cent. In non-watershed area majority of farmers belonged to old age group (>50 years) i.e. 40 per cent followed by middle age group (35-50) 35 per cent and young age (18-35) 25 per cent. there was no significant difference in the age groups of both the

category of sample farmers. The results are in line with findings of (Vaidyanath, 2016) (Table 4.3).

Out of 30 sample farmers in watershed area, 6.67 per cent of them were illiterate, the remaining majority of 93.33 per cent were educated. Out of which 46.67 per cent attained primary education, 23.33 per cent had high school education 13.33 per cent of them attained pre university course (PUC) and 10 per cent of them received graduation. Similarly, in non-watershed area 10 per cent of the sample farmers were illiterate and the remaining 90 per cent were literates. Out of the literates, 35 per cent attained primary education, 30 per cent possessed high school education, 15 per cent received pre university course and 5 per cent obtained graduation and 5 per cent possessed post-graduation. It is evident from the results that majority of sample farmers studied up to primary and high school very few of them completed graduation. There was no significant difference in the education level of both the category of sample farmers. (Table 4.3).

In watershed area nuclear families were higher with 70.00 per cent whose family size consists of more than four members, and joint family with 30.00 per cent. The nuclear families were higher with 65.00 per cent, and joint family with 35.00 per cent families in non-watershed area. There was no significant difference in the family type of both the category of sample farmers (Table 4.3).

Majority of farmers in the watershed area belonged of marginal land holding category (70 %) followed by small land holding farmers with 23.33 per cent, and only few farmers were having large land holding with 6.67 per cent. In non-watershed area majority of farmers were with marginal land holding 75 per cent followed by small land holding farmers with 25 per cent. There was no significant difference in the land holding categories of both the category of sample farmers. Similar results were observed in the study by Vaidyanath (2016) where due to fragmentation land holding of farmers land holding size decreased, hence prevalence of more number of marginal and small land farmers in both watershed and non-watershed areas. (Table 4.3).

With respect to average land holding, the average land holding was higher in watershed area with 1.86 acres where rainfed and irrigated area accounts for 0.71 acres and 1.15 acres respectively. The corresponding average land owned by non-watershed farmers was 1.40 acres accounting rainfed and irrigated areas of 1.05 acres and 0.35 acres respectively. Average area under irrigation was higher in watershed area compared to non-watershed area, since implementation soil and water conservation activities under watershed improved access to water and hence increased area under irrigation.

4.2.2 Farm inventory of sample households in PMKSY-WD and KfW watershed and non-watershed area

The ownership status of farm assets and equipments that are in possession with the sample farmers is depicted in table 4.4. From the table it is evident that under PMKSY-WD, 6.66 per cent of the farmers possessed bullock cart, 20 per cent of farmers owned tractors, 3.33 per cent of them owned power tiller, 46.66 per cent of farmers owned sprayers and 35 per cent of farmers owned borewell which was comparatively higher than that of non-watershed area (NWA) where 15 per cent farmers owned tractors, 30 per cent possessed sprayers and 15 per cent farmers owned borewell (Table 4.4).

Table 4.4: Farm -inventory of beneficiary and non-beneficiary sample farmers in PMKSY-WD and KfW-WP area (2018-19). (number of assets)

Sl. No.	Characteristics	PMKSY-WD		KfW-WP	
		Beneficiaries	Non – Beneficiaries	Beneficiaries	Non – Beneficiaries
1	Bullock cart	2(6.66)	0(0.00)	0(0.00)	0(0.00)
2	Tractor	6(20.00)	3(15.00)	2(6.66)	0(0.00)
3	Power tiller	1(3.33)	0(0.00)	0(0.00)	0(0.00)
4	Sprayers	15(46.66)	7(30.00)	13(36.66)	4(20.00)
5	Functioning Borewell	13(35.00)	3(15.00)	14(33.66)	5(25.00)

Note: Figures in parentheses indicate percentage to total sample, PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW-WP- Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

In KfW watershed project 6.66 per cent of farmers owned tractors, 36.66 per cent owned sprayers and 33.33 per cent of farmers owned borewell, which was comparatively higher than that of non-watershed farmers where 20 per cent of them owned sprayers and 25 per cent farmers owned borewell (Table 4.4). More number of borewells was observed in watershed area compared to NWA as watershed activities increased recharge of water in farm and even increased number of functioning bore wells. More number assets were found in watershed area because of availability of water increased cultivation intensity and also increased income of farmers, which made them possess required farm equipment's to carry out farm operation (Table 4.4). The findings are in line with the study by Nirankusha (2015) in which increase in farm assets of watershed beneficiary over non-beneficiary was observed because of prospectus and increased farm incomes as a result of increased productivity due to watershed intervention. Thus, the hypothesis of "The watershed interventions have positive impact on asset creation in the watershed area" is accepted.

4.2.3 Livestock inventory of sample households in PMKSY-WD and KfW watershed and non-watershed area

The livestock inventory of the sample farmers in PMKSY-WD revealed that in watershed area (WA) 30 per cent of sample farmers owned local cows, 16.66 per cent owned buffalo and 6.66 per cent of farmers had bullock pairs. Sheep and poultry were owned by 3.33 and 6.66 per cent of sample farmers respectively. Similarly, in NWA 30 per cent of farmers owned local cows, 5 per cent owned buffalo and 5.00 per cent of farmers had bullock pairs. Sheep and poultry were owned by 10.00 and 5.00 per cent of farmers respectively. Percentage of farmers owning cattle is comparatively high in WA than NWA due to watershed interventions (Table 4.5).

Under KfW WP 53.33 per cent of farmers owned local cows and 3.33 per cent of them had bullock pairs. Sheep and poultry were owned by 36.66 and 70.00 per cent of farmers respectively. Whereas in NWA, 40 per cent of farmers owned local cows and 15.00 per cent of farmers had cross breed cow. Sheep and poultry were owned by 15.00 and 35.00 per cent of farmers respectively. (Table 4.6) It is evident from the results that Sheep and poultry birds were more in KfW watershed project when compared to PMKSY-WD

because in KfW watershed project to augment farmer's income, poultry and sheep were distributed. Same results were observed in the study taken by Ravi (2007) in Dharwad, where farmers under sujala watershed project had more livestock compared to non-watershed farmers (Table 4.5).

Table 4.5: Livestock inventory of sample farmers in Watershed and non-watershed areas (2018-19). (number)

Sl. No.	Livestock	PMKSY -WD		KfW-WP	
		Beneficiaries	Non – Beneficiaries	Beneficiaries	Non – Beneficiaries
1	Bullock pair	4(6.66)	2(5.00)	2(3.33)	0(0.00)
2	Milch animals				
a	Local cow	24(30.00)	22(30.00)	58(53.33)	17(40.00)
b	Buffalo	11(16.66)	2(5.00)	0(0.00)	0(0.00)
c	Crossbreed cow	4(6.66)	2(5.00)	22(36.33)	5(15.00)
3	Calves and Heifers (below 1 year)	0(0.00)	0(0.00)	2(3.33)	0(0.00)
4	Sheep	5(3.33)	15(10.00)	114(36.66)	40(15.00)
5	Goats	0(0.00)	0(0.00)	30(3.33)	0(0.00)
6	Poultry	22(6.66)	5(5.00)	289(70.00)	49(35.00)

Note: PMKSY -WD-Pradhan Mantri Krishi Sinchayi Yojana Watershed Development, KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project
 Figures in parentheses indicate percentage of number of sample farmers owning asset.

4.3 Cropping pattern of sample farmers.

Cropping pattern of both (PMKSY-WD and KfW watershed) sample farmers is elucidated in Table 4.8. In PMKSY-WD Ragi, tomato were the major sole crops grown with 21.40 and 6.65 per cent of gross cropped area respectively and mango crop was grown with 41.07 per cent of GCA and silver oak under agro forestry with 1.81 per cent of the GCA. Pigeon pea and field bean intercrop with ragi was cultivated under 15.04 per cent of GCA and Cropping Intensity of farmers in WA was 170.29 per cent.

Table 4.6: Cropping pattern of sample farmers under PMKSY-WD and KfW watershed projects (2018-19)

Sl. No.	Crops	PMKSY-WD				KfW-WP			
		Beneficiaries		Non-Beneficiaries		Beneficiaries		Non-Beneficiaries	
		Area (acre)	Percentage to GCA (%)	Area (acre)	Percentage to GCA (%)	Area (acre)	Percentage to GCA (%)	Area (acre)	Percentage to GCA (%)
I	Sole crop								
1	Ragi	37.00	21.40	20.05	36.42	14.50	14.22	4.75	12.67
2	Pigeon pea	4.00	2.31	0.00	0.00	0.00	0.00	0.00	0.00
3	Horse gram	5.00	2.89	1.50	2.72	2.00	1.96	1.00	2.67
4	Paddy	0.00	0.00	0.00	0.00	2.00	1.96	1.50	4.00
5	Ground nut	0.00	0.00	0.00	0.00	12.25	12.01	2.00	5.33
6	Tomato	11.50	6.65	5.50	9.99	11.50	11.27	7.50	20.00
7	Capsicum	1.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00
8	Onion	2.00	1.16	0.00	0.00	1.25	1.23	0.00	0.00
9	Mulberry	2.50	1.45	1.00	1.82	0.00	0.00	0.00	0.00
10	Chilli	1.75	1.01	0.00	0.00	0.00	0.00	0.00	0.00
11	Knol-khol	0.00	0.00	0.00	0.00	1.50	1.47	0.00	0.00
II	Intercrop								
1	Ragi + field bean	6.00	3.47	14.00	25.43	8.50	8.33	3.50	9.33
2	Ragi + pigeon pea + Field bean	26.00	15.04	4.50	8.17	25.75	25.25	15.25	40.67
III	Perennials								
1	Mango	71.00	41.07	8.50	15.44	16.25	15.93	2.00	5.33
2	Silver oak	3.13	1.81	0.00	0.00	0.00	0.00	0.00	0.00
IV	GCA (acres)	172.88	100.00	55.05	100.00	102.00	100.00	37.50	100.00
V	NCA (acres)	101.00		40.05		60.00		28.00	
VI	CI (%)	170.29		137.45		171.03		133.92	
VI	Simpson's Index	0.85		0.77		0.84		0.79	

