JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Profitability of Irrigated Agriculture: A Case Study of Paddy Cultivation in Barpeta District, Assam

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Abstract: This study investigates the profitability of irrigated agriculture as compared to rain-fed agriculture by considering a development block of Assam as case study. The study reveals that there is urgent need of creation irrigation potentiality in the state as well as its utilization. The study shows that the use of irrigation in the agriculture increases production but it is less profitable as compared to non-irrigated agriculture. However, use of irrigation has positive impact on employability and production.

Index Terms **– Irrigation, Paddy, Kharif, Rabi, RIPI**

1. INTRODUCTION

Among the others irrigation is considered as an important input to boost agricultural productivity. Increased agricultural productivity not only provides better income but also it is considered as an important component of food security. According to Global Hunger Index 2021, with a score of 27.5, the level of hunger in India is serious. Necessity of irrigation arises due to increase in population, which results in falling per capita availability of land. Significant association has been also found between development of irrigation and agriculture (Ghosh et al., 2012).

Besides, rainfall data revealed that precipitation is insufficient during the agricultural year with a high variation throughout the country (Chatterjee N, 1995). Therefore, to increase agricultural production by bringing additional land under cultivation, by increasing cropping intensity and by increasing farmland productivity; importance should be given on irrigation (Joshi B.H., 1999). Recognizing the importance of irrigation as a crucial input in India's agricultural development, harnessing of water resources for irrigation has been given an important place in our successive Five-Year Plans. Besides, due to the varying magnitude of growth in source-wise irrigated area, perceptible shifts of sources from canal and tank irrigation to well irrigation was observed over space and time (S Selvaranjan, *et al., 2001*).

Assam the gateway of Northeast India is basically an agricultural state. Agriculture plays a vital role in the economy of Assam as it shares 22 percent to the Gross State Domestic Product of the state and support about 70 percent of rural population in terms of occupation and livelihood support (Economic Survey, Assam, 2021-22). However, there is a general hype that as a rain fed state Assam does not require irrigation infrastructural facilities since rainfall is very high in this region compared to other major agricultural states[1]. But the perception contradicts to the rainfall data since rainfall pattern of the states is uneven, which occurs heavily during the Kharif season, causing floods in the whole Brahamaputra Agro Climatic Zone in one hand and on the other, precipitation is less than annual average during the Rabi season. Besides it is a fact that productivity of important crops in the state also showed mixed results due to various reasons. For example, the average yield rate of rice production in Assam was 1802 kg per hectare as against 2638 kg per hectare for the country in 2018-19 (RBI, online database). Again, the productivity of wheat was 1398 kg per hectare against that of 3533 kg for the country for the year 2018-19. Thus it reflects that to sustain agricultural production, state should not only increase the agricultural land uses but also use its available water resource through irrigation (Nigam J, 2006).

In order to increase production and to accelerate agricultural productivity, Government of Assam started major, medium and minor irrigation projects. Due to a number of reasons[2] major and medium irrigation schemes in Assam cannot realize the expected potentiality, for which minor irrigation schemes still serves the purpose (Dutta, 2002). Of minor irrigation schemes Deep Tube Well schemes have failed to encompass their objective and under the auspices of various schemes such as World Bank funded Assam Rural Infrastructure and Agricultural Services Society (ARIASP), NABARD's Samriddha Krishak Yojana (SKY) and Rural Infrastructure Development Fund (RIDF), Shallow Tube Well (STW) irrigation becoming more and more practiced. Although various department of state government are emphasizing on irrigation potentiality creation at the same time we have to think on the both impact of irrigation on farmers and on farmland. Regarding the impact of irrigation Gogoi M found that as a cumulative effect of increased crop intensity, adoption of HYV *Ahu* rice cultivation and enhanced yield rates of all irrigated crops, there had been an augmentation in the total volume of agricultural production in the sample areas (Dutta, 2002). But it did not look into the monetary impact of irrigation on small farmer.

Therefore, the present study endeavors to assess impact of irrigation on productivity and monetary gains. The paper also tries to analysis of the problem of farmers regarding irrigated agriculture.

The study is based on both primary and secondary data. The impact of irrigation has been studied with the help of secondary data collected from different published government's reports and publications, online databases and websites etc. Since secondary information regarding cost-benefit of irrigated agriculture is not available, therefore a case study method is devised by conducting household survey of two villages under Chenga Development Block of Barpeta district in the February, 2021. The data so collected are analyzed with suitable statistical techniques.

