

Valuation of Panchganga River Ecosystem Services in Urban Kolhapur District of Maharashtra (India)

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Abstract It is of topmost importance to undertake an economic valuation of the ecosystem services such as a river, which is aquatic and natural ecosystem, because of their very important role in the development and welfare of the society. It is against this overall backdrop, the present research study attempts to carry out an economic valuation of the services of the Panchganga river as an aquatic ecosystem. The empirical analysis of the economic valuation of the services in monetary terms being provided by the Panchganga river ecosystem estimates its total economic value. No doubt, it is worth of Rs. 5459.41 lakh per annum is really important and valuable, which indicates its role in the socio economic development of the area under our study. It is an indicator of the number and variety of services being provided by the Panchganga useful for agriculture, allied activities, industry and business development along with water for domestic use of the area and its people. The analysis of the determinants of the economic value of the Panchganga river reveals that the non-economic than the economic factors are very much dominant and effective in generating the total economic value.

Keywords Economic Valuation, Ecosystem, River Ecosystem, Ecosystem Services, Techniques of Valuation, Components and Determinants of Economic Value

JEL Classification: Q5, Q51, Q57, Q58

1. Introduction

Resources play a vital role in overall development of any economy. In absence of resources, a single productive activity cannot be started, hence economic growth and development is rather impossible. In a global sense, [1] describe ecosystem resources such as water, air and soil as Natural Capital. These resources can be renewable or non-renewable. The other form of capital is Industrial Capital, which consists of Manufactured Capital such as physical enterprises and farm machinery, and Human Capital such as skills and knowledge. Production results from the combining of Natural and Industrial Capital [2]. Resources are a means of economic activities and consequently development of the economy. "Sustainable development" is a loosely used oxymoron these days. The term "sustainable" clearly is indicative of the acceptance of the fact that natural assets are not infinite. There is a misconception and misunderstanding that natural resources are free of cost and gift of the nature, as a result, those are not utilized properly, optimally, and rationally as well. Actually, the scarcity of natural resources is of higher gravity consequently their proper allocation and optimal utilization is of crucial importance. In order to better engage decision-makers in conservation efforts, WWF believes there is an urgent need to synthesize and strengthen the evidence base regarding the relationship between improved river health and the benefits human societies derive from rivers [3]. The evidence suggests that rivers have the potential to provide a wide range of benefits to society, for example supporting key livelihood activities

and economic sectors, nurturing social relations and spiritual well-being, and contributing to strategic goals such as food-energy-water security, poverty reduction or climate resilience [3]. Ecosystems are a very integral and important part of the nature and environment, which provide the number of services as natural resources are useful for growth and development of the economy. The ecosystems that provide the services are 'natural capital' (NC) using the general definition of capital as a stock that yields a flow of services over time [1]. Freshwater ecosystems have been described as "biological assets (that are) both disproportionately rich and disproportionately imperiled." They need not be so threatened [4]. Of the many paradoxes of human existence, this has to be one of the starkest: even as we depend for our lives on the rivers, even as we venerate them in every culture, we also pollute them, block their flow, divert them into lifeless channels, and desecrate them in every conceivable way [5]. Aquatic ecosystems also provide a home to many species including the phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals, and others. It is against this overall backdrop, the present research study attempts to estimate an economic value of the services of the Panchganga river as an aquatic eco system.

2. Review of Research Studies

A review of some of the research studies relating to topic of the present research study to identify a research gap is as follows.

Earth's 21 largest lakes hold 2/3 of all global, liquid, surface, fresh water and occupy diverse ecological and social settings. The study has identified seven ecosystem services for which there were quantitative data across most or all of these large lakes. Approximately 1.35 million tonnes of fish are harvested per year from these lakes by commercial or artisanal means, with approximately 95% of this harvest coming from the African large lakes [6]. The Ecosystem value of rice–fish coculture ecosystems in the study area was 255,529 RMB/hm²/year and was 37.9% higher than that in rice monoculture, while the Ecosystem value increased by at least 6.74 times than direct economic value in rice monoculture. In addition, the Ecosystem value of rice–fish co-culture increased by 2.31 times, as compared direct economic value with rice–fish co culture [7]. Most studies focused on provisioning services. The available estimates indicate that forests of Bangladesh are worth USD 840 ha⁻¹ yr⁻¹ on average. The value was the highest for the Sundarbans (USD 2176 ha⁻¹ yr⁻¹) while the hill forests' value was a distant second with USD 1066 ha⁻¹ yr⁻¹ [8]. Diverse benefits were derived from provisioning (e.g., crop production), regulating (e.g., flood prevention), supporting (e.g., soil formation), and cultural (e.g., farming lifestyle) services provided by the watershed. A disproportionately higher number of cultural services were identified and rated as highly important [9]. Study

three projects, namely, Hirakud, Ukai and Indira Gandhi Nahar Project (IGNP), clearly demonstrates the glaring and complete dichotomy between pre-construction projections and post-construction realities. Water-logging, salinity, sedimentation and health hazards have a high possibility of occurrence [10]. Rivers have the potential to provide a wide range of benefits to society but are often exploited to deliver a narrow range of objectives, to the detriment of river health and other human needs (i.e. sub-optimal investment decisions) [3]. Sustainability in the Murray-Darling Basin should be defined as the indefinite preservation of: - a functional and diverse ecosystem which, as well as meeting aesthetic and ethical requirements, provides a natural resource suitable for (all) human uses and production; and - a socio-economic system capable of using the natural resource productively to the maximum good of the current and future communities [2]. There is growing recognition, however, that functionally intact and biologically complex freshwater ecosystems provide many economically valuable commodities and services to society [4]. Over the long term, intact ecosystems are more likely to retain the adaptive capacity to sustain production of these goods and services in the face of future environmental disruptions such as climate change. Pointed how the Indian court's order and the New Zealand law are potentially breakthrough decisions, but raise difficult and complex questions of interpretation, implementation, and redressal. They have also stressed that there are fundamental contradictions between growth-led "development" and the rights of nature, or indeed, of ecological sustainability, even from a human-centered point of view [5]. Observed that the Cities, like living organisms, depend on external metabolic flows to keep them alive. Among all the metabolic flows of matter and energy none is more important than water – especially water used for meeting basic drinking water and other domestic consumption needs [11]. The Supreme Court's verdict directing the Government of India to implement the interlinking of rivers seems to have overlooked the regional and international implications of what the Indian Court strangely considers "the rivers of the country" [12].

The foregoing review of research studies reveals that the number of studies relating to ecosystems have been carried out. They have covered the ecosystems like lakes, rivers, forests and others. But they are prominently in broader perspectives and apparently look at the ecosystem services and their economic valuation. River is a very important ecosystem, which provides the number of services useful for economic development as well as human welfare, therefore, the present study attempts the valuation of the services of river ecosystem namely Panchganga in the number of aspects.