Note: GCA- Gross Cropped Area, NCA-Net Cropped Area, CI- Cropping Intensity, PMKSY -WD-Pradhan Mantri Krishi Sinchayi Yojana-watershed development KfW-WP- Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Whereas in non-watershed area ragi was grown as a main field crop with 36.42 per cent and ragi intercrop with field bean 25.43 per cent of the total cultivated area. Mango was with 15.44 per cent of GCA and CI was 137.45 per cent in NWA. Simpsons index is higher in WA (0.85) than NWA (0.77) which indicates more crop diversity in WA compared to NWA because of increased water availability and improved soil fertility due to watershed activities in the study area (Table 4.6). Under KfW-WP, ragi, tomato and groundnut were the major sole crops taken with 14.22, 11.27 and 12.01 per cent GCA respectively and mango as a perennial crop with 16.25 per cent of GCA. Pigeon pea and field bean intercrop with ragi with 25.25 per cent of GCA and Cropping Intensity was 171.03 per cent in WA. Similarly, in non-watershed area ragi was grown as a main field crop with 12.67 per cent and ragi intercrop with field bean and pigeon pea with 40.67 per cent of GCA. Mango was grown as a perennial crop with 5.33 per cent of GCA and CI was 133.92 per cent (Table 4.6). The cropping intensity is higher in both watershed project areas compared to non-watershed area due to increased water availability upon watershed intervention favored higher area under cultivation. The study conducted by Nirankusha (2015) and Palinisami *et al.* (2011) also revealed similar results where cropping pattern and cropping intensity were influenced by watershed interventions which resulted in improved soil health and moisture holding capacity of soils. Simpsons index is higher in WA (0.84) than NWA (0.79) which indicates more crop diversification in WA compared to NWA. The hypothesis made “The watershed interventions had positive impact on land use and cropping pattern” is accepted.

4.4 Production and productivity of major crops under different watershed project

Production and productivity of major crops were analyzed in watershed and non-watershed areas to assess the impact of watershed activities on yield of crops. Crops which were grown by majority of farmers and commonly under both watershed and non-watershed area were considered for comparison.

4.4.1 Production and productivity of crops cultivated under PMKSY-WD

Crop wise production and productivity of sample farmers under PMKSY-WD is presented in table 4.7.

Table 4.7: Production and productivity of major crops cultivated by beneficiaries and non-beneficiary sample farmers in PMKSY-WD

Sl. No.	Crops	Watershed area			Non-watershed area			Difference in productivity (quintals/ac)	Difference in productivity percentage (%)
		Total area (acre)	Production (quintals)	Productivity (quintals/acre)	Total area (acre)	Production (quintals)	Productivity (quintals/ac)		
1	Ragi	37.00	378.14	10.22	20.05	134.93	6.73	3.48	34.09
2	Tomato	11.50	1469.93	127.82	5.50	643.11	116.93	10.89	8.51
3	Horse gram	5.00	34.90	6.98	1.50	6.75	4.50	2.48	35.53
4	Mango	71.00	3288.72	46.32	8.50	272.34	32.04	14.32	30.92

Table 4.8: Production and productivity of major crops cultivated by beneficiary and non-beneficiary sample farmers in KfW-WP

Sl. No.	Crops	Watershed area			Non-watershed area			Difference in productivity (quintals/ac)	Difference in productivity percentage (%)
		Total area (acre)	Production (quintals)	Productivity (quintals/acre)	Total area (acre)	Production (quintals)	Productivity (quintals/ac)		
1	Ragi	14.50	149.93	10.34	4.75	33.25	7.00	3.34	32.33
2	Tomato	11.50	1383.75	120.32	7.50	817.87	109.05	11.27	9.36
3	Paddy	2.00	35.00	17.50	1.50	15.43	10.29	7.21	41.22
4	Ground nut	12.25	140.88	11.50	2.00	17.14	8.57	2.93	25.47
5	Horse gram	2.00	15.00	7.50	1.00	5.00	5.00	2.50	33.33
6	Mango	16.25	777.40	47.84	2.00	62.92	31.46	16.38	34.24

Production of major crops cultivated in the WA observed higher compared to NWA. The productivity of major crops cultivated was higher in WA compared to NWA and difference in productivity was higher in Mango with 14.32 quintals/ac followed by tomato (10.89 quintals/ac). The production and productivity of mango was higher in WA when compare to NWA due to distribution of mango seedlings in the WA with percentage change in productivity 30.92. There is considerable increase in productivity of all the crops where higher per cent increase was in horse gram and ragi with 35.53 and 34.09 per cent respectively, due to watershed interventions like farm pond, trench cum bund, check dam and nala bund which increased water availability and further increased yield in the WA (Table.4.7). The study conducted Thakur *et al.* (2014) reported that on an average production and productivity of different crops was found to be increased after the implementation of project.

4.5.2 Production and productivity of crops cultivated under KfW watershed project.

Production of major crops cultivated in the WA observed higher compared to NWA. The productivity of major crops cultivated was higher in WA compared to NWA and difference in productivity was higher in Mango with 16.38 quintals/ac followed by tomato (11.27 quintals/ac). The percentage difference in productivity of mango and ragi was observed with 34.24 and 32.33 respectively compared to NWA due to improved seeds of ragi and pigeon pea which were distributed by the implementing agency. There is considerable percentage increase in productivity of crops, like paddy, mango and horse gram with 41.22, 39.06 and 33.33 respectively due to watershed activities like tank -silt application, Vermi-compost pits, Compost pit, preparation of Jeevamrutha and Panchagavya in the WA which improved soil fertility and contributed for higher crop yield (Table 4.8). The results are similar to study taken by Gaurav Chaudhary (2013) where the production and productivity of major crops was higher in beneficiaries compared to non-beneficiaries' farm because of various treatments taken under the WDP, the availability of moisture has improved which ultimately increased productivity of major crops. Hence, the hypothesis made "Production and Productivity of major crops cultivated under watershed area are higher than in the non-watershed area" is accepted.

4.5 Cost, returns and income of sample farmers under both watershed projects

4.5.1 Cost and returns of sample farmers under both watershed projects

In estimation of cost and returns of crops on per acre basis, the cost on various labour and material items like human labour, bullock labour, machine labour, seeds, farm yard manure, chemical and bio fertilizers, plant protection chemical, interest on working capital, marketing costs and the managerial costs including imputed value of owned resources were considered as variable costs. The costs on rental value of land, land revenue, depreciation on various machineries and equipment and interest on fixed capital were considered as a part of fixed costs.

4.5.1.1 Cost and returns of major crops per acre under PMKSY-WD

The total cost of cultivation per acre was found to be higher in WA compared to NWA and it was higher in tomato crop with ₹ 83977 and ₹ 77545 respectively and it was lower for horse gram with ₹ 23164 and ₹ 20641 respectively. The gross returns per acre was also observed higher in WA compared NWA and it was higher in tomato with ₹ 198627/acre ₹ 142623/acre respectively. The net returns was found to be higher in WA compared to NWA and was observed higher tomato ₹ 114650 and ₹ 65078 respectively was lower in horse gram ₹ 10102 and ₹ 4866 respectively (Table 4.9). These results are in line with findings of Nirankusha (2015) where he reported that per acre respective crop gross and net return obtained by watershed farmers was substantially higher than that of non-watershed farmers this was because of soil and water conservation activities which enhanced yield of crops.

When net returns per rupee of expenditure was estimated to be higher in WA when compared to NWA and was observed higher in tomato (₹ 2.37 and ₹ 1.84 respectively). and lower in horse gram (₹ 1.41 and ₹ 1.24 respectively) because of improved yield by watershed interventions which further increased net returns of crops.

Table 4.9: Cost and returns of major crops cultivated by beneficiary and non-beneficiary sample farmers in PMKSY-WD**(₹/acre)**

Sl. No.	Crop	Ragi+ Field bean		Ragi+ Field bean+ pigeon pea		Ragi		Horse gram		Tomato	
		B	N-B	B	N-B	B	N-B	B	N-B	B	N-B
1	TVC	20566	18696	24492	21813	19103	17223	13924	12270	64077	60079
2	TFC	8490	7797	8490	7797	8490	7797	8490	7797	8490	7797
3	Marketing cost	1369	1168	1570	1156	1243	920	750	575	11411	9670
4	TC	30425	27660	34552	30764	28836	25940	23164	20641	83977	77545
5	GR	45416	35187	50881	38752	41040	32651	33266	25507	198627	142623
6	NR	14991	7237	16329	7989	12204	6712	10102	4866	114650	65078
7	Returns per rupee of expenditure	1.49	1.27	1.47	1.26	1.42	1.26	1.41	1.24	2.37	1.84

Note: B- Beneficiary, N-B – Non-beneficiary, TVC –Total variable cost, TFC- Total fixed cost, TC- Total cost, GR- Gross returns, NR- Net returns.

4.6.1.2 Cost and returns of major crops per acre under KfW-WP

Table 4.10 shows the Cost and returns of major crops per acre under KfW WP where the total cost of cultivation per acre was found to be higher in tomato crop with ₹ 78341 and ₹ 70612 respectively, followed by groundnut (₹ 35607 and ₹ 30778 respectively) and it was lower for ragi ₹ 28214 and ₹ 26488 respectively. Total cost of all corresponding crops was low in KfW-WP compared to PMKSY-WD because of soil fertility enhancing watershed activities like tank slit application, Vermicompost pits, Compost pit, preparation of Jeevamrutha and Panchagavya taken by KfW WP reduced the use of chemical fertilizer and plant protection chemicals. The gross returns per acre of major crops was observed higher in WA compared to NWA and it was higher in tomato with ₹ 191465 and ₹ 141622 respectively and lower in ragi (₹ 42036 and ₹ 34125). The net returns of major crops cultivated was higher in WA compared to NWA and it was higher in ₹ 113123 and ₹ 71011 respectively lower in ragi (₹ 13485 and ₹ 7648 respectively) (Table 4.10). Similar results were observed in the study taken by Nirankusha (2015). Hence, the hypothesis “Net returns from major crops cultivated in watershed area is higher than the non-watershed area” is accepted.

When net returns per rupee of expenditure was estimated in KfW WP, it was observed higher in tomato with ₹ 2.44 and ₹ 2.01 respectively and lower in ragi (₹ 1.37 and ₹ 1.29 respectively). Similar results were observed by Nirankusha (2015) where he reported higher profitability of per rupee of cost incurred in major crops of watershed area. Thus the hypothesis “Net returns of crops under cultivation is higher in watershed area than non-watershed area” is accepted.

