

# Reconciling changing cropping pattern and Integrated Watershed Management Program (IWMP): A study

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**Abstract**— Analyzing the land use pattern of India, offers more interesting and fascinating facts about its usage. Out of the India's total geographic area of 329 million hectares, only 306 million hectares has been classified and surveyed so far, which accounts for 93%. The remaining 7% of the geographic area is yet to be surveyed as it includes deep oceans, inaccessible mountains, deserts, and impenetrable forests. Out of the total reporting land [306 million hectare], the land which is used for agricultural purpose i.e. for growing food grains and orchards is just 141 million hectare, which accounts for just 46%. This is known as 'Net Sown Area'. Hence only about 141 million hectare of the total reporting land is used for agriculture purpose, only once in a year [agricultural year]. A portion of this net sown area is used for cultivation more than once in a year [agricultural year]. This is known as 'Area Sown more than once'. Hence out of 141 million hectare, 49 million hectare is used for cultivation more than once. The 'Net Sown Area' and 'Area Sown More than Once' put together represents total cropped area, which is 190 million hectare, which accounts for 62% of the total reporting area. India stands 7th in the world in terms of total geographic area but stands 2nd in terms of cultivated land. U S A stands 1st in terms of cultivated land. The area sown more than once has increased significantly during the last seven decades. It was just 14 million hectare during 1950's, but now 49 million hectare of land is used for cultivation more than once a year. Several factors are responsible for this increase but, one factor which plays predominant role in increasing the usage of area sown more than once is, Integrated Water Resource Management (IWRM). This paper attempts to reconcile effective implementation of Integrated Water Resource Management Program and its consequent effect on cropping intensity and pattern.

**Index Terms**— Watershed Programmes, Cropping pattern, Area sown more than once, Agricultural Productivity, Cultivation area.

## INTRODUCTION

Water resource development is crucial for ensuring food security in many regions of world. Irrigated agriculture has been estimated as a major consumer of water, which accounts for 80 percent at the global and 86 percent of the total water use in developing countries. The rain fed areas are the centres of poverty, malnutrition, food insecurity, which are prone to severe land degradation, water scarcity and poor infrastructure. Watershed development program is accordingly perceived as an effective device to counter lot of those issues and perceived as potential tool for farming development and improvement in delicate and minimal rainfed territories. It plays a vital role in improving the cropping intensity. Intensity of cropping means "The number of crops raised on a field during an agricultural year". Intensity of Cropping is 135 during 2009-10. This intensity of cropping was just about 111 during 1950's. Growing population and related socio-economic developments are placing increasing pressure on the water resources in India.

Demand for water, in all the sectors of the country, is increasing, while adequate supply is constantly diminishing. Failure of monsoon rains and the increasing water stress are greater concerns coupled with anthropogenic carbon dioxide emissions, global warming and climate change that lead to the intensification of the hydrologic cycle. Growing convexity of water resource systems and the challenges of its management led the international community to introduce the concept of Integrated Water Resource Management (IWRM). The concept surfaced after a realization that an integrated approach can deliver more efficient ways of addressing complex water resource management problems. Since the daily lives of 600 million people in India depend directly on functioning of watersheds providing drinking water, irrigation, energy, groundwater recharge and inland fisheries, suitable strategies of watershed prioritization and planning is necessary. Failures in

watershed prioritization and planning can have serious ramifications.

Ramachandran. K. et al., (2004) characterizes, “Watershed is a locale (or zone) assigned with an all-around characterized topographic limit and water outlet. It is a geographic district inside which hydrological conditions are to such an extent that water ends up concentrated inside a specific area.” Heathcote (1998) characterizes the watershed as “The most suitable unit for the administration of water assets, water quality and connections among the common and human frameworks on the planet”. Watershed is a geo-hydrological unit comprised of all land and water within the confines of a drainage divide. Essentially a watershed is all the land and water area, which contributes run off to a common point. Watershed is a land area that captures rainfall and conveys the overland flow and runoff to an outlet in the main flow channel. It may be flat or may include hillocks, hills or mountains. Each and every water and land area is a part of watershed. The integrated watershed programme can operate to achieve the inclusive growth with the integration of different stakeholders such as SHGs, User groups, Participatory Rural Appraisal (PRA) exercises, awareness camps, exposure visits and programmes on literacy, family welfare, social services and other income generating activities.