3. Research Methodology

The present research study is of analytical in nature

which intends to carry out data based analysis of economic value of the services of Panchganga river ecosystem. The major objective of the study is; to estimate and analyse economic value of services being provided by the Panchganga river ecosystem. The study is mainly dependent on the Primary data collected by administering a well-designed questionnaire among the 100 household respondents comprising about 500 individual respondents approximately, selected purposively considering their social stratification from the urban area of Kolhapur and Ichalkaranji cities of the Kolhapur district in the catchment area of Panchganga river ecosystem. The services being provided by the Panchganga river in its catchment area especially categorized under Provisioning and Social or cultural services have been taken into account, which are also categorized into consumptive and non-consumptive. The necessary collected primary data has been processed and analysed by adopting a computer software package SPSS so as to reveal descriptive statistics such as mean, range, frequency, percentage / relative shares and arithmetic calculations. The use of graphs and figures is made wherever necessary and useful.

The necessary primary data has been collected by administering a questionnaire from the 100 households which stands approximately at 500 individual respondents. It is a purposive sample from the urban area of Kolhapur district of Maharashtra, which is the catchment area of the Panchganga river ecosystem. Total 100 household respondents have been selected from Kolhapur and Ichalkaranji cities 50 each, worth of 500 individual respondents. The social stratification of the respondents has been taken into account, which comprises of 55% Open category, 18% SC, 10% NT and 17% OBC in accordance with the government norms of representation. The occupational profile of the respondents shows that 51% agriculturists, 29% government servants, 2% private servants, 13% businessmen, and 5% labours. Thus our sample is inclusive, varied and comprehensive as well.

4. Results and Discussion

The study mainly depends on the primary data collected

and the analysis of the results.

4.1. Economic Value of Panchganga River Ecosystem Services

An Ecosystem is a community of plants and animals interacting with each other in a given area, and also with their abiotic (non-living) environments. The concept of ecosystem services was given increased public recognition through the Millennium Ecosystem Assessment (MEA)1 launched in 2001 by the UN Secretary General and completed in 2005. Monetary value of the services being provided by the ecosystems like river is economic value. It has the number of components based on the types and variety of services provided by the Panchganga river.

4.2. Components of Economic Value of Services of Panchganga River Ecosystem

The ecosystem services are classified in to four major types or categories. They are i) Provisioning Services: Products obtained from ecosystems such as • Food • Fresh Water • Fuel wood • Fiber • Bio chemicals • Genetic Resources. ii) Regulating Services: Benefits obtained from regulation of ecosystem processes namely • Climate Regulation • Water Regulation • Disease Regulation • Pollination • Water Purification. iii) Socio - Cultural Services: Nonmaterial benefits obtained from ecosystems like • Recreational • Aesthetic • Educational • Heritage • Spiritual & Religious • Inspirational. iv) Supporting Services: Services necessary for the production of all other ecosystem services such as - Soil Formation - Nutrient Cycling - Primary Production. Some important services have been considered so as carry out economic valuation of the services of the Panchganga river as an aquatic ecosystem.

1) Value of Water for Domestic Use

River water is used for drinking purpose as well as other purposes in the house, the sum totality of that is described as the domestic use of water. Its requirement in study area and monetary value estimation is as follows.

Table 1. Water Requirement for Domestic use and its Value Per Annum

Monthly Water Requirement	Frequency	Percent	Valid Percent	Cumulative Percent	Value of Water for Domestic Use @Rs.7 per 1000 liters (Rs)
Not Answered / NA	3	3.0	3.0	3.0	---
10000 liters	6	6.0	6.0	9.0	5040
7000 liters	20	20.0	20.0	29.0	11760
5000 liters	52	52.0	52.0	81.0	21840
2000 liters	19	19.0	19.0	100.0	3192
Total	100	100.0	100.0		41832

Source: Calculated by the Researcher Based on Field Survey March 2020

From the data in Table 1, it is found that the majority of households (52%) under our study requires 5000 liters water monthly, which is followed by 7000 liters (20%), 2000 liters (19%) respectively, but a very few (6%) also require 10000 liters water. When the economic value of Panchganga river water for domestic use was estimated, it stood at Rs. 41832 per annum, which is prominently contributed by the households using 5000 liters water monthly followed by families use water 7000 and 2000 liters monthly. The economic value of river water for domestic purpose can be significantly greater, when it is estimated by taking into account the total households and population, this we reveal sufficiently from Table 1. People do not know the economic value and the importance of the river water being used for domestic purpose in the houses. The water charges are also very lower and negligible when it is compared with the bottled water. This necessitates to increase water rates for domestic use, but it will not be affordable for the poor and rural people is resulting in under estimation of the value as well as excessive and sub optimal use of the water. The market prices of the water should be considered as shadow prices of water will enable not exact but realistic estimation of the economic value of the river water. The wrong thinking of the people that water is a free gift of nature is responsible for the under estimation of economic value of the river water and its miss and irrational use as well.

India as well as Maharashtra are agricultural economies due to their heavy dependence of the population on agriculture as a source of livelihood. This demands the computation of economic value of the river water being used for agriculture. As agriculture is a means of livelihood for the majority of people in Maharashtra as well as in India their life and livelihood is determined by the water from the aquatic ecosystem like river. Unfortunately, agriculture is seasonal and depends on the rainfall for water needs and requirements. This further increases the economic value and importance of the river water especially to the agriculture, which is very important economic activity. We should look at in this perspective also while estimating

economic value of the river water to the agriculture.

2) Value of Water to Agriculture

Agriculture is a major source of employment and livelihood in India as well as in the state of Maharashtra, Table 2 below depicts the necessary data about it.

Table 2. Source and Requirement of Water for Agriculture

Water Requirement		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Answered/NA	42	42.0	42.0	42.0
	10 lakh liters	5	5.0	5.0	47.0
	7 lakh liters	30	30.0	30.0	77.0
	5 lakh liters	15	15.0	15.0	92.0
	2 lakh liters	8	8.0	8.0	100.0
	Total	100	100.0	100.0	

Source: Field Survey March 2020

Panchganga river is a major source of water for agriculture in Kolhapur district. But at the same time, the lack of availability of water for agriculture is also in considerable magnitude. And it is used for a variety of activities and operations in agriculture. It is observed that the majority of the farmers under study area 7 lakh and 5 lakh liters water per month for agriculture, is really valuable and significant as well. It is responsible and contributing to creating economic value of river water to agriculture. But a very important and noteworthy thing is the lack of availability and consequently access to the water for agriculture is also a thing of concern and an obstacle in generating economic value of water from agriculture, which demands increasing access and facility of river water to the farmers under the study area.

It is against this background, it is of crucial importance to estimate economic value of the production of the food grains, which is a component of water to agriculture, undertaken in the study area by making use of Panchganga river. On the basis of the data in Table 3 the monetary value of food grains production has been computed.