Comparison of cost and returns of mango crop is depicted in table 4.11, where total variable and total cost of beneficiary under watershed activity was higher compared to non-beneficiary because watershed activities increased water availability which further increased use of labour for harvesting, pesticide spraying and even increased marketing cost. Net returns realized was higher in beneficiary farm (₹ 72406 and ₹ 76610) compared to non-beneficiary (₹ 35040 and ₹ 29858) under both PMKSY-WD and KfW watershed projects respectively, this was due to increased water availability and soil fertility due to watershed interventions which further increased net returns (Table 4.11).

Table 4.10: Cost and returns of major crops cultivated by beneficiary and non-beneficiary sample farmers in KfW-WP

(₹/acre)

Sl. No.	Crop	Ragi+ Field bean		Ragi+ Field bean+ pigeon pea		Ragi		Tomato		Ground nut		Paddy	
		B	N-B	B	N-B	B	N-B	B	N-B	B	N-B	B	N-B
1	TVC	20722	18487	20227	19920	19665	18261	60449	54945	26247	22461	21913	19563
2	TFC	7310	6906	7310	6906	7310	6906	7310	6906	7310	6906	7310	6906
3	marketing cost	1415	1329	1422	1388	1565	1320	10582	8760	2050	1411	1916	1109
4	TC	29448	26722	29959	28214	28551	26488	78341	70612	35607	30778	31140	27579
5	GR	45395	34805	46154	38726	42036	34125	191465	141622	51500	42444	45387	38013
6	NR	15947	8083	17195	10512	13485	7638	113123	71011	15892	11666	14247	10436
7	Returns per rupee of expenditure	1.54	1.30	1.59	1.37	1.37	1.29	2.44	2.01	1.45	1.38	1.46	1.38

Note: B- Beneficiary, N-B – Non-beneficiary, TVC –Total variable cost, TFC- Total fixed cost, TC- Total cost, GR- Gross returns, NR- Net returns.

Table 4.11: Comparison of cost and returns of mango in watershed and non-watershed area
(₹ /acre)

Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
1	Fixed cost	8490.04	7796.54	7310.83	6906.95
2	Amortized establishment cost	5618.46	6628.93	5871.08	6881.55
3	Variable cost	21388.14	20845.43	21559.06	19741.76
4	Marketing cost	7015.49	6372.00	8784.00	7493.33
5	Cost of cultivation including marketing cost	42511.99	41642.47	43524.91	41023.83
6	Yield (quintals)	46.32	32.00	47.84	31.46
7	Price per quintal	2485.00	2386.00	2515.00	2244.00
8	Gross returns	109299.61	70053.77	114263.97	64000.88
9	Net returns	72406.11	35040.64	76610.46	29858.60
10	Returns per rupee of expenditure	2.57	1.68	2.63	1.56

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW-Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project.

4.6.2 Annual income of sample farmers under PMKSY-WD and KfW watershed projects

Income of the sample farmers from different watershed projects was estimated by adding net returns per acre of all the crop and average livestock income and off-farm income of sample farmers in study area for 2018-19.

4.6.2.1 Annual income of sample farmers under PMKSY-WD in the study area

Table 4.12 depicts Annual Income of sample farmers under PMKSY-WD. It was observed that net returns for all crop was higher in watershed area (₹ 240682) when compare to non-watershed area (₹ 126922) with difference in income of (₹ 113759) which is 47.27 per cent higher than NWA this is due to soil and water conservation activities like farm pond, trench cum bund, check dam and nala bund increased soil fertility which further enhanced crop yield and farm income. Similar findings were reported by Nirankush (2015) (Table 4.12).

Table 4.12: Average annual Income of beneficiary and non-beneficiary farmers under PMKSY-WD (₹/farm)

Sl. No.	Income source	PMKSY-WD		Difference in income	Percentage change in income (%)
		Beneficiaries Income	Non-beneficiaries Income		
I	Income from crops	240682.11	126922.64	113759.5	47.27
II	Livestock income	32967.06	27465.92	5501.14	16.69
III	Off-farm and Non-farm income	10358.25	16354.86	-5996.61	-34.21
IV	Total income	284007.42	170743.42	113264	39.88

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development

Annual income from Livestock per farm was 16.69 per cent higher in watershed area (₹ 32967.06) than the non-watershed area (₹ 27465.92) with the difference in income of (₹ 5501.14) this was due to animal health camps conducted during the implementation of watershed project along with the supply of annual and perennial fodder kits, construction

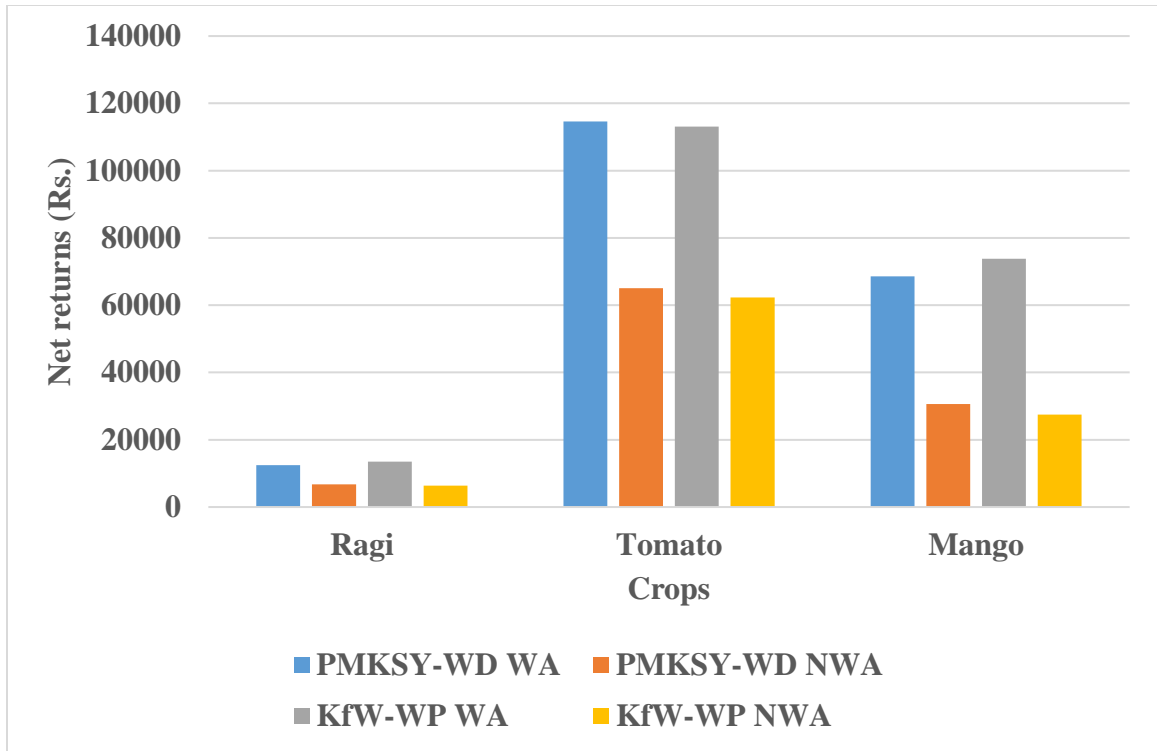


Fig. 4.1: Net returns of major crops in cultivated in PMKSY-WD and KfW-WP

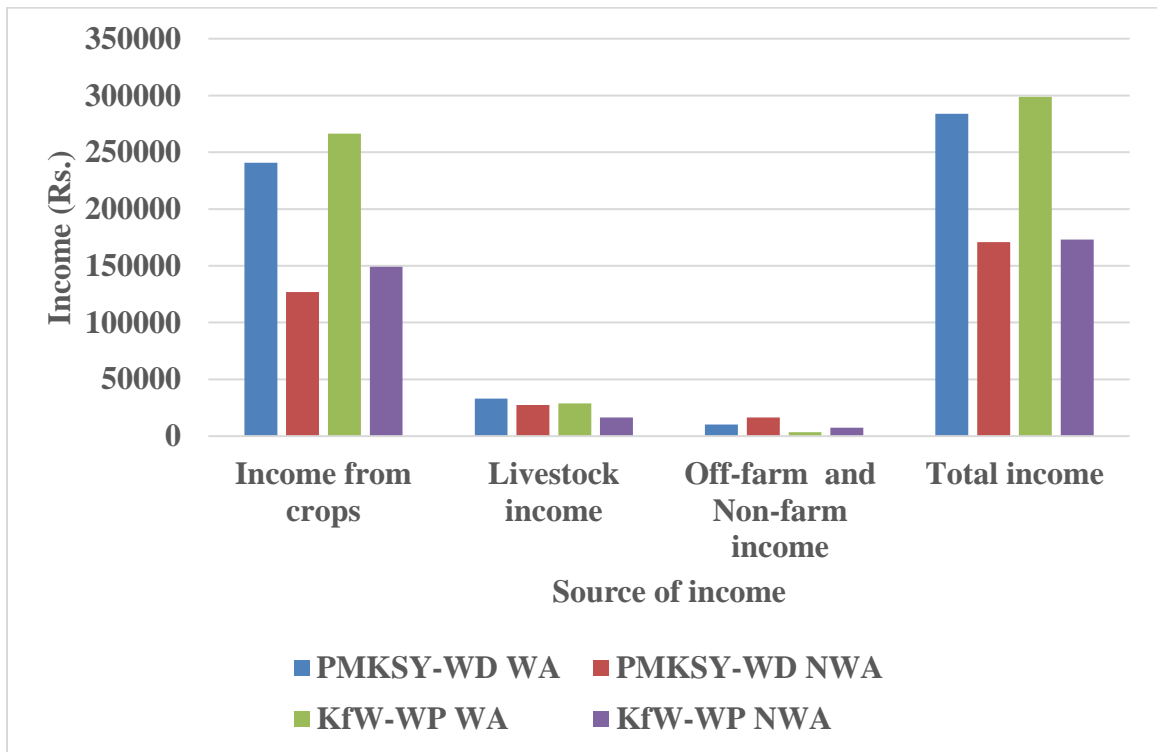


Fig. 4.2: Annual income of sample farmers in PMKSY-WD and KfW-WP

of cattle pond, cattle and sheep sheds helped farmers in maintenance of livestock in WA. (Table 4.12) similar findings were observed in the studies by Nirankush (2015) and Gaurav (2013).

The off-farm and Non-farm income of non-watershed area was high with ₹ 16354.86 which is 34.21 per cent higher than watershed area with ₹ 10358.25 income. This was because in non-watershed area the farm income is less hence people tends to do other work for their source of income. The total income of watershed area (₹ 284007) was 39.88per cent higher than non-watershed area (₹ 170743) due to all supplemented activities done under watershed project which enhance the livelihood of people.