Integrated watershed management recognizes that the natural resources and the environment of a watershed can be successfully well preserved and protected by integrating and well managing the available natural resources which are decaying. Some are being misused, vulnerably protected and they are also prone to excess use. The main objective is to develop policies which promote the sustainable use of natural resources and take into consideration of economic, social, and environmental issues of the watershed. Therefore, against this background successful implementation of IWMP concept requires coordinated action by the various government authorities that are concerned with land and water management. Activities of watershed project include Soil and dampness protection measures like terracing, bunding, trenching, and laying vegetative boundaries and so on. Rainwater reaping exercises like homestead lakes, permeation tanks, check dams and so forth. Planting and sowing of multi-season trees, bushes, grasses, vegetables, and field improvement encouraging regular recovery and

promotion of agro-ranger service and agriculture. The measures are expected to promote innovation, training, augmenting noteworthy changes among the members encouraging group investment helping the asset less individuals. It enables production framework and miniaturized scale undertaking. It also includes soil and moisture conservation, land leveling, drainage line treatment, contour cultivation, relocation tanks and form ponds. It also includes afforestation schemes like tree plantation in degraded forests, Panchayat land development, community land development, and private land development. Integration of the other activities may include sheep rearing, piggery, poultry activities and bee keeping activities. In most of the villages it includes the production activities and cropping patterns like introduction of suitable crops, inter cropping activities, improved crop varieties, cultivation, and crop management activities. Further, watershed activities will create employment through land based and productive activities. Wage earning can be improved through community asset creation by building village roads and community buildings.

The Gram Panchayats shall also extend their support in organizing and helping in various circumstances for providing necessary information about the local available resources and the requirement of people for proper planning of watershed programme for the area to assist implementing agency. Gram panchayats have helped the agencies in selecting the species of their choice for plantation and pasture development. It helps in the formation of Watershed Committee and is also very much necessary to execute watershed programme through gram panchayat support. The Panchayat should also take the responsibility of the assets created in the watershed area, such as gully structures, check dams, community forestry and pasture lands.

#### OBJECTIVES OF THE STUDY

- To review the operating mechanism of integrated watershed programmes at state levels.
- To measure the impact of the watershed works on socio-economic status of farmers.
- To analyze the economic impact of watershed interventions on household income, consumption expenditure and water table.
- To give suggestions for better accessibility of integrated watershed programmes.

RESEARCH METHODOLOGY

Study locale: Kolar district is selected purposefully as it is one of the most backward districts in the state where the present programme is being implemented from the formulation of IWMP (2009). Lakshmisagara Gram Panchayat at Sreenivasapura taluk in Kolar district covering all villages and all micro watersheds under the jurisdiction are selected.

Sample size: 350 respondents

Sampling method: Random sampling method

Data Collection:

Primary Data: Has been collected through, Direct personal interview, Method of questionnaire and Method of Schedule

Secondary Data: Journals, Evaluation reports, and Annual reports of different departments including the NGOs, Watershed department and Boards.

Statement of the problem:

The IWDP has been functioning in Karnataka state since 2008. The present study attempts to understand the IWMP in a holistic way. In this direction, the study tries to explore and find answers to some of the research questions, such as, to what extent is the investment in watershed programme economically feasible? What is the potential of watershed programme to generate employment opportunities and equity during implementation and after its completion? What is the impact of these programmes on cropping pattern and intensity?.