Table 3. Economic Value of Water for Food grains Production

Quantity		Frequency	Percent	Valid Percent	Cumulative Percent	Value of Water for Food grains
Valid	Not Answered / NA	42	42.0	42.0	42.0	Nil
	Rs. 20 lakh	1	1.0	1.0	43.0	Rs 20 lakh
	15 lakh	17	17.0	17.0	60.0	255
	10 lakh	18	18.0	18.0	78.0	180
	5 lakh	22	22.0	22.0	100.0	110
	Total	100	100.0	100.0		Rs. 565 lakh

Source: Calculated by the Researcher based on Field Survey March 2020

From the data in Table 3, the estimated economic value of the river water used for food grains stood at Rs. 565 lakh per annum for the respondents into our consideration. Its decomposition further reveals that the majority of farmers received Rs. 10 lakh per annum, which is followed by Rs. 15 lakh and very rarely Rs. 20 lakh. Its further analysis reveals that Rs 565 lakh is the total economic value generated from the river water supplied to the production of food grains. The decomposition analysis of the total economic value of the water to food grains production depicts that Rs 255 lakh have been generated by 17% of our respondents by accepting Rs 15 lakh pa, which is followed by Rs 180 lakh by 18% respondents with Rs 10 lakh pa and Rs. 110 lakh by our maximum respondents (55%) with Rs. 5 lakh pa indicates small and marginal farmers and their desire to undertake production of food grains. Again, the lower and unfair prices with their wide fluctuations and limited waiting capabilities of the farmers is also an affecting factor.

The farmers in Kolhapur district also undertake production of flowers. But the respondents into our consideration are not producing flowers, and hence no economic value generation. This reveals that in the study area flowers are produced and economic value is generated even by using river water, but unfortunately our selected respondents are not participating in producing flowers. This does not mean river water has no any role and contribution in generating economic value from flower production. It is just a weakness of the sampling method and design. This can be avoided by a census study, but is expensive in terms of time as well as money. But we should also take into account the hidden role of Panchganaga river in generating economic value through flower production. This is adequately proved from the data in Table 4.

Table 4. Economic Value of Water for Production of Flowers

Production of flowers		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Answered / NA	42	42.0	42.0	42.0
	No	58	58.0	58.0	100.0
	Total	100	100.0	100.0	

Source: Field Survey March 2020

Like flowers the production of raw cotton is also undertaken in Kolhapur district, but the respondents under our study are not taking production of raw cotton, hence no

any economic value creation. This is also the same as of economic value form water to production of flowers. In reality the farmers under the study area are using river water to produce raw cotton, but they are not our respondents at this moment. This is again related to sampling method and design. But my observation illustrates that Panchganga river water is used to undertake production of raw cotton and consequently economic value is generated. But as they are not part of our sample, their economic value from production of the raw cotton is missed out. This has resulted in to that extent under estimation of economic value from raw cotton by using river water. The necessary details we find in the data given in Table 5.

Table 5. Production of Raw Cotton and Its Economic Value

Production of raw cotton		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Answered /NA	42	42.0	42.0	42.0
	No	58	58.0	58.0	100.0
	Total	100	100.0	100.0	

Source: Field Survey March 2020

Sugarcane is a major crop in Western Maharashtra and prominently in Panchganga river basin. Hence naturally it is an important source of economic value generation from the Panchganga river water. The detailed data about the sugarcane production and related aspects have been presented in Table 6.

From the data in Table 6, the noteworthy fact is production of sugarcane is undertaken by using river water in the study area is worth of Rs. 380 lakh per annum. Its break up reveals that the majority of households (26%) are getting Rs. 5 lakh per annum, which is followed by Rs. 10 lakh (16%) and Rs. 15 lakh (6%) respectively. This is mainly because the number of small and marginal farmers is big in our household respondents than the large sized farmers. Besides this, we find an excessive supply of sugarcane production due to comparatively less efforts and expenses as well. This is resulting in getting unfair price of sugarcane by the farmers, which is also affecting the income earnings of the sugarcane growing farmers in the study area. If mixed farming along with horticulture and floriculture in sugarcane farming, it will enhance health of soil as well earnings of the farmers. There is urgent need to pay price of sugarcane and other agriculture produce as per cost of production.

Table 6. Production of Sugar Cane and its Economic Value / Income

Income from Sugar cane		Frequency	Percent	Valid Percent	Cumulative Percent	Value of water to Sugar cane
Valid	Not Answered/Not Applicable	52	52.0	52.0	52.0	Nil
	15 lakh	6	6.0	6.0	58.0	Rs. 90 lakh
	10 lakh	16	16.0	16.0	74.0	160
	5 lakh	26	26.0	26.0	100.0	130
	Total	100	100.0	100.0		380

Source: Calculated by the Researcher based on Field Survey March 2020

Table 7. Production of Fruits and Its Economic Value

	Income form Fruits	Frequency	Percent	Valid Percent	Cumulative Percent	Value of Water to Fruit Prod.
Valid	Not Answered/NA	94	94.0	94.0	94.0	Nil
	5 lakh	6	6.0	6.0	100.0	Rs 30 lakh
	Total	100	100.0	100.0		Rs. 30 lakh

Table 8. Vegetable Production and Its Economic Value

	Value from Vegetable	Frequency	Percent	Valid Percent	Cumulative Percent	Value of water to vegetables (Rs in lakh)
Valid	Not Answered/Not Applicable	82	82.0	82.0	82.0	Nil
	Rs. 5 lakh	8	8.0	8.0	90.0	40
	Rs. 3 lakh	2	2.0	2.0	92.0	6
	Rs. 2 lakh	8	8.0	8.0	100.0	16
	Total	100	100.0	100.0		62

Source: Calculated by the Researcher based on Field Survey March 2020

Like sugarcane, now a days fruits are also considered as cash crops, which give income to the producers. But the reality is rather different in Kolhapur district, the farmers prefer the production of sugarcane than fruits. This is adequately revealed from the data in Table 7.

The data in Table7 sufficiently shows that farmers in the area under study prefer sugarcane and neglect the production of the fruits. As a result it could contribute only a meagre and insignificant economic value. This trend among the farmers in the study area is observed because fruits are seasonal, perishable and have to sell at unreasonable prices due to production glut. For this, what is required is mixed cropping along with development of fruit processing units coupled with incentives and support to growers and knowledge and awareness as well. The setting up of agro processing units is urgent need of the hour.

Now a days, the importance of vegetables is increasing day by day due to their relevance in the balanced and nutritional diet. The scenario of the production of vegetable and its monetary value in the study area has been presented in Table 8.

It is adequately proved from the data in Table 8 that, out of our total household respondents only 19% have been engaged in the production of vegetables. As a result, the total income generated from vegetable production stood at Rs. 62 lakh only due to their priority to sugarcane production and majority of households (16%) received income between 2 to 5 lakh with a very lesser share of respondents getting Rs 3 lakh per annum. This trend has been developed among the vegetable growers due to its perishable nature, seasonal in character, unreasonable prices and absence of facility of processing and value addition. The mixed cropping can help us enhancing area and production of vegetable, but surety of price and risk protection mechanism is urgently needed.

Agriculture is a broader economic activity hence it is of crucial importance to analyse the decomposition of the economic value generated by agriculture. All the necessary

statistical information is given in Table 9.