Table 4.13 depicts annual income of sample farmers under KfW watershed area. It was observed that net returns for all crop was higher in watershed area (₹ 266499) compared to non-watershed area (₹ 149204) with difference in income of ₹ 117294 which is 44.01per cent higher than NWA.

Table 4.13: Average annual income of beneficiary and non-beneficiary under KfW-WP (₹ /farm)

Sl. No.	Income source	KfW-WP		Difference in income	Percentage change in income (%)
		Beneficiaries income	Non-beneficiaries income		
I	Income from crops	266499.46	149204.6	117294.86	44.01
II	Livestock income	28781.46	16521.43	12260.03	42.64
III	Off-farm and Non-farm income	3574.43	7463.27	-3888.84	52.11
IV	Total income	298855.35	173189.3	125666.05	42.05

Note: KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) watershed project

Annual income from Livestock per farm was 42.64 per cent higher in watershed area (₹ 28781.46) than the non-watershed area (₹ 16521.43) with the difference in income of ₹ 12260.03 due to promotion of fodder production programme by supplying of fodder

seeds, construction of cattle pond and promoting Sheep rearing, Backyard Poultry by supply of sheep's and poultry birds, distribution of Backyard Poultry sheds. similar findings were observed in the studies by Nirankush (2015) and Gourav (2013).

The Off-farm and Non-farm income of non-watershed area was higher with ₹ 7463.27 which was 52.11 per cent higher than watershed area with ₹ 7463.27 this was because in non-watershed area the farm income is lower than WA and people tending to do other work for their source of income. The total income of watershed area (₹ 298855) was 42.05 per cent higher than non-watershed area (₹ 173189) due to all supplemented activities done under watershed project which enhance the livelihood of people in both the projects. Annual income of beneficiaries of watershed area is more compared to non-watershed area (Fig.2). Hence the hypothesis “Annual income derived from watershed beneficiaries is higher than non-beneficiary” is accepted.

4.7 Resource use efficiency of ragi production in watershed projects

Cobb-Douglas production function was used to assess the resource use efficiency in the production of the major crop ragi among the beneficiaries and non-beneficiaries of watershed project, as ragi is major crop in study area and cultivated by farmers in both watershed and non-watershed area.

4.6.1 Resource use efficiency of PMKSY-WD

Watershed beneficiary farmers: The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) was less than one for area (0.291), seed (0.722), fertilizer (0.805) and FYM (0.431). While, machine labour (2.214) and human labour (1.044) is more than one. The MVP to MFC ratio for area, seed, fertilizer and FYM were less than one, indicating that these resources are over utilized thus there is a scope to reduce the use of these inputs to increase the profitability. Ratio of MVP to MFC was greater than one for human labour and machine labour indicating underutilization of these resources indicating that there is a scope to increase the use of these resources to increase the profitability. The regression coefficients fertilizer (0.376) FYM (0.642) and human labour (0.172) was significant at

five per cent level of significance and that of area (0.865) was significant at one per cent level of significance (Table 4.14).

Non-beneficiary farmers: The ratio of MVP to MFC was less than one for FYM (0.437) and Machine labour (0.409) indicating that, expenditure on these resources should be reduced in order to make optimum allocation of resources whereas, MVP to MFC ratio for area (1.050), seed (4.317), fertilizer (2.678) and machine labour (1.722) is greater than one indicating that, use of these resources should be increased. The regression coefficient value of seed and fertilizer was significant at five per cent level of significance.

4.7.2 Resource use efficiency of KfW WP

Watershed beneficiary farmers: The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) was less than one for seed (0.849), fertilizer (0.454) and machine labour (0.303). While, FYM (1.092), human labour (1.892) and area (1.461) is more than one. These ratios indicate that, for every rupee spent on these inputs would give return of 1.461 (land), 0.849 (seeds), 0.303 (machine labour), 0.454 (fertilizer), 1.092 (FYM) and 1.892 (human labour). The MVP to MFC ratio for seed, fertilizer and human labour were less than one, indicating that these resources are over utilized thus there is a scope to reduce the use of these inputs to increase the profitability. Ratio of MVP to MFC was greater than one for area, FYM and machine labour indicating underutilization of these resources indicating that there is a scope to increase the use of these resources to increase the profitability. The regression coefficients value for area (0.606), seed (2.12) and fertilizer (0.194) was significant at five per cent level of significance (Table 4.14).

Non-beneficiary farmers: The ratio of MVP to MFC was less than one for FYM (0.396) and area (0.901) indicating that, expenditure on these resources should be reduced in order to make optimum allocation of resources whereas, MVP to MFC ratio for human labour (1.219), seed (3.296), fertilizer (4.644) and machine labour (3.526) is greater than one indicating that, expenditure on human labour should be increased. The regression coefficient value of seed and area was significant at five per cent and one per cent level of significance respectively (Table 4.14).

Table 4.14: Resource use efficiency of Ragi production in both watershed projects

Particulars	PMKSY-WD				KfW-WP			
	Beneficiary		Non-beneficiary		Beneficiary		Non-beneficiary	
	b	MVP/MFC	b	MVP/MFC	b	MVP/MFC	b	MVP/MFC
Area (acres)	0.865** (5.09)	0.291	0.607 (0.69)	1.050	0.606* (3.40)	1.461	0.477** (4.38)	0.901
Human labours (man days)	0.177 (0.99)	1.044	0.353 (1.38)	0.409	0.144 (1.40)	1.892	0.132 (0.03)	1.219
Machine labour (hours)	0.565 (0.07)	2.214	0.565 (0.92)	1.722	0.289 (1.69)	0.303	0.903 (1.10)	3.526
Seed (kg)	0.018 (0.54)	0.722	0.207* (2.11)	4.317	0.020* (2.12)	0.849	0.172* (2.33)	3.296
Fertilizer (kg)	0.376* (2.37)	0.805	0.159* (2.02)	2.678	0.194* (2.51)	0.454	0.602 (1.36)	4.644
FYM (ton)	0.642* (2.38)	0.431	0.219 (1.65)	0.437	0.175 (1.02)	1.092	0.301 (1.20)	0.396
R ²	0.73		0.74		0.76		0.70	

Note: 1. ** indicates Significant at one per cent level of significance and * indicates significant at five per cent level of significance, b – regression coefficient, MVP – Marginal value of product, MFC – Marginal factor cost, figures in the parenthesis indicated t-value of regression coefficient.

4.8 Constraints faced by implementing agency and beneficiaries in project implementation

With the opinion from sample farmers and relative studies, to analyze constraints faced by sample farmers and implementers six constraints were listed for both the watershed projects. Garrett's ranking technique was used to calculate score and constraints were ranked according ascending order of score.

4.8.1 Constraints faced by beneficiaries in project implementation.

Responses were taken from sample farmers in the study area, where Lack of awareness about benefits of watershed technology and Obstruction for cultural operation by water harvesting structure were first and second major constraint for PMKSY-WD with score 71.37 and 64.87 respectively. Whereas Obstruction for cultural operation by water harvesting structure of the farmers was ranked first with score 73.37 followed by lack of awareness about benefits of watershed technology with score 63.93 in KfW watershed project. High Maintenance cost of structures and Uncertain rainfall were ranked third and fourth in both PMKSY-WD and KfW watershed area. Small and fragmented nature of holdings and Groupism and village politics and ranked least with score 47.70 and 33.97 score respectively in PMKSY-WD and 42.07 and 25.33 score respectively in KfW-WP respectively (Table 4.15). Hence the hypothesis made "Lack of awareness about the watershed technology and obstruction for cultural operation by soil and water conservation structures are the major constraints faced by beneficiaries during watershed project implementation" is accepted.

4.8.2 Constraints faced by implementing agency in project implementation.

Constraints faced by implementing agency in project implementation was taken from both the implementers in the study area, where Poor participation by the farmers during training programmes and Political interference ranked first and second for PMKSY-WD. Whereas Political interference ranked first followed by Poor participation by the farmers during training programmes in KfW-WP. Failure to recognize advantages of watershed activities by farmers and Small and fragmented nature of holdings were third and fourth in both PMKSY-WD and KfW watershed area. Delay in releasing the

sanctioned amount ranked least in the PMKSY-WD and KfW watershed project in the study area. Thus the hypothesis made “Poor participation by the farmers in training programmes is the major constraint faced by the implementing agency during implementation of the watershed project” is accepted.

Table 4.15: Constraints faced by beneficiaries during implementation of the watershed projects

Sl. No.	Constraints faced by farmers	PMKSY-WD		KfW-WP	
		Score	Rank	Score	Rank
1	Lack of awareness about benefits of watershed technology	71.37	I	63.93	II
2	Obstruction for cultural operation by water harvesting structure	64.87	II	73.37	I
3	High Maintenance cost of water harvesting structures	59.47	III	60.03	III
4	Uncertain rainfall	53.40	IV	54.43	IV
5	Small and fragmented nature of holdings	47.70	V	42.07	V
6	Groupism and village politics	33.97	VI	25.33	VI

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) watershed project

Table 4.16: Constraints faced by implementing agencies in implementing watershed project

Sl. No.	Implementers	PMKSY-WD	KfW-WP
1	Poor participation by the farmers during training programmes	I	I
2	Political interference	II	II
3	Failure to recognize advantages of watershed activities by farmers	III	III
4	Small and fragmented nature of holdings	IV	V
5	Limited availability of labour	V	IV
6	Delay in releasing the sanctioned amount	VI	VI

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development, KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) watershed project.

V SUMMARY AND CONCLUSION

A concise summary of the research, along with the salient findings, is presented in this chapter. Based on the conclusions drawn from the study, policy recommendations are suggested.

5.1 Introduction

Water is an essential natural resource that needs to be conserved, protected and judiciously used for all needs including food security, energy production, and industrial establishments. The availability of water, temporally and spatially is dependent on the precipitation. In India, 65 per cent of the land under cultivation is dependent on rainfall. With the changing global climate, the number of rainy days has decreased and feeding growing population is the biggest challenge in the country. Watershed is one of those methods that conserves soil health and improves it and helps to achieve food security. This approach has become the corner stone for sustainable development of agriculture sector to achieve food and water security. Considering the significance of watershed on rural livelihood, the present study is taken on two watershed projects PMKSY-WD and KfW in Srinivaspur taluk of Kolar district. This study gives ample scope for and perfect picture of the economically efficient and sustainability of watershed activities in watershed area on soil health, water availability and rural livelihood over non-watershed area. Following mentioned points were considered as main objectives of the study:

Objectives of study are:

1. To document the activities taken up under PMKSY-WD and KfW watershed projects in the study area.
2. To analyse the economic benefits derived from PMKSY-WD and KfW watershed projects in the study area.
3. To identify the major constraints faced by the implementing agency and beneficiaries during implementation of the watershed projects in the study area.