Data Analysis:

The Overall Household Incremental Income of the Beneficiaries (Rs. per year)

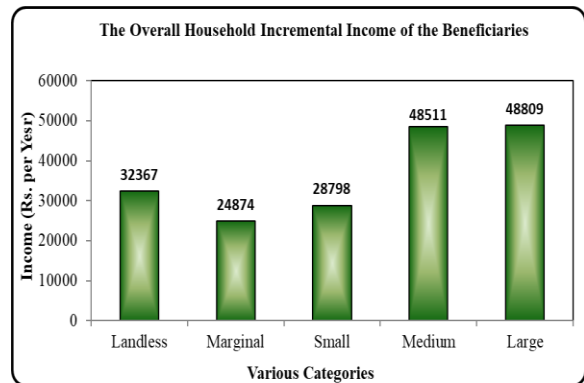
Particulars of Income	Landless	Marginal	Small	Medium	Large
Agriculture	Nil	1390	2604	4898	2868
Sericulture	Nil	2146	4571	14263	12723
Horticulture	Nil	00	108	174	646
Income from garden crops	Nil	00	00	110	414
Income from Livestock*	Nil	1148	1181	-68	-1013
Income from Poultry	900	840	1130	1390	1620
Income from Dairy	6732	4356	3960	5940	6732

Income from fishery #	315	342	89	110	219
Income from labour	24420	14652	11655	2294	Nil
Income from Hiring out Tractor labour	Nil	Nil	Nil	15200	17800
Income from Other sources	Nil	Nil	3500	4200	6800
Total	32367	24874	28798	48511	48809

Source: Primary Data

Note:

1. Income from other sources include the income earned from middleman activities
2. \*\*Livestock hired out for agricultural activities in the study area.
3. # Fish is found in the farm ponds and sometimes check dams. Though the HHs consume directly just for accounting purpose the imputed cost on that is worked out.



The incremental income from the wages has been much more for the landless labourers constituting about Rs. 24,000, this is followed by marginal farmers who are getting about Rs. 15,000 and small farm category getting Rs. 12,000. There are certain activities where the beginning is made like vegetables, garden crops (mango garden), poultry, etc. The total incremental income of the family as a whole there is a positive relation between the farm size and the increase in income. The marginal farmers get about Rs. 25,000 and the large farmers are getting Rs. 49,000. The incremental income for medium and large farmers is high mainly because the income from hiring out tractor labour is more for these categories. The landless labourers are also getting higher income from the labour (wages). This is not incremental income this

is the actual and total income for the whole year. The percentage change from 2009-10 to 2015-16 is about 36.78 percent. Per annum, this is about 7.36 percent. The increase in income is on par with the GDP growth rate projected for the country as a whole in the 12th Five Year Plan. There is a positive relationship between the size classes and increase in income because as the size class increases the incremental income also is more. In case of the large farm category also there is an increased income of about 25.93 percent and per annum which is about 5.19 percent. Primary data collected from a sample of 300 beneficiary farmers and landless category 50 households was processed by using descriptive as well as certain sophisticated statistical methods. Simple statistical methods including averages and percentages/ratios as well as frequency distribution to compare the socio-economic status of the beneficiaries and non-beneficiary farmers were used. More sophisticated statistical methods viz., correlation and regression analysis as well as Gini coefficient were also used to examine the relationship between different socio-economic characteristics / variables to throw more light on the impact of watershed project.

Results of Correlation Analysis

Sl. No.	Associated Socio-economic Variables	Karl Pearson's Correlation Coefficient
1.	Number of functioning bore wells and Cropping intensity	+ 0.63
2.	Cropping intensity and employment in person days	+ 0.71
3.	Cropping intensity and number of person days of hired labour	+ 0.82
4.	Cropping intensity and area under vegetable crops	+ 0.59
5.	Number of protective irrigation for standing crop and yield per ha (of ragi/maize/groundnut crop)	+ 0.72
6.	Cropping intensity and quantity of institutional credit availed	+ 0.54
7.	Farm household income and number of defaults in repayment of credit	(-)0.61
8.	Farm household income and amount of loans (from both money lenders & institutions) outstanding	(-)0.86
9.	Cropping intensity and quantity of fodder (produced both exclusively and as by-product of field crops)	+ 0.56
10.	Cropping intensity and number of livestock possessed (including bullocks, dairy animals, sheep and goats)	+ 0.67
11.	Cropping intensity and farm household income	+ 0.87