Table 9. Decomposition of Economic Value of Water to Agriculture

Sr. No.	Item	Value (Rs in Lakh)	% Share
1	Food grains	565	54.48
2	Flowers	Nil	00
3	Raw cotton	Nil	00
4	Sugar cane	380	36.64
5	Fruits	30	2.89
6	Vegetables	62	5.97
	Total Value from Agriculture	1037	100

Source: Calculated by the Researcher

From the data in Table 9, it is found that the economic value which agriculture generates by using Panchganga river water is from in all six sources. But all are not of equal importance and weightage, a wide disparity is found. Agriculture could generate an economic value worth of Rs. 1037 lakh per annum. Out of which, the food grains production played a vital role by contributing a lion's share of 54.48%, which is followed by Sugar cane with 36.64% share, and 5.97% by Vegetables and 2.89% by fruits. This reveals the importance of food grains in food security. The farmers also have priority to cash crop of sugar cane. But the neglect of the crops like flowers, raw cotton and less importance to fruits and vegetables is a thing of concern. This indicates an unbalanced and lopsided cropping pattern, which is not income and livelihood sustainable. This is possible through mixed cropping, fair prices, knowledge and awareness and due support and incentives. The setting up of agro processing units will also help a lot in this regard. The agriculture policy with due attention towards all these things is very urgently necessary to incorporate and implement.

Figures play a very important role in showing the trends in very important variables under study, which we can experience from the Figure 1 and 2 below.

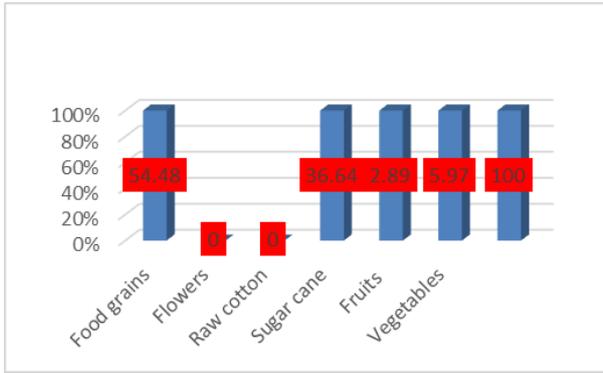


Figure 1. Share of Each Crop in Total Value from Agriculture

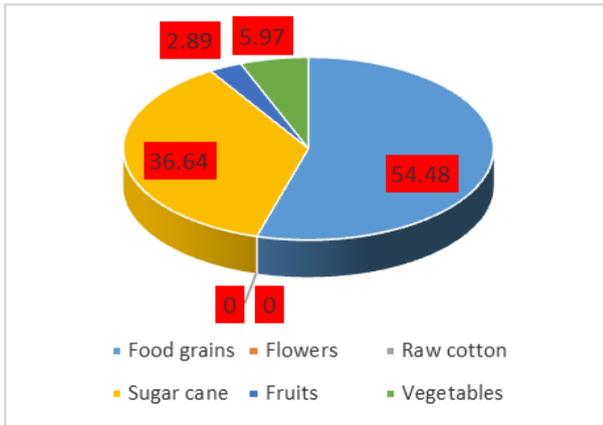


Figure 2. Decomposition of Economic Value from Agriculture

The above figure 1 and 2 show the trends in the

contributions of the different sub agro activities in total agricultural production and their relative shares in economic value from Panchganga river water use in agriculture. This demands a balanced cropping pattern in the study area. This requires the support of industry sector especially agro processing industries.

3) Value of Water to Animal Husbandry

Animal husbandry is an allied activity of agriculture. It is also important and requires water. Therefore, it is very much necessary to examine the role of animal husbandry in generating economic value by using Panchganga river water. The necessary data is illustrated in Table 10.

The data results in Table 10 indicates that, it is well that a considerable number of household respondents (42%) are busy in animal husbandry, and more importantly they use river water. The value of the Panchganga River water to allied activities is worth of Rs. 107 lakh per annum is no doubt, a considerable one, but not appreciable. The majority of our household respondents (22%) received Rs 2 lakh income per annum, which is followed by Rs. 3 lakh (11%) and Rs. 5 lakh (6%) respectively. This is mainly because the respondents under our consideration are not aware of the importance and relevance of the animal husbandry as an agro allied activity. It is very much effective in enhancing the level of income and development of other economic activities also. The development of processing of products of animal husbandry activities and the assured market will enable in their growth and development.

Table 10. Value of Water from Animal Husbandry

Value from Animal Husbandry		Frequency	Percent	Valid Percent	Cumulative Percent	Value of water to Animal Husbandry (Rs. In lakh)
Valid	Not Answered / NA	61	61.0	61.0	61.0	Nil
	Rs. 5 lakh	6	6.0	6.0	67.0	30
	Rs. 3 lakh	11	11.0	11.0	78.0	33
	Rs. 2 lakh	22	22.0	22.0	100.0	44
	Total	100	100.0	100.0		107

Source: Calculated by the Researcher based on Field Survey March 2020

Economic Value of Water from Fishing:

Like animal husbandry, fishing is also a very important agriculture allied activity, but it is very closely linked to river and its water. Fishery resources, in the balanced and nutrient diet, are of crucial importance. But that knowledge and awareness is very much needed. The necessary statistical information about it we get in Table 11.

Table 11. Economic Value of Water from Fishing

Participating in Fishing		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not Answered / NA	42	42.0	42.0	42.0
	No	58	58.0	58.0	100.0
	Total	100	100.0	100.0	

Source: Field Survey March 2020

It is clear from the data in Table 11 and interviews and discussion that fishing is carried out in the Panchganga river water, but the households under our consideration carry out fishing for self-consumption and not for sale. It is unfortunate that the fishery farmers are not our respondents at this moment, but that does not mean fishery production is not being carried out in the Panchganga river basin. It is a well-known fact that the prices of fishes are always remunerative. But it is seasonal occupation and fishery is highly perishable. But support and incentives of the government and development of processing units will definitely enable fishery activities in the basin area and also enhance level of income of the growers. Even fishery

production for the self-consumption is also substantially increase its production and real income earnings.

4) Value of Water to Industry:

Industry plays a very vital role in the rapid and higher economic growth of the economy. This poses the need for examining the role played by the industry in generating income or economic value with the help of water of the Panchganga river. Table 12 below shows useful data relating to industry only in the study area.

From the data in Table 12, the contribution of industry in generating an economic value of river water is no doubt considerable and not negligible. The economic value generated by the industry by using river water is worth of Rs. 60 lakh per annum. Its break up reveals that a majority of our respondents received (5%) Rs 5 lakh per annum , which is followed by (2%) respondents with Rs. 10 lakh pa and Rs 15 lakh pa (1%), which indicates even though Kolhapur is industrially developed area the industry sector is dominated by small, micro and medium industries in the study area, which require lesser water and also the earnings are lower. The Industrialisation in the urban and sub urban areas coupled with agro processing and allied activities is needed, which can increase the demand for river water and also earnings from them. Industry is an assured and well proved source of rapid and overall development of the economy. Hence industrial development should be given priority and lion's share in the development policy of the central, state as well as local government in the country like India.