5.2 Sampling

Sampling was done purposively selected Yeldur nala sub watershed project implemented under PMKSY-WD and Mudimadagu Watershed project implemented under KfW watershed projects in -Srinivaspur taluk of Kolar district. A total of 100 sample farmers, comprising 50 farmers from each projects were selected, of which 30 farmers were the beneficiaries from both watershed projects and remaining 20 sample farmers were from non-watershed area (control).

5.3 Data source

To achieve the objectives of this study, the required primary data were collected from the respondents in the study area chosen. The primary data on general information of the farmer, farm inventory, cropping pattern, watershed activities undergone were collected with the help of pre-tested schedules using personal interview method. Secondary data regarding project implementation, activities taken under project, functioning of project, maintenance and cost incurred were collected from both PMKSY-WD and KfW watershed officials.

5.4 Analytical tools used for the study

Different analytical tools such as Descriptive statistics, Crop diversity index, resource use efficiency and Garrett's ranking were the tools used in this study to analyze the data and infer the results.

Major findings of the study

Demographics

Among the sample farmers in PMKSY WP majority per cent of farmers belonged to old age group (>50 years) i.e. 63.33 per cent in WA, similarly in NWA 55 per cent of farmers belonged to old age group. In KfW WP 53.33 per cent of farmers in WA and 40 per cent of farmers in NWA belonged to old age groups. Very few young age group farmers were found among sample farmers. More number of joint families were found in PMKSY-WD area compared to non-watershed area. Majority of sample farmers in both projects had

education up to primary and high school very few among sample farmers attained higher education i.e. PUC and above.

With regarding to land holdings majority of sample farmers in PMKSY-WD area had medium land holding with 33.33 per cent. Whereas in NWA 70 per cent of farmers had marginal land. In KfW WP majority of farmers in both WA and NWA had marginal land holding with 70 and 75 per cent respectively. Total average land holding and average land under irrigation was higher in WA 3.36 acre and 1.15 acre respectively than NWA 2.02 acre and 0.4acres respectively in PMKSY-WD. Similarly, in KfW WP average land holding and average irrigated land were higher in WA with 1.86 acre and 1.15 acre respectively than NWA 1.40 acre and 0.35 acre respectively.

Assets created under both PMKSY-WD and KfW WP

Among the sample farmers in PMKSY-WD 29 farmers were benefited with trench cum bund, and eight farmers with farm pond and one with field bund. Whereas in KfW WP 10 and benefited with farm pond, seven with trench cum bund, and two sample farmers with field bund and boulder bund. 27 check dam, fourcattle pond and four nala bund were constructed under common property in PMKSY-WD whereas three recharge pit and five cattle pond were constructed under KfW WP. other than soil and water conservation activities majority of sample farmers were benefited with Dry land horticulture, agroforestry, animal health camp and fodder production under PMKSY-WD. Whereas under KfW WP majority of sample farmers were benefited by fodder production kits, ragi seeds distribution, backyard poultry and dry land horticulture activities. More number of soil and water conservation activities under watershed were taken in PMKSY-WD than KfW WP.

Farm inventory

About 20 per cent of the sample farmers owned tractor, 46 per cent owned sprayers and 35 per cent owned bore well in PMKSY-WD which was comparatively higher than NWA where 15 per cent, 30 per cent and 15 per cent of sample farmers owned tractor, sprayer and bore well respectively. In KfW WP, tractors, sprayers and bore well were owned by 6.66 per cent, 36.66 per cent and 33.36 per cent of sample farmers respectively

in WA which is quite higher than NWA where only 20 per cent and 25 per cent of farmers had sprayers and bore well respectively and no one owned tractor.

Livestock inventory

In PMKSY-WD, majority of farmers in WA owned local cows with 30 per cent and very few owned buffalo, bullock pairs, sheep, and poultry. Similarly, 30 per cent farmers in NWA owned local cows, and very few of them owned bullock pairs, buffalo and sheep. Where as in KfW WP 70 per cent of farmers had poultry, 53.33 per cent had cows, 36.66 per cent had sheep and very few of them had bullock pair, calves and goats in WA whereas in NWA majority of sample farmers had local cow with 40 per cent, and 35 per cent of farmers owned poultry. KfW WP beneficiaries had more number of livestock compared to PMKSY-WD beneficiaries.

Crop diversification

More crop diversity was found in watershed area of both PMKSY-WD and KfW watershed areas with Simpson's index value 0.85 and 0.84 respectively compared to NWA with Simpson's index value 0.77 and 0.79 in both PMKSY-WD and KfW watershed projects respectively.

Production and productivity

Production and productivity of major crops cultivated was observed higher in WA compared NWA in PMKSY-WD. Percentage increase in productivity of crops in WA over NWA was observed higher in horse gram with 35.33 per cent followed by Ragi 34.09 per cent and mango 30.92 per cent. Similarly, in KfW WP production and productivity of major crops cultivated was found higher in WA than NWA. The percentage increase in productivity of crops cultivated in WA over NWA was higher in paddy with 41.22 per cent followed by mango 34.24 per cent and ragi 32.33 per cent.

Cost and returns of major crops

Total variable cost and total cost per acre was observed higher in tomato with ₹ 64077 and ₹ 83977 respectively in PMKSY-WD. Similarly, in NWA total variable cost

and total cost were highest in tomato. Net returns of all the major crops were higher in WA than NWA, and it was higher in tomato with ₹ 114650. Returns per rupee of expenditure was also found higher in WA than in NWA, and it was higher in tomato with ₹ 2.37 and ₹ 1.84 over expenditure for beneficiary and non-beneficiary farms respectively.

Similarly, in KfW WP total variable cost, and total cost were found higher in tomato in both WA and NWA. Net returns of all the major crops were found higher in WA than NWA, and it was higher in tomato with ₹ 113124. Returns per rupee of expenditure was also found higher in WA than in NWA, and it was higher in tomato with ₹ 2.44 and ₹ 2.01 over expenditure for beneficiary and non-beneficiary respectively. Increased net returns of WA than NWA are due to improved soil health and water availability by watershed activities.

Income of the sample farmers

Annual income per farm was found higher in watershed area than non-watershed area in both PMKSY-WD and KfW WP that is ₹ 284007 and ₹ 298855 respectively than NWA in both the projects ₹ 170743.42 and ₹ 173189.32 respectively. This increase in WA income over NWA is due to enhanced yield and income by implementing soil and water conservation, soil health improvement, and income generating activities by watershed projects.

Resource use efficiency of crop under both watershed projects

The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of beneficiaries under PMKSY-WD was less than one for area (0.291), seed (0.722), fertilizer (0.805) and FYM (0.431) indicating that these resources are over utilized thus there is a scope to reduce the use of these inputs. While, machine labour (2.214) and human labour (1.044) is more than one indicating the underutilization of these resources and there is a scope to increase the use of these resources to increase the profitability.

In KfW WP the ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) of beneficiaries was less than one for FYM (0.437) and Machine labour 0.409) indicating that, expenditure on these resources should be reduced in order to make optimum

allocation of resources whereas, MVP to MFC ratio for area (1.050), seed (4.317), fertilizer (2.678) and machine labour (1.722) is greater than one indicating that underutilization of these resources and there is a scope to increase the use of these resources to increase the profitability.

Constraints faced by implementing agency and beneficiaries in the implementing watershed project

As responded by sample farmers, the major constraints faced by farmer beneficiary in the implementation of the watershed project Lack of awareness about benefits of watershed technology and Obstruction for cultural operation by soil and water conservation structures in both PMKSY-WD and KfW WP. Poor participation by the farmers during training programmes and Political interference were the major constraints faced by implementing agency in both PMKSY-WD and KfW WP.

Policy recommendations

The main purpose of this study was to assess the farmer's economic benefits in the watershed and compare the same with non-watershed area. Based on the results and grass root reality, this study recommends the following policy implications.

- It is evident from the results that income generating activities viz., sheep and poultry rearing under KfW watershed project augmented farmers income, hence income generating activities need to be encouraged by implementing agency.
- There is lack or no maintenance of soil and water conservation activities like trench cum bund, field bund and boulder bund by beneficiaries in watershed area. In this regard effort should be initiated by watershed development department to form watershed farmer's association to undertake maintenance work of the structures.
- Majority of beneficiaries have complained about the obstruction for cultural operations by soil and water conservation structures, which is a major constraint in implementation of watershed activities. Hence, watershed development researchers should develop improved practices which will overcome these problems.

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APPENDICES

Appendix I: List of activities and their cost in the Yeldur nala sub watershed project (PMKSY-WD) and Mudimadagu watershed project (KfW-WP)

Sl. No.	Activities	Units	PMKSY-WD		KfW-WP		
			Physical	Cost (₹ lakh)	Physical	Cost (₹ lakh)	
1	Field Bund	Cum	2748.64	284.79	935.26	0.68	
2	Boulder Bund	Cum	0.00		41.88	0.21	
3	Check dam	Cum	27.00		0.00	0.00	
4	Farm Pond	No.	51.00		10.00	1.59	
5	Cattle Pond	No.	4.00		5.00	1.01	
6	Nala bund	No.	4.00		0.00	0.00	
7	Diversion channel	Meter	0.00		168.94	0.10	
8	Percolation tank	No.	1.00		0.00	0.00	
9	Dry land horticulture (Mango seedlings)	No.	65846.00	15.53	1783.00	1.48	
10	Agro Forestry (silver oak seedling)	No.	49989.00	46.61	0.00	0.00	
11	Common land plantation	No.	0.00	0.00	7000.00	0.50	
12	Tank silt application	No.	0.00	0.00	164.00	3.99	
13	Vermicompost	No.	0.00	0.00	10.00	1.12	
14	Green Manure	No. of farmers	0.00	0.00	250.00	1.35	
15	Compost pit	No.	0.00	0.00	89.00	1.31	
16	Application of zinc, boron, sulphate (1 acre)	No. of farmers	0.00	0.00	350.00	1.28	
17	Agriculture Promotion in ragi	No.	0.00	0.00	151.00	0.66	
18	Sheep rearing	No.	0.00	0.00	58.00	4.48	
19	Backyard Poultry	No.	0.00	0.00	120.00	3.57	
20	Backyard Poultry (shed)	No.	0.00	0.00	56.00	1.74	
21	Green Fodder promotion	No.	0.00	0.00	3.00	0.47	
22	Kitchen gardening	No.	0.00	0.00	250.00	0.53	
23	Recharge pit	No.	0.00	0.00	11.00	1.99	
24	Training and capacity building	No of trainings			39.00	14.26	
	Management, supervision and exposure visits		0.00	0.00			
25	Animal health camp	No.	24.00	54.45	0.00	0.00	
26	Animal Travis	No.	4.00		0.00	0.00	
27	Cattle shed	No.	3.00		0.00	0.00	
28	Fodder cutter	No.	20.00		0.00	0.00	
29	Vegetables mini kit	No.	800.00		0.00	0.00	
30	Fodder production (jowar)	No	410.00		100.00	0.60	
31	Saretra hemata seeds distribution	No	673.00		0.00	0.00	
32	Cost on income generating activities (training)	-	-		25.00	0.00	0.00
33	Other costs (bank expenditure)	-	-		0.27	0.00	0.00
	Total cost				426.61		42.32