12.	Cropping intensity and value of farm assets possessed	+ 0.53
13.	Farm household income and farm assets possessed	+ 0.67
14.	Cropping intensity and value of non-farm assets possessed	+ 0.79
15.	Farm household income and value of non-farm assets possessed	+ 0.81
16.	Cropping intensity and number of agricultural extension programs attended/farm specialists consulted	+ 0.78
17.	Farm household income and number of school drop-outs	(-) 0.48
18.	Farm household income and average number of years of schooling of children	+ 0.67
19.	Farm household income and expenditure on children's education	+ 0.85
20.	Farm household income and expenditure incurred on health care	+ 0.87
21.	Farm household income and household savings	+ 0.34

ANALYSIS AND FINDINGS

Increase in cropping intensity leads to rise in on-farm employment measured in person days. The coefficient of correlation between these two variables is + 0.71. There is also a very high degree of correlation between cropping intensity and number of person days of hired on-farm labour (+0.82). Watershed development brings about diversity in the cropping pattern in the command area due to improvement in the availability of water for irrigation. Farmers tend to shift cultivation from cereal crops like ragi to vegetables, fruits and flowers fetching higher incomes. Farmers in many taluks in Kolar region including Srinivasapur taluk are known to grow vegetables like tomatoes using ground water irrigation to profit themselves from the nearby metropolitan markets. Watershed development improves ground water table thereby increasing the cropping intensity and enabling farmers to grow vegetables using bore well water. The coefficient of correlation between cropping intensity and area under vegetable crops is + 0.59. The yield per ha. of field crops like ragi, maize, and groundnut has gone up with the increase in the number of protective irrigations provided to the standing crops. The coefficient of correlation between the number of protective irrigation for standing crops and yield per ha (of ragi/maize/groundnut crop) is found to be + 0.72. With the increase in cropping intensity farmers tend to avail increasing amount of credit, especially from institutional sources, the coefficient of

correlation between these variables being + 0.54. Further, it is found that there is a negative relationship between the farm household income and the number of defaults in repayment of credit (coefficient of correlation is (-) 0.61), which means that repayment of credit rises with the rise in household income. Farm household income and amount of loans (from both money lenders & institutions) outstanding tend to vary inversely; the coefficient of correlation in this respect is as high as (-) 0.86.

Increase in cropping intensity has a positive impact on fodder production and livestock possessed by farmers. The quantity of fodder (produced both exclusively and as by-product of field crops) increases with the increase in cropping intensity and thereby facilitates maintenance of larger number of livestock by the farmers. The coefficients of correlation of cropping intensity with fodder production and livestock are + 0.56 and +0.67 respectively. Increase in cropping intensity and hence farm household income obviously lead to an increase in the number and value of both farm and non-farm assets possessed by farmers. This relationship is corroborated by the fact that correlation coefficient is: + 0.87 between cropping intensity and farm household income, + 0.53 between cropping intensity and the value of farm assets possessed, + 0.67 between household income and farm assets possessed, + 0.79 between cropping intensity and the value of non-farm assets possessed and, +0.81 between the household income and the value of non-farm assets possessed.

#### CONCLUSION

With the watershed works there is a change in the cropping pattern. Farmers started cultivating maize and mango. The income from maize has been remunerative and also the mango gardens started yielding more due to improvement in the water table. Therefore, the watershed works are suggested to change the cropping pattern on commercial basis and in turn to increase the returns. Almost all the households have agreed that in the sample villages the soil improvement has taken place, improvement in the water table, improvement in the availability of fodder and fuel and there is a greater change in the adoption of horticultural crops. Hence, Horticultural Department should extend need-based services to promote the crops and farmers respectively. Increase in cropping intensity and hence farm household

income obviously lead to an increase in the number and value of both farm and non-farm assets possessed by farmers. This relationship is collaborated by the fact that correlation coefficient is: + 0.87 between cropping intensity and farm household income, + 0.53 between cropping intensity and the value of farm assets possessed. To increase the cropping intensity in the study area, there is a need for considering socio-economic status for implementation of watershed works.

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