Table 12. Source, Requirement and Economic Value of Water for Industry

Water Requirement		Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	Not Answered/Not Applicable	92	92.0	92.0	92.0	
	10000 liters	1	1.0	1.0	93.0	
	5000 liters	4	4.0	4.0	97.0	
	2000 liters	3	3.0	3.0	100.0	
	Total	100	100.0	100.0		
Value of Water / Income		Frequency	Percent	Valid Percent	Cumulative Percent	Value of water to industry (Rs in lakh)
Valid	Not Answered/Not Applicable	92	92.0	92.0	92.0	Nil
	15 lakh	1	1.0	1.0	93.0	15
	10 lakh	2	2.0	2.0	95.0	20
	5 lakh	5	5.0	5.0	100.0	25
	Total	100	100.0	100.0		60

Source: Calculated by the Researcher based on Field Survey March 2020

5) Value of Water to Business:

Like industry, business is also very important economic activity, which also requires the use of water. The adequate data relating to the development of business is depicted in Table 13.

The data in Table 13 sufficiently shows that, economic value of the Panchganga river water supplied to businesses is naturally considerable, which stood at Rs. 190 lakh per annum. The further analysis of the breakup of the economic value from use of water for business reveals that the majority of business households (13%) received income worth of Rs 5 lakh pa, which is followed by Rs 10 lakh pa (7%), Rs 20 lakh pa (2%) and Rs 15 lakh pa (1%) respectively. This is because the Kolhapur district has cities and towns and not metros, hence the extent and magnitude of business activities is comparatively smaller and medium and they are getting comparatively smaller amount of earnings. Besides this, the business communities have alternative sources of water such as bore well, well than the

river. These have impact on earnings from businesses and the generation of the economic value from the Panchganga river water. Actually, Kolhapur is an industrially and business district with considerable industrial and business development, but it is just because of our respondents in business activities. What is urgently needed is, the growth and development of the business activities in the small cities, cities and sub urban areas also.

Ecosystems do not only provide consumptive services, but also provide non consumptive or social or cultural services.

6) Value of Panchganga River as a Religious place:

Religion has a special importance in the life of human beings. India is known as a religious country. Hence it is relevant to examine the economic value of the Panchganga river as a religious place, which is a social service. The useful data is given in Table 14.

Table 13. Source, Requirement and Value of Water for Business

Quantity of Water Required		Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	Not Answered/NA	79	79.0	79.0	79.0	
	10000 liters	1	1.0	1.0	80.0	
	7000 liters	4	4.0	4.0	84.0	
	5000 liters	6	6.0	6.0	90.0	
	2000 liters	10	10.0	10.0	100.0	
	Total	100	100.0	100.0		
Value of Water		Frequency	Percent	Valid Percent	Cumulative Percent	Value of water to business (Rs in lakh)
Valid	Not Answered/Not Applicable	77	77.0	77.0	77.0	Nil
	Rs. 20 lakh	2	2.0	2.0	79.0	40
	15 lakh	1	1.0	1.0	80.0	15
	10 lakh	7	7.0	7.0	87.0	70
	5 lakh	13	13.0	13.0	100.0	65
	Total	100	100.0	100.0		190

Source: Calculated by the Researcher

Table 14. River as a Religious Place and its Economic Value

Willingness to Pay		Frequency	Percent	Valid Percent	Cumulative Percent	WTP Religious value of river (Rs in lakh)
Valid	Not Answered /NA	15	15.0	15.0	15.0	Nil
	Rs. 20 lakh	7	7.0	7.0	22.0	140
	15 lakh	39	39.0	39.0	61.0	585
	10 lakh	22	22.0	22.0	83.0	220
	5 lakh	17	17.0	17.0	100.0	85
	Total	100	100.0	100.0		1030
Value of River as a Religious place		Frequency	Percent	Valid Percent	Cumulative Percent	Actual Religious value of river (Rs in lakh)
Valid	Not Answered /NA	16	16.0	16.0	16.0	Nil
	Rs. 20 lakh	12	12.0	12.0	28.0	240
	15 lakh	38	38.0	38.0	66.0	570
	10 lakh	25	25.0	25.0	91.0	250
	5 lakh	9	9.0	9.0	100.0	45
	Total	100	100.0	100.0		1105

Source: Calculated by the Researcher based on Field Survey March 2020

From the data in Table 14, a significant number of respondents are willing to pay for the protection, conservation of the river as an ecosystem, which forms its economic value. The economic value of the river as a religious place stood at Rs. 1030 lakh, which is really significant and substantial as well. It has been mainly contributed by Rs. 15 lakh (39%), which is followed by 10 lakh (22%), 5 lakh (17%), and 20 lakh (7%) respectively. This reveals that people are desirous to subscribe a part of their total income as a value of the river ecosystem. This indicates that the people are well aware of the role and importance of the river in the socio economic development of the economy and society. It is a well-known fact that river provides the number of services useful for the wellbeing of the people and consequently that gives an increased satisfaction. They look at river as a religious place not as a blind belief and superstition, but its role and relevance in the human welfare. It is need of the hour to further increase the contribution of the river eco system in generating economic value. The sources through which the importance and role of river as a religious place can be increased through providing knowledge and awareness, fairs and trades, commercial and business complexes, development of tourist and visit place and more importantly development of transport and communication infrastructure and facilities. Besides this, the respondents also give economic value to the river as a religious place, when it is considered the total economic value stood at Rs. 1105 lakh.

7) Value of Panchganga River as a Recreational Place:

Likewise, some people also look at river ecosystem as a recreational place and consequently assign economic value. This also necessitates discussing on the economic value of

the Panchganga river as a place of recreation. Table 15 provides the necessary statistical information.

Really it is noteworthy that, a majority (67%) of our respondents believe that river is a place of recreation and consequently contributes to the economic value, which stood at Rs. 800 lakh, that comprised of prominently Rs. 10 lakh per annum (29%), Rs. 15 lakh (22%), Rs. 5 lakh (16%), and Rs. 20 lakh (5%) respectively. This is a clear indicator that people derive benefits of recreation from the river as an ecosystem. People look at river in a perspective of a source of recreation. It is because, river has a natural beauty. Besides this, the entertainment from river is spiritual environment. As a result, people derive recreational benefits of river. As a result, they have assigned a significant economic value of Rs. 800 lakh to the Panchganga river as a recreational place. Still people are not educated and aware of the role of the river as a means and source of entertainment. When in that direction the efforts will be undertaken then the more and more people will attract towards river for their entertainment and enhancing the level of satisfaction and wellbeing. But one thing is very much clear that when more and more people take entertainment benefits of river, which will increase economic value of the river ecosystem and further it will raise the total economic value of the river ecosystem services. The ignorance and absence of awareness is very much responsible for under estimation of the value of river as a recreational place.

8) Aesthetic Value of River:

People have also the perspective of looking at river as an aesthetic place and consequently it has an economic value. The necessary data is depicted in Table 16.