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau ("credit institute for reconstruction") Watershed Project
Source: PMKSY-WD, 2018 and KfW, 2019

Appendix II: Cost and returns of ragi intercrop with field bean cultivated by beneficiary and non-beneficiary sample farmers in PMKSY-WD

(**₹/acre**)

Ragi +Field bean /acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	3.00	6.00	5.00	3.00
2	Total area (acres)	6.00	14.00	8.50	3.50
3	Average area (acres)	2.00	2.33	2.00	1.17
4	Labour man days	41.83	37.60	41.00	38.36
5	Cost of owned human labour (₹)	6082.52	3637.98	4096.00	3771.43
6	Cost of hired human labour (₹)	5344.44	7101.89	7069.54	6942.86
7	Total human labour cost (₹)	11426.97	10739.87	11165.54	10714.29
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	1.14	0.43	1.48	0.86
10	Bullock labour cost (₹)	1000.00	1000.00	1000.00	1000.00
11	Bullock labour wages (₹)	1084.88	435.16	1476.92	642.86
12	Machine labour hours	5.82	5.40	6.50	4.71
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	3494.44	3289.85	3899.08	2828.57
15	Seeds and seed material (₹)	390.00	374.57	350.00	419.14
16	FYM and silt (₹)	1067.00	1157.14	932.00	1057.71
17	Fertilisers (₹)	1343.50	1371.43	1123.00	1222.29
18	Plant protection chemicals (₹)	414.00	376.29	420.00	392.57
19	Interest on working capital (₹)	1345.46	952.12	1355.66	1209.42
20	Total variable cost (₹)	20566.24	18696.42	20722.20	18486.85
21	Rental value of land (₹)	6500.00	6350.00	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00	20.00	20.00
23	Depreciation (₹)	1413.00	952.29	357.88	43.96
24	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
25	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
26	Marketing cost (₹)	1369.00	1167.86	1415.00	1328.57
27	Total cost (₹)	30425.28	27660.82	29448.03	26722.37
28	Gross returns (₹)	45416.00	35187.32	45395.00	34805.14
29	Net returns (₹)	14990.72	7236.51	15946.97	8083.77
30	Gross returns per rupee of total cost (₹)	1.49	1.27	1.54	1.30
31	Cost of production (₹/quintal)	3320.72	3636.29	3030.60	3897.01

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development

KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Appendix III: Cost and returns of ragi intercrop with pigeon pea and field bean cultivated by beneficiary and non-beneficiary sample farmers in PMKSY-WD (₹/acre)

Ragi +Pigeon pea +Field bean/acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	6.00	4.00	12.00	11.00
2	Total area (acres)	26.00	4.50	25.75	15.25
3	Average area (acres)	4.33	1.13	2.15	1.39
4	Labour man days	46.49	39.04	43.44	39.99
5	Cost of owned human labour (₹)	4205.98	5317.95	3917.52	4340.73
6	Cost of hired human labour (₹)	8285.47	5434.19	6950.13	6830.79
7	Total human labour cost (₹)	12491.45	10752.14	9451.79	9777.15
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	0.69	1.78	1.24	1.44
10	Bullock labour cost (₹)	1000.00	1000.00	1000.00	1000.00
11	Bullock labour wages (₹)	948.72	1638.97	1242.72	1185.01
12	Machine labour hours	6.92	7.33	7.53	6.17
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	5692.31	4315.38	4515.21	3700.47
15	Seeds and seed material (₹)	423.92	364.44	455.77	631.87
16	FYM and silt (₹)	1307.69	1391.11	1211.65	1330.82
17	Fertilisers (₹)	1413.23	1457.78	1410.17	1434.69
18	Plant protection chemicals (₹)	612.46	465.78	523.34	465.25
19	Interest on working capital (₹)	1602.29	1426.99	1415.86	1394.37
20	Total variable cost (₹)	24492.07	21812.60	20226.51	19919.63
21	Rental value of land (₹)	6500.00	6350.00	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00	20.00	20.00
23	Depreciation (₹)	1413.00	952.29	357.88	43.96
24	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
25	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
26	Marketing cost (₹)	1570.15	1155.56	1422.04	1387.54
27	Total cost (₹)	34552.26	30764.7	29959.38	28214.12
28	Gross returns (₹)	50881.07	38752.84	46154.29	38726.40
29	Net returns (₹)	16328.81	7989.00	17194.91	10512.28
30	Gross returns per rupee of total cost (₹)	1.47	1.26	1.59	1.37
31	Cost of production (₹/quintals)	2196.68	2694.89	2033.63	2373.54

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

**Appendix IV: Cost and returns of ragi cultivated by beneficiary and non-beneficiary
sample farmers in PMKSY-WD (₹/acre)**

Ragi/acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	14.00	9.00	12.00	6.00
2	Total area (acres)	37.00	20.05	14.50	6.00
3	Average area (acres)	2.64	2.23	1.21	1.00
4	Labour man days	35.41	31.89	38.42	34.77
5	Cost of owned human labour (₹)	3592.59	3414.12	3805.98	3739.29
6	Cost of hired human labour (₹)	6607.41	5661.60	7149.24	6685.71
7	Total human labour cost (₹)	10200.00	9075.72	10955.22	10425.00
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	1.51	1.35	1.21	1.29
10	Bullock labour cost (₹)	1000.00	1000.00	1000.00	1000.00
11	Bullock labour wages (₹)	2074.07	1364.12	1213.79	1285.71
12	Machine labour hours	5.38	5.64	6.63	4.82
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	4422.22	3429.79	3975.17	2892.86
15	Seeds and seed material (₹)	349.24	323.19	395.59	336.00
16	FYM and silt (₹)	548.65	673.32	567.72	623.00
17	Fertilisers (₹)	1044.32	1083.14	1002.21	1256.00
18	Plant protection chemicals (₹)	177.08	147.23	268.97	248.00
19	Interest on working capital (₹)	1317.09	1126.76	1286.51	1194.66
20	Total variable cost (₹)	19103.69	17223.27	19665.17	18261.23
21	Rental value of land (₹)	6500.00	6350.00	6500.00	6000.00
22	Land revenue (₹)	20.00	20.00	20.00	20.00
23	Depreciation (₹)	1413.00	952.29	357.88	43.96
24	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
25	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
26	Marketing cost (₹)	1243.24	920.20	1575.17	1320.00
27	Total cost (₹)	28836.97	25940.01	28550.17	26488.18
28	Yield (quintals)	10.22	6.73	10.34	7.00
29	Gross returns (₹)	41040.55	32651.71	42036.35	34125.50
30	Net returns (₹)	12204.58	6711.70	13485.18	7638.32
31	Gross returns per rupee of total cost (₹)	1.42	1.26	1.47	1.29
32	Cost of production (₹/quintals)	2757.20	3725.92	2657.77	3771.77

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau ("credit institute for reconstruction") Watershed Project

Appendix V: Cost and returns of tomato cultivated by beneficiary and non-beneficiary sample farmers in PMKSY-WD (₹/acre)

Tomato/acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	7.00	6.00	9.00	5.00
2	Total area (acres)	11.50	5.50	11.50	7.50
3	Average area (acres)	1.64	0.92	1.28	1.50
4	Labour man days	78.23	70.77	72.61	43.10
5	Cost of owned human labour (₹)	8939.18	11918.05	10500.51	11684.44
6	Cost of hired human labour (₹)	19143.48	13877.83	18743.47	17086.67
7	Total human labour cost (₹)	28082.66	25795.88	29243.98	28771.11
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	2.50	2.18	1.17	1.00
10	Bullock labour cost (₹)	1000.00	1000.00	1000.00	1000.00
11	Bullock labour wages (₹)	2502.42	2731.86	1167.70	1000.00
12	Machine labour hours	3.65	2.18	5.32	2.51
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	3002.90	1639.11	3191.72	1508.57
15	Seeds and seed material (₹)	4453.62	4365.82	4595.65	3546.67
16	FYM and silt (₹)	4453.62	4145.45	4335.65	4452.00
17	Fertilisers (₹)	4260.87	4494.55	4011.65	4437.33
18	Plant protection chemicals (₹)	2069.57	1589.61	2077.04	1896.67
19	Interest on working capital (₹)	2522.02	2264.41	2461.80	1423.00
20	Total variable cost (₹)	64076.62	60079.41	60449.12	54945.35
21	Rental value of land (₹)	6500.00	6350.00	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00	20.00	20.00
23	Depreciation (₹)	1413.00	952.29	357.88	43.96
24	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
25	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
26	Marketing cost (₹)	11410.61	9669.82	10581.65	8760.00
27	Total cost (₹)	83977.27	77545.77	78341.6	70612.3
28	Yield (quintals)	127.82	116.93	120.32	109.05
29	Gross returns (₹)	198627.52	142623.96	191465.18	141622.74
30	Net returns (₹)	114649.82	65078.19	113123.58	71011.44
31	Gross returns per rupee of total cost (₹)	2.37	1.84	2.44	2.01
32	Cost of production (₹/quintals)	571.38	597.60	567.26	565.67

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Appendix VI: Cost and returns of paddy cultivated by beneficiary and non-beneficiary sample farmers in KfW-WP (₹/acre)

Paddy/acre			
Sl. No.	Particulars	KfW-WP	
		Beneficiary	Non-Beneficiary
1	No. of samples	2.00	2.00
2	Total area (acres)	2.00	1.50
3	Average area (acres)	1.00	0.75
4	Labour man days	38.89	19.61
5	Cost of owned human labour (₹)	5464.62	5464.29
6	Cost of hired human labour (₹)	6153.85	5464.29
7	Total human labour cost (₹)	11618.46	10928.57
8	Wage rate (₹)	400.00	400.00
9	Bullock labour days	0.98	0.00
10	Bullock labour cost (₹)	1000.00	1000.00
11	Bullock labour wages (₹)	984.62	0.00
12	Machine labour hours	5.42	3.21
13	Machine labour cost (₹)	600.00	600.00
14	Machines labour wages (₹)	3249.23	1928.57
15	Seeds and seed material (₹)	771.00	780.00
16	FYM and silt (₹)	968.00	1578.86
17	Fertilizers (₹)	1781.00	2326.29
18	Plant protection chemicals (₹)	1107.50	1064.57
19	Interest on working capital (₹)	1433.59	955.98
20	Total variable cost (₹)	21913.39	19562.84
21	Rental value of land (₹)	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00
23	Depreciation (₹)	357.88	43.96
24	Interest on fixed capital (₹)	432.95	642.99
25	Total fixed cost (₹)	7310.83	6906.95
26	Marketing cost (₹)	1916.00	1109.29
27	Total cost (₹)	31140.22	27579.08
28	Yield (quintals)	17.50	10.29
29	Gross returns (₹)	45387.18	38013.82
30	Net returns (₹)	14246.96	10436.74
31	Gross returns per rupee of total cost (₹)	1.46	1.38
32	Cost of production (₹/quintals)	1623.57	2681.76

Note: KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Appendix VII: Cost and returns of ground nut cultivated by beneficiary and non-beneficiary sample farmers in KfW-WP (₹/acre)

Ground nut/acre			
Sl. No.	Particulars	KfW-WP	
		Beneficiary	Non-Beneficiary
1	No. of samples	9.00	2.00
2	Total area (acres)	12.25	2.00
3	Average area (acres)	1.36	1.00
4	Labour man days	34.21	22.18
5	Cost of owned human labour (₹)	4883.60	3937.82
6	Cost of hired human labour (₹)	4661.01	6100.84
7	Total human labour cost (₹)	9544.61	10038.66
8	Wage rate (₹)	400.00	400.00
9	Bullock labour days	1.20	0.55
10	Bullock labour cost (₹)	1000.00	1000.00
11	Bullock labour wages (₹)	1203.70	554.62
12	Machine labour hours	8.16	4.99
13	Machine labour cost (₹)	600.00	600.00
14	Machines labour wages (₹)	4895.06	2994.96
15	Seeds and seed material (₹)	2430.00	1834.29
16	FYM and silt (₹)	2619.00	2278.29
17	Fertilisers (₹)	3213.00	2463.43
18	Plant protection chemicals (₹)	624.50	1050.86
19	Interest on working capital (₹)	1717.09	1245.41
20	Total variable cost (₹)	26246.96	22460.50
21	Rental value of land (₹)	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00
23	Depreciation (₹)	357.88	43.96
24	Interest on fixed capital (₹)	432.95	642.99
25	Total fixed cost (₹)	7310.83	6906.95
26	Marketing cost (₹)	2050.00	1411.29
27	Total cost (₹)	35607.79	30778.74
28	Yield (quintals)	11.50	8.57
29	Gross returns (₹)	51500.00	42444.49
30	Net returns (₹)	15892.21	11666.75
31	Gross returns per rupee of total cost (₹)	1.45	1.38
32	Cost of production (₹/quintals)	2918.07	3591.17

Note: KfW-WP - Kreditanstalt für Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Appendix VIII: Cost and returns of ground nut cultivated by beneficiary and non-beneficiary sample farmers in PMKSY-WD and KfW-WP (₹/acre)

Horse gram/acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	3.00	2.00	1.00	1.00
2	Total area (acres)	5.00	4.00	2.00	1.00
3	Average area (acres)	1.67	2.00	2.00	1.00
4	Labour man days	30.40	28.00	27.50	11.40
5	Cost of owned human labour (₹)	3236.36	3100.00	1869.23	4080.00
6	Cost of hired human labour (₹)	4690.91	4300.00	3115.38	2760.00
7	Total human labour cost (₹)	7927.27	7400.00	4984.62	6840.00
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	0.00	0.00	0.69	0.00
10	Bullock labour cost (₹)	1000.00	1000.00	1000.00	1000.00
11	Bullock labour wages (₹)	1090.91	500.00	692.31	600.00
12	Machine labour hours	3.60	2.50	2.08	1.80
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	1963.64	1500.00	1246.15	1080.00
15	Seeds and seed material (₹)	240.00	190.00	185.00	160.00
16	FYM and silt (₹)	753.60	825.00	850.00	900.00
17	Fertilisers (₹)	912.00	940.00	750.00	840.00
18	Plant protection chemicals (₹)	126.00	112.50	142.50	110.00
19	Interest on working capital (₹)	910.94	802.73	134.93	140.70
20	Total variable cost (₹)	13924.36	12270.23	8985.50	10670.70
21	Rental value of land (₹)	6500.00	6350.00	6500.00	6200.00
22	Land revenue (₹)	20.00	20.00	20.00	20.00
23	Depreciation (₹)	1413.00	952.29	357.88	43.96
24	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
25	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
26	Marketing cost (₹)	750.00	575.00	825.00	750.00
27	Total cost (₹)	23164.4	20641.77	17121.33	18327.65
28	Yield (quintals)	6.98	4.50	7.50	5.00
29	Gross returns (₹)	33266.61	25507.45	25995.00	23405.50
30	Net returns (₹)	10102.22	4865.68	8873.67	5077.85
31	Gross returns per rupee of total cost (₹)	1.44	1.24	1.52	1.28
32	Cost of production (₹/quintals)	3461.74	4512.07	2172.84	3688.37

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project

Appendix IX: Establishment cost of mango cultivation by beneficiary and non-beneficiary sample farmers in PMKSY-WD and KfW-WP (₹/acre)

Sl. No.	Particulars	Units	PMKSY-WD beneficiaries		PMKSY-WD non-beneficiaries		KfW-WP beneficiaries		KfW-WP non-beneficiaries	
			Qty	₹	Qty	₹	Qty	₹	Qty	₹
I	Variable cost									
	Material input									
1	Planting material	Number	64.00	7680.00	59.00	7080.00	62.00	0.00	57.00	6840.00
2	Farm yard manure	Tractor load	3.40	11900.00	4.30	15050.00	3.60	12600.00	4.10	14350.00
3	Chemical Fertilizer cost		0.00	6350.00	0.00	7628.00	0.00	6035.00	0.00	7246.00
4	Plant protection Chemicals	-	0.00	3260.00	0.00	2780.00	0.00	3357.00	0.00	2873.00
A	Sub total		0.00	29190.00	0.00	32538.00	0.00	21992.00	0.00	31309.00
	Labour									
1	Male	Man days	30.00	12000.00	28.00	11200.00	32.00	12800.00	29.00	11600.00
2	Female	Man days	26.00	6500.00	23.00	5750.00	28.00	7000.00	26.00	6500.00
3	Bullock labour	Pair days	8.20	8200.00	9.23	9230.00	8.60	8600.00	8.80	8800.00
4	Machine labour	Machine hours	10.67	6402.00	8.26	4956.00	9.67	5802.00	7.92	4752.00
B	Sub total	-		33102.00		31136.00		34202.00		31652.00
	A+B			62292.00		63674.00		56194.00		62961.00
C	Interest on working capital @ 10% per annum	-		6229.20		6367.40		5619.40		6296.10
D	Total variable cost (A+B+C)			68521.20		70041.40		61813.40		69257.10
II	Fixed Cost									
1	Depreciation	-		2826.00		2222.00		715.16		512.92
2	Rental value of land	-		31150.00		31000.00		35000.00		32500.00
3	Land revenue	-		140.00		140.00		140.00		140.00
4	Managerial cost @10% of working capital	-		6852.12		7004.14		6181.34		6925.71
E	Total fixed cost			40968.12		40366.14		42036.50		40078.63
F	Total cost (D+E)			109489.32		110407.54		103849.90		109335.73
G	Amortised establishment cost			5618.46		6628.93		5871.08		6881.55

Appendix X: Maintenance cost of mango cultivation by beneficiary and non-beneficiary sample farmers in PMKSY-WD and KfW-WP (₹/acre)

Mango/acre					
Sl. No.	Particulars	PMKSY-WD		KfW-WP	
		Beneficiary	Non-Beneficiary	Beneficiary	Non-Beneficiary
1	No. of samples	17.00	6.00	10.00	1.00
2	Total area (acres)	71.00	9.00	16.00	2.00
3	Average area (acres)	4.00	1.00	2.00	2.00
4	Labour man days	29.00	30.00	29.00	25.00
5	Cost of owned human labour (₹)	1979.00	4107.00	3994.00	3046.00
6	Cost of hired human labour (₹)	9569.00	6748.00	8621.00	8123.00
7	Total human labour cost (₹)	11548.00	10955.00	12615.00	11169.00
8	Wage rate (₹)	400.00	400.00	400.00	400.00
9	Bullock labour days	1.00	1.00	2.00	0.00
10	Bullock labour cost (₹)	239.00	706.00	615.00	500.00
11	Bullock labour wages (₹)	1641.00	970.00	1521.00	846.00
12	Machine labour hours	2.00	2.00	4.00	3.00
13	Machine labour cost (₹)	600.00	600.00	600.00	600.00
14	Machines labour wages (₹)	1239.00	1207.00	2282.00	2031.00
15	Seeds and seed material (₹)	374.00	732.00	337.00	625.00
16	FYM and silt (₹)	1796.00	1741.00	1499.00	1542.00
17	Fertilisers (₹)	2091.00	2742.00	1814.00	2086.00
18	Plant protection chemicals (₹)	1300.00	1187.00	1154.00	1070.00
19	Amortised establishment cost (₹)	5618.46	6628.93	5871.08	6881.55
20	Interest on working capital (₹)	1399.00	1304.00	336.00	373.00
21	Total variable cost (₹)	21388.00	20845.00	21559.00	19742.00
22	Rental value of land (₹)	6500.00	6350.00	6500.00	6200.00
23	Land revenue (₹)	20.00	20.00	20.00	20.00
24	Depreciation (₹)	1413.00	952.29	357.88	43.96
25	Interest on fixed capital (₹)	557.04	474.25	432.95	642.99
26	Total fixed cost (₹)	8490.04	7796.54	7310.83	6906.95
27	Marketing cost (₹)	7015.49	6372.00	8784.00	7493.33
28	Total cost (₹)	42511.99	41642.47	43524.91	41023.83
29	Yield (quintals)	46.32	32.00	47.84	31.46
30	Gross returns (₹)	109299.61	70053.77	114263.97	64000.88
31	Net returns (₹)	72406.11	35040.64	76610.46	29858.60
32	Returns per rupee of expenditure (₹)	2.57	1.68	2.63	1.56
33	Cost of production (₹/quintals)	921.64	1290.976	913.60	1294.88

Note: PMKSY-WD - Pradhan Mantri Krishi Sinchayi Yojana-Watershed Development
KfW-WP - Kreditanstalt fur Wiederaufbau (“credit institute for reconstruction”) Watershed Project.