Table 15. River is a Recreational Place and its Economic Value

	Value	Frequency	Percent	Valid Percent	Cumulative Percent	Recreational value of river (Rs in lakh)
Valid	Not Answered/NA	28	28.0	28.0	28.0	Nil
	Rs. 20 lakh	5	5.0	5.0	33.0	100
	15 lakh	22	22.0	22.0	55.0	330
	10 lakh	29	29.0	29.0	84.0	290
	5 lakh	16	16.0	16.0	100.0	80
	Total	100	100.0	100.0		800

Source: Calculated by the Researcher based on Field Survey March 2020

Table 16. River as an Aesthetic Place and its Economic value

	Value of River as an Aesthetic Place	Frequency	Percent	Valid Percent	Cumulative Percent	Aesthetic value of river
Valid	Not Answered/Not Applicable	16	16.0	16.0	16.0	Nil
	Rs. 20 lakh	32	32.0	32.0	48.0	640
	15 lakh	19	19.0	19.0	67.0	285
	10 lakh	25	25.0	25.0	92.0	250
	5 lakh	8	8.0	8.0	100.0	40
	Total	100	100.0	100.0		1215

Source: Calculated by the Researcher based on Field Survey March 2020

The data results in Table 16 reveals that, it is very important that a majority and significant (84%) number of our respondents have a faith in the river has an aesthetic importance. Hence they assign an economic value to the aesthetic services being provided by the river ecosystem. In our study, the economic value of the aesthetic services of the Panchganga river is worth of Rs. 1215 lakh per annum, is really considerable, which reveals that the major share is of Rs. 20 lakh per annum (32%), which is followed by Rs. 10 lakh (25%), Rs. 15 lakh (19%) and Rs. 5 lakh (8%) respectively. In the real sense of meaning, the economic value as an aesthetic source assigned to river is large when we take into account the size of sample and its stratification. Actually, understanding the concept of aesthetic value and deriving such benefits is possible in the case of educated only, and cannot be expected from illiterate. And the area under study is not that level of literacy. When people are having the knowledge and awareness of aesthetic benefits and value then more and more people will derive such benefits and consequently economic value of such a service of river eco system will increase substantially. This requires the efforts for education, knowledge, awareness and importance of the aesthetic services and benefits of river ecosystem, which requires government policy as well as people's movement and awareness in this regard.

9) Value of River as a Tourist place:

It is a well-known fact that river is well recognized as a tourist place. This necessitates examining the economic value of the Panchganga river as a tourist place. The useful data in provided in Table 17.

It is clear from the data in Table 17 that the economic value of the Panchganga river is considerable and not negligible. It is worth of Rs. 580 lakh per annum, with a major contribution of Rs. 10 lakh (21%), which is followed by Rs. 15 lakh (16%), Rs. 5 lakh (6%), and Rs. 20 lakh (5%) respectively. This is sufficient to infer that people in the Panchganga river basin are deriving benefits as a tourist place. And this is in accordance with the recent trend developed among the people about tourism and its role in satisfaction and wellbeing. But the noteworthy thing is still the people do not have the knowledge and awareness about the tourism benefits of the river. As a result, to the extent desirable, people are not deriving the benefits of the river as a tourism place. This has resulted in undervaluation of the river as a source of tourism services and their benefits. For this, what is required is along with creating awareness and knowledge about the importance of the river as a tourist place, it is also required to develop river sites as tourist spots. This will enable correct valuation of this service of river as an ecosystem, and increase its economic value as well. In this regards, the government and educational institutes, colleges and universities can play a crucial role.

10) Habitat of Genetic / Rare Species in Agriculture/ Fish/ Fruits:

River is also a habitat center for the rare species in agriculture, fish, fruits and others etc. This naturally assigns economic value to the river ecosystem. Its analysis in the context of Panchganga river is very much necessary. This can be analysed with the help of data in Table 18.

Table 17. River as a Tourist place and its Economic Value

Value of River as a Tourist place		Frequency	Percent	Valid Percent	Cumulative Percent	Value of River as a Tourist Place (Rs in lakh)
Valid	Not Answered/Not Applicable	52	52.0	52.0	52.0	Nil
	Rs. 20 lakh	5	5.0	5.0	57.0	100
	15 lakh	16	16.0	16.0	73.0	240
	10 lakh	21	21.0	21.0	94.0	210
	5 lakh	6	6.0	6.0	100.0	30
	Total	100	100.0	100.0		580

Source: Calculated by the Researcher based on Field Survey March 2020

Table 18. Genetic / rare species in agriculture/ fish/ fruits and its Value

Value of River as source of Genetic / Rare Species		Frequency	Percent	Valid Percent	Cumulative Percent	WTP for rare species (Rs in lakh)
Valid	Not Answered/Not Applicable	54	54.0	54.0	54.0	Nil
	Rs. 20 lakh	1	1.0	1.0	55.0	20
	15 lakh	18	18.0	18.0	73.0	270
	10 lakh	20	20.0	20.0	93.0	40
	5 lakh	7	7.0	7.0	100.0	35
	Total	100	100.0	100.0		365

Source: Field Survey March 2020

From the data in table 18, the economic value of the river under study as a habitat of Genetic / Rare Species in Agriculture/ Fish/ Fruits stood at Rs. 365 lakh per annum, which is decomposed as 10 lakh (20%), 15 lakh (18%), 5 lakh (7%) and 20 lakh (1%) respectively. It is really considerable, but might not be significant. The reasons are simple and common. The majority of people do not know this service of the river ecosystem. Likewise, they also do not know the need and importance of such service and its benefits. But the thing of appreciation is some people know that only they are contributing to the economic value of river ecosystem from this service. It is of crucial importance to increase the contribution of this service and consequently value in the total economic value. This is possible through reaching to the entire society by education, knowledge, awareness and providing necessary infrastructure and other facilities.

11) Willingness to Pay for Panchganga River:

The economic value of the ecosystems is estimated not only on the basis of its services provided and their economic values, but also the willingness to pay of the people. This is also one of the indicators and method of valuation of the ecosystem services. The necessary data is presented in Table 19.

From the data in Table 19, it is observed that the people in the Panchganga river basin are desirous to give monetary subscriptions and contributions as they derive the number of benefits from its a variety of services being provided. The total economic value of the Panchaganga as an ecosystem stood at Rs. 3180 lakh per annum, is really a significant one. It is an indicator of the contribution of river

ecosystem to the economic development of the economy. But compared to the actual economic value estimated on the basis of the services provided by the Panchganga as an ecosystem is considerably lower, which is the result of the human tendency. It is because, everybody desires to accept more amount as a compensation, but ready to pay less as subscription. This sufficiently proves that people are ready and desirous to pay for the preservation, conservation and protection of the Panchganga river as an ecosystem, is really a thing of appreciation. But the respondent households or people are willing to pay for the river as an ecosystem is very important and appreciable as well.

12) Total Economic Value of Panchganga River Ecosystem Services:

There is a very close relationship between ecosystem and economic development of the economy. The sum total of benefits both the economic as well as noneconomic of the services provided by the ecosystems are eco system services.

According to [13] Chee, Yung (2004) the Principal techniques for monetary valuation comprise of 1) Market-based with Production approach have Production function analysis (PF); replacement or restoration cost (RC). 2) Surrogate market having Revealed preference approach includes Travel cost method (TCM); hedonic pricing (HP). 3) Simulated market has a Stated preference approach comprises of Contingent valuation (CV). The present study has used a combination of market based and surrogate market techniques and methods, wherever applicable for the economic valuation of the Panchganga river ecosystem services. It is adequately proved from the data in Table 20.