APPENDIX XI

UNIVERSITY OF AGRICULTURAL SCIENCES GKVK BENGALURU

Schedule for “Economic Evaluation of PMKSY and KfW Watershed Projects in Kolar District of Karnataka”

District

Taluka

Village

1. General Information

Name of respondent		Age (in years)	
Education*		Telephone	
Occupation	Main		
	Subsidiary		

* 1=Illiterate, 2=primary,3=Secondary, 4=PUC, 5=Degree and 6=Post graduation

2. Household composition and occupation

Sl. No.	Particulars	Number	Dependents	Working on farm	Working off farm		
					Govt.	Private	Self employed
1	Male						
2	Female						
3	Children						
	Total						

3. Land operated

* If leased-in / leased-out, rent paid / received (₹/acre): _____ (per season / per year) irrigated/rainfed

Source-wise area irrigated Well: _____ Borewell: _____ farm pond _____

Tank: _____ Others: _____ Conjunctive _____

Sl. No.	Particulars	Soil type	Irrigated		Rainfed		Total (Ac)
			Acre	Value (₹/Ac)	Acre	Value (₹/Ac)	
1	Owned						
2	Leased In*						
3	Leased Out*						
4	Total operated						

4. Agricultural assets

Sl. No.	Particulars	Nos.	Year of purchasing	Cost	Subsidy	Present value	Rental earnings	Annual repairs	Maintenance cost
A	Farm house								
B	Farm machines								
i	Bullock cart								
ii	Tractor								
iii	Power tiller								
vi	Sprayers								
C	Irrigation								
i	Well/Borewell/Micro								
F	Others (specify)								

5. Details of livestock

Sl. No.	Animals	Nos.	Particulars of output	Year of purchase	Purchase Values of animals (₹)	Cost of rearing	Main Product#		By-product	
							Qty	Price	Qty (qtls)	Price
1	Draught animals									
2	Milch animals a. Local cow b. Crossbreed cow c. She buffalo									
3	Calves and Heifers (below 1 year)									

4	Sheep									
5	Goats									
6	Poultry									
7	Piggery									
8	Others									

Note: # (Qty in kgs, Litre) Bullock rent: _____ per hour

6. Cropping pattern of the study area:

Sl. No.	Crops	Area of Crops grown in acres		
		<i>kharif</i>	<i>Rabi</i>	Summer
1				
2				
3				
4				
5				
6				

7. Details of water harvesting structures (under private property)

Sl. No.	Type of WHS	No.	Year of construction	status (Functional / Non-functional)	Reasons for functional and non functional	Management	
						managed	Not managed
1.	Farm ponds						
2.	Recharge pit						
3.	Field bunds						
4.	Trench cum bund						
5.	Nala bunds						
6.	Check dam						
7.	Gokatte						
8.	Others (specify)						

8. Details of water harvesting structures (under common property)

Sl. No.	Type of WHS	No.	Year of construction	status (Functional / Non-functional)	Reasons for functional and non functional	Management	
						managed	Not managed
1.	Gokatte						
2.	Recharge pit						
3.	Check dam						
4.	Nala bund						

9. Details on Ground Water Irrigation

Particulars	Year of drilling	Before WSH		After WSH	
		Bore well yield acres irrigated (inches)	No of	Bore well yield acres irrigated (inches)	No of
Number of functioning bore wells					
1					
2					
3					
4					

11. Other activities (if any)

Activities	PMKSY	KFW	year	Other information if any(specify)
Dry land horticulture				
Agro forestry				
Fodder production promotion				
Construction of cattle sheds				
Participation in the animal health camp				
Annual and Perennial fodder minikits				
Tank slit application				
Vermi compost pits				
NADEP compost structures				
Compost pit				
Jeevamrutha and Panchagavya				
Floriculture				
Sheep rearing				
Backyard poultry				
Training Income Generation activity for SHG members				

12. Rates prevailing in the study area

Human labour (₹/day):

Bullock labour(₹/day):

Machine labour(₹/hr) :

Transportation (₹/hr):

Land rent (₹) :

Land revenue (₹) :

Farm yard manure (TL/CL/Tonnes):

13. Crop wise Costs and returns (Annuals)

Crop: _____ Variety: _____

Season: _____ Area: _____

A. Labour utilization

Sl. No.	Particulars	Freq	Owned (days)		Hired (days)		Bullock Pair	Machine Hours
			M	W	M	W		
1.	Clearing of bushes							
2.	Ploughing							
3.	Harrowing							
4.	Clod crushing							
5.	FYM transportation							
6.	FYM application							
7.	Seed bed preparation							
8.	Nursery preparation							
9.	Sowing/Transplanting							
10.	Fertilizer application							
11.	Thinning/gap filling							
12.	Inter-cultivation							
13.	Topping							
14.	Weeding							
15.	Irrigation							
16.	Spraying							
17.	Watch and ward							
18.	Harvesting							
19.	Threshing							
20.	Bagging, transport, marketing							
21.	Others (specify)							

B. Material Costs

Sl. No	Particulars	Units	Quantity (kg or qtl)	Rate (₹)	Value (₹)
1.	Seed treatment material				
2.	Seeds				
3.	FYM				
4.	Tank silt / External soil				
5.	Bio-fertilizers				
6.	Fertilizers				
7.	Growth regulators				
8.	Plant protection chemicals				
9.	Bio pesticides				

C. Output Production and Returns

Sl. No.	Particulars	Units	Quantity (Qtls)	Home consumption	Sold quantity	Price/unit (₹)	Total Returns
1.	Main Product						
2.	By product						

D. Marketing Cost

Sl. No.	Particulars	Amount (₹)
1	Bagging, loading and unloading costs	
2	Cleaning/grading cost	
3	Transportation cost	
4	Commission charge/brokerage/market cess/tax	
5	Storage cost	
6	Grain losses (kgs/qtls)	
7	Other charges if any (₹)	

14. Crop wise Costs and returns (Perennials)

Crop: _____ Variety: _____ Season: _____
 Area: _____ Spacing: _____ Year of Planting: _____
 Gestation Period: _____
 Rainfed/irrigated (well/farm pond) _____

A. Establishment Cost

Sl. No.	Particulars	Freq	Family		Hired		Bullock Pair		Machine Hours	
			M	W	M	W	owned	hired	owned	hired
1.	Land Levelling									
2.	Ploughing									
3.	Cleaning									
4.	Pit opening									
5.	Pit Filling.									
6.	Nursery preparation (If Practiced)									
7.	Irrigation									
8.	Watch and Ward									

B. Material Costs

Sl. No.	Particulars	Units	Quantity	Rate(₹)	Value(₹)
	Materials				
1.	Planting material				
2.	FYM				
3.	Vermicompost.				
4.	Tank silt / External soil				
5.	Bio-fertilizers				
6.	Fertilizer				
7	Growth regulators				
8	Plant protection chemicals				
9	Bio pesticides				

C. Maintenance Cost

Sl. No.	Particulars	Freq	Family		Hired		Bullock Pair		Machine Hours	
			M	W	M	W	owned	hired	owned	Hired
1.	Earthing up									
2.	Ploughing									
3.	Harrowing									
4.	Clod crushing									
5.	Inter Cultivation									

6.	Nutrient Management a. Green Manure b. FYM c. Vermicomposting. d. Chemical Fertilizers. e. Silt application f. Neem Cake									
7.	Plant protection chemicals									
8.	Bio Pesticides									
9.	Traps									
10.	Growth Regulators									
11.	Irrigation									
12.	Watch and Ward									

D. Output Production and Returns

Sl. No.	Particulars	Units	Quantity	HH consumption qty	Sold qty	Price/unit (₹)	Total Returns
1.	Main Product						
2.	By product						

E. Marketing cost

Sl. No.	Particulars	Amount (₹)
1	Bagging, loading and unloading costs	
2	Cleaning/grading cost	
3	Transportation cost	
4	Commission charge/brokerage/market cess/tax	
5	Storage cost	
6	Produce losses (kgs/qtls)	
7	Other charges if any (₹)	

15. Agro forestry

Tree crop planted	No. of trees planted	Year of planting	No. of trees survived Age of trees	Cost of planting	Maintenance cost per year	Year of harvest	Returns realized if any (₹) (With year)
Silver oak							
Mango							
Others (specify)							

16. Contribution of farmers to the watershed (if any)

Sl. No.	Activities	Contribution to the construction of WHS		Maintenance of structures	
		Labor (man days)	Monetary contribution (₹)	Labor (man days)	Monetary contribution (₹)
1.	Farm ponds				
2.	Recharge pit				
3.	Field bunds				
4.	Trench cum bund				
5.	Nala bunds				
6.	Check dam				
7.	Gokatte				
8.	Horticulture crops				
9.	Forest seedlings				
10.	Others (specify)				

17. Constraints faced by beneficiaries during implementation of the watershed projects

Sl. No.	Constraints faced by farmers	PMKSY-WD	KfW
1	Lack of awareness about benefits of watershed technology		
2	Obstruction for cultural operation by water harvesting structure		
3	High Maintenance cost of water harvesting structures		
4	Uncertain rainfall		
5	Small and fragmented nature of holdings		
6	Groupism and village politics		

18. Constraints faced by implementing agencies in implementing watershed project

Sl. No.	Implementers	PMKSY-WD	KfW-WP
1	Poor participation by the farmers during training programmes		
2	Political interference		
3	Failure to recognize advantages of watershed activities by farmers		
4	Small and fragmented nature of holdings		
5	Limited availability of labour		
6	Delay in releasing the sanctioned amount		