Table 19. Valuation (Willingness to Pay) of Panchganga river

		Frequency	Percent	Valid Percent	Cumulative Percent	WTP of Panchganga (Rs in lakh)
Valid	Rs. 50 lakh	37	37.0	37.0	37.0	1850
	Rs. 25 lakh	41	41.0	41.0	78.0	1025
	Rs. 15 lakh	17	17.0	17.0	95.0	255
	Rs. 10 lakh	5	5.0	5.0	100.0	50
	Total	100	100.0	100.0		3180

Source: Field Survey March 2020

Table 20. Total Economic Value of Panchganga Ecosystem and Its Components

Sr. No	Item / Component	Value (Rs in lakh)	% Share
1	Domestic use	0.41	7.50
2	Agriculture	1037	18.99
3	Agriculture Allied	107	1.95
4	Industry	60	1.09
5	Business	190	3.48
6	Religious Place	1105	20.24
7	Recreational Place	800	14.65
8	Aesthetic Value	1215	22.25
9	Tourist Value	580	10.62
10	Value of Rare Species	365	6.68
	Total	5459.41 lakh	100
	WTP for Panchganga	3180 lakh	

Source: Calculated by the Researcher

From the data in Table 20, it is found that, though there are the number of components of total economic value of the Panchganga river services, there are only a few components which are prominent and dominant. They are agriculture (19%), religious place (20%), Recreational place (15%), and aesthetic value (22%). This is because the importance of agriculture in general, and food grains in particular is well known and people give more importance to the social services of the river ecosystem even though they are not known much about them. When they will fully equip with the knowledge and awareness of the social services of the river ecosystem this will further increase the economic value of the ecosystem. But the need of the hour is, in the economic components all the components should contribute significantly. Besides this, the contribution of the non-economic or social services also should increase in total value so that the total economic value of the river ecosystem will increase and more importantly the contribution to the development of the economy will increase significantly. But the focused policies and efforts are very much needed for this.

Figures show trends in important variables under study very clearly and adequately. It can be proved from the figure 3 and 4.

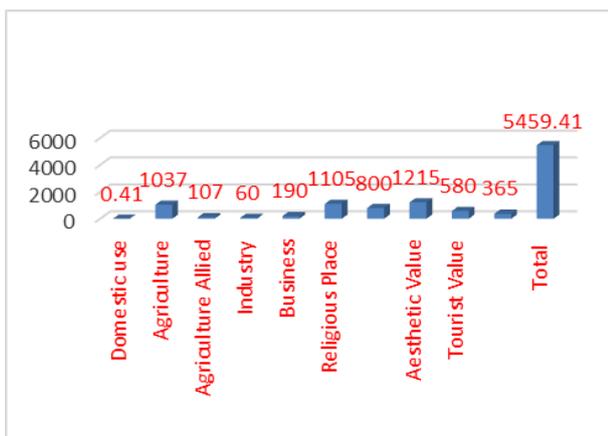


Figure 3. Contribution of Different in Total Value of Panchganga River

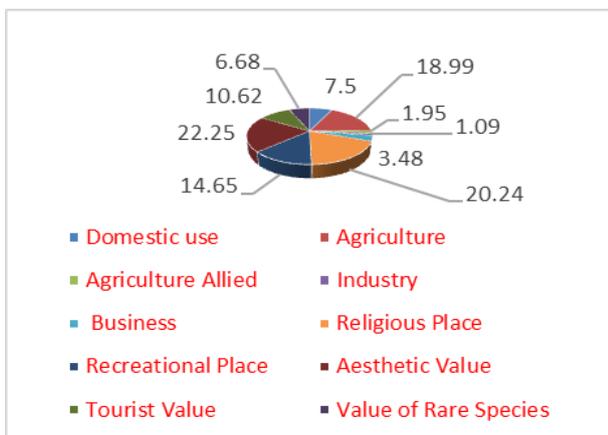


Figure 4. Components of Economic Value of Panchganga River

It is adequately revealed from the figure 3 and 4 that the absolute as well as relative / percentages contributions of the different components are different with wide variation in the total economic value of the Panchganga river ecosystem services.

13) Consumptive and Non Consumptive Use Value of Panchganga Services

Direct Use Value (of Ecosystems): The economic or social value of the goods or benefits is derived from the services provided by an ecosystem that are used directly by an economic agent. These include consumptive uses (e.g., harvesting goods) and non-consumptive uses (e.g., enjoyment of scenic beauty). Table 21 provides the necessary data about it.

Table 21. Consumptive and Non Consumptive Use Value of Panchganga Services

Sr. No	Item / Component	Value (Rs in lakh)	% Share
1	Consumptive Direct Use Value	1334.41	24.44
	i) Domestic use	0.41	0.03
	ii) Agriculture	1037	77.71
	iii) Agriculture Allied	107	8.01
	iv) Industry	60	4.49
	v) Business	190	14.23
2	Non Consumptive Direct Use Value	4125	75.55
	i) Religious Place	1105	26.78
	ii) Recreational Place / Value	800	19.39
	iii) Aesthetic Value	1215	29.45
	iv) Tourist Value	580	14
	v) Value of Rare Species	365	8.84
3	Total Direct Use Value	5459.41	100
	WTP for Panchganga	3180	

Source: Calculated by the Researcher

The data in Table 21 shows that, Total direct use value of the services supplied by the Panchganga river to the urban areas of the Kolhapur district is worth of Rs. 5459.41 lakh, is no doubt a significant value. Fortunately, it is substantially greater than the willingness to pay (WTP) shown by the respondents. The total economic value of the services of the Panchganga eco system is mainly non consumptive and very much greater than consumptive value, is an indicator of how people give more importance to river ecosystem and its social services such as a religious and cultural means than the economic resource. It is a good sign that people besides direct consumptive services they also like non consumptive services of the river. And more importantly, they are more in quantity as well as value than the non-consumptive services. Besides this, the people do

not know much about the non-consumptive services and their value of river. When the people get equipped with their importance, knowledge and awareness naturally further quantum and value will increase and consequently their contribution in total economic value as well as overall development of the economy will also increase. But purposeful and systematic efforts in this regards are very much and urgently needed. The further analysis of the breakup of both the consumptive and non-consumptive value of Panchganga river ecosystem reveals that the non-consumptive value has been prominently contributed by the aesthetic value (29.45%), and agriculture (78%) was dominant for consumptive value.

The figure 5 and 6 below reveals the trends in consumptive and non-consumptive value of the Panchganga river in absolute terms as well relative terms as well.

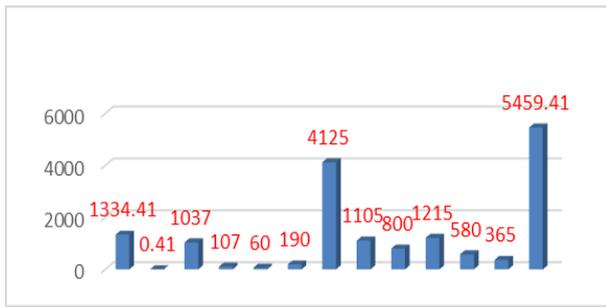


Figure 5. Consumptive and Non Consumptive Contributors of Total Value of Panchganga River

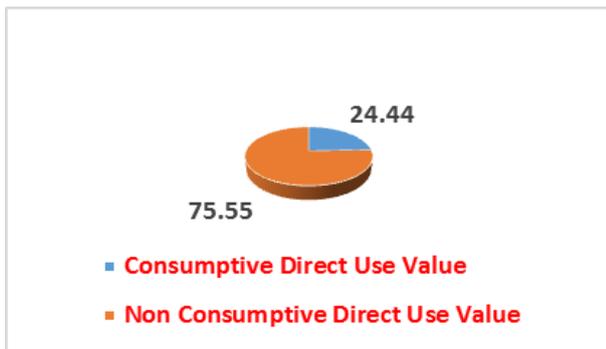


Figure 6. % Share of Consumptive and Non Consumptive Value in Total Value

From the figure 5 and 6 the contributions of the different items of consumptive and non-consumptive value have wide variations in absolute as well relative terms indicating differences in their importance and role in development.

14) Determinants of Economic Value of Eco System Services of Panchganga River:

It is not just the estimation of the economic value of the ecosystem services is sufficient and adequate, but it is also inevitable and desirable to attempt for the analysis of the determinants of the economic value of the river as an ecosystem.

Table 22. Determinants of Economic Value of Ecosystem Services of Panchganga River

Sr. No	Item / Component	Value (Rs in lakh)	% Share
1	Domestic use	0.41	0.75
2	Agriculture & Allied	1144	20.95
3	Industry	60	1.09
4	Business	190	3.48
5	Others	4065	74.45
	i) Religious Place	1105	27.18
	ii) Recreational Place	800	19.68
	iii) Aesthetic Value	1215	29.88
	iv) Tourist Value	580	14.26
	v) Value of Rare Species	365	8.97
	Total	5459.41	100

Source: Calculated by the Researcher

It is observed that the determinants of the economic value of the Panchganga river ecosystem are basically divided into domestic use of water, agriculture & allied, industry, business and others comprising of religious place, recreational place, aesthetic value, tourist place and the value for rare species, which are social services of the ecosystem. It is adequately proved that others is a prominent determinant with a major contribution of 74.45% to the total value, which is followed agriculture & allied activities .business, industry and domestic use of water respectively. This adequately reveals that people want economic services of the ecosystem like river. But they also want and like non-economic or social services of the ecosystem. And in this study, it is observed that people prefer social services than economic services. Hence the value and contribution of social services or others is more and increasing. This indicates that along with economic services of the ecosystem, we should also attempt for extracting the benefits of the non-economic or social services of the ecosystem and their role in the development of the economy and consequently in the welfare of the society. The study observes that policy and practice related to water management have failed to create inclusive solutions due to blinkered disciplinary thinking about a resource that plays multiple sociocultural, environmental, economic and ecological roles [14].

The application of descriptive statistics for data analysis is provided below.

	N	Minimum	Maximum	Mean
Total Value	1	5459.410	5459.410	5459.41000
Domestic Use	1	.410	.410	.41000
Agriculture	1	1144.000	1144.000	1144.00000
Industry	1	60.000	60.000	60.00000
Others	1	190.000	190.000	190.00000
Valid N (listwise)	1			

The application of the descriptive statistics for the data analysis, especially on the determinants of economic value of the services of Panchganga river ecosystem points out that the total economic value of the ecosystem services was worth of Rs. 5459.41 lakh on an average. This was ranged between the minimum and maximum of Rs. 5459.41 lakh. The average economic value contributed by the agriculture stood at Rs. 1144 lakh and remained the same for minimum as well maximum. In the case of industry, it was Rs. 60 lakh and Rs. 0.41 lakh for domestic use and Rs. 190 lakh for others. The application of the descriptive statistics reveals that in generating total economic value of the Panchganga river ecosystem the agriculture was important and prominent, which was followed by Others, Industry and Domestic use respectively. This further highlights the role and importance of the agriculture dependent on river water in the food security as well as overall development of the economy. The study concludes that present strategy of investment in flood control through dams and embankments is doing more harm than good [15].

5. Major Conclusions and Policy Suggestions

The empirical analysis of the economic valuation of the services in monetary terms being provided by the Panchganga river ecosystem estimates its total economic value. No doubt, it is worth of Rs. 5459.41 lakh per annum is really important and valuable, which indicates its role in the socio economic development of the area and economy under our study. It is an indicator of the number and variety of services being provided by the Panchganga river useful for agriculture, allied activities, industry and business development along with water for domestic use of the area and its people. But this economic value is restricted to sample area and sample respondents only, which can be very much larger and higher relating to entire area and population of the Kolhapur district of Maharashtra state in India. It plays an important role in the development of the economic activities mentioned above by supplying its very valuable water. The study concludes that our urban metabolism framework treats the city as a tightly-coupled social-ecological system and shows that a spatially explicit understanding of consumption patterns is crucial to addressing three central aspects of the water conundrum – equity, ecological sustainability and economic efficiency [16]. Besides this, Panchganga also provides the non-consumption services like religious place, aesthetic value, tourist place, recreational place, rare species habitat center and others, which are non-economic or social services. People have a perspective that they give more importance to non-economic or social/cultural services (75%) than the economic services (25%) of the Panchganga ecosystem, is really surprising and peculiar even in the era of science, technology and modern. In economic services the

agriculture and allied activities and their value is so much higher hence ahead (21%) than services to other economic activities is a proof of importance of the agriculture and allied activities for the survival of the human beings. The study infers that preferences of the households and the resulting WTP values reveal that the households are more concerned about minimising certain harmful effects that affect the quality of the marsh as well as their welfare [17]. The analysis of the determinants of the economic value of the Panchganga river ecosystem reveals that the non-economic than the economic factors are very much dominant and effective in generating the total economic value of the Panchganga ecosystem services. The research reveals that there is agreement about the existence and importance of the links between ecosystem services (both market and non-market) and the underlying stocks of ecosystem assets from which they are generated, as well as the use of these services by economic units [18].

It is very much urgently needed to consider the importance of the economic services of the eco system like river in economic development of the economy. The rigorous efforts are urgently needed for extracting non-economic services fully and their benefits and role in the overall development. The provision of imparting education and creating awareness among the people about the ecosystem services, their value and their role in development and welfare of the society is necessary to be made. The government should enlist the river ecosystems, their services, quantification and the data is necessary and urgently needed to avail and preserve. The budgetary provisions of all layer governments for the conservation, protection, maintenance and growth of ecosystems and their services should be made adequately.

6. Concluding Remarks

River ecosystems are a means and source of development especially of the economy in its catchment area and basin. Hence the estimation of the economic value, their components and determinants is of crucial importance. But one single study especially a research paper is not sufficient and adequate at all, which requires the number of such studies in the variety of forms. This will enable proper allocation and utilization of the natural ecosystem like river and its variety of services, and more importantly their economic importance and contribution to the development of the economy and society as well.

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