The paper is divided into four sections. Section I delves with the background and importance of the study. Section II discusses the present status of irrigation in Assam. In section-III, findings of the study are analyzed, which is followed by section IV, where conclusion from the study has been made.

2. STATUS OF IRRIGATION IN ASSAM

Irrigation development in Assam has started since first five-year plan under the auspices of irrigation and agriculture department of Assam, which got momentum after the World Bank's project under the name of Assam Rural Infrastructure and Agricultural Services Project (ARIASP) in 1995 with NABARD's Samriddha Krishak Yojana (SKY) and Rural Infrastructure Development Fund. In view of the uncertainties in the production of Kharif crop due to flood and high rainfall, the State Agriculture Department has emphasised on Rabi crops by developing assured irrigation facilities through installation of pump sets, especially Shallow Tube Well (STW) and Low Lift Pump (LLP).

At present the development of irrigation facilities in the state has been done though the departments of Irrigation, Agriculture, and Panchayat & Rural Development. Irrigation department as a nodal department works and maintains major, medium and minor irrigation schemes while other two departments are confined to only minor irrigation schemes.

Out of the total geographical area of 78.44 lakh hectares, the Gross Cropped Area (GCA) of Assam is 40.64 lakh hectares up to 2019-20 (Economic Survey, Assam, 2021-22). As on 31 March 2015, the state had irrigation potential of 11.27 lakh hectares, which is 40 percent of the net cropped area and out of which, only 7.33 lakh hectares (26% of the net cropped area) was under utilizable assured irrigation (Department of Irrigation, GoA).

Although the development of irrigation facility in the state has been done through various schemes and projects, at present the development of the same has been emphasized through Rural Infrastructure Development Project (RIDF), Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Rastriya Krishi Vikash Yojana (RKVY) and Bringing Green Revolution to Eastern India (BGREI). According to the State Irrigation Plan prepared under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) scheme, present scenario of crop water demand in Assam is portrayed in table 1.

Table 1- Present Scenario of Crop Water Demand in Assam

Gross Cropped area	4075871 Ha
Net Cropped Area	2817500 Ha
Irrigated area	748530 Ha
Irrigation potential created (As on 31st March, 2015)	11.27 Lakh Ha (40% of the net cropped area)
Net cropped area brought under utilizable assured irrigation	7.33 Lakh (26% of the net cropped area)
Crop water demand	29065 MCM
Water potential requirement	29065 MCM
Existing water potential	9008 MCM
Water potential to be created	20371 MCM

Source: Department of Irrigation, Government of Assam

Table 1 reflects that net cropped area is about 69 percent of the gross cropped area. Besides, against crop water demand of 29065 MCM, the existing water potential is 9008 MCM only. Thus it reflects that the existing crop water potential can only met 31 percent of the crop water demand.

As a major provider of irrigation facilities in the state, the irrigation department has alone created 10.41 hectare as on March, 2021. Table 2 details the different government irrigation schemes executed by irrigation department in Assam. As reflected in the table, it is observed that out of 20 major and medium irrigation schemes of different types 80 percent has been completed as on 2020-21. Similarly, the completion rate of minor irrigation schemes is 74.6 percent. It is also observed from the table that majority of the irrigation schemes are belong to the minor irrigation scheme. The completion rate of *Har Khet Ko Pani* under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY-HKKP) is 24.2 percent of the total.

Table 2: Number of Government Irrigation Schemes (up to 2020-21)

Status of Irrigation Schemes	Category	Major & Medium	Minor	Total
Completed	Surface Flow	13	1614	1627
	Surface Lift	3	483	486
	GW Lift		785	785
	Total	16	2882	2898
	PMKSY-HKKP		2348	2348
Ongoing	Surface Flow	3	378	381
	Surface Lift	1	139	140
	GW Lift		465	465
	Total	4	982	986
	PMKSY-HKKP		7347	7347
Total irrigation schemes		20	3864	3884
% of total irrigation schemes completed		80.0	74.6	74.6
Total PMKSY HKKP-Tube Wells		-	9695	9695
% of PMKSY HKKP-Tube Wells Completed		-	24.2	24.2

Source: Department of Irrigation, Assam

2.1 Creation of Irrigated Area and Utilization of Created Irrigation Potential

Understanding the need of creation of irrigated area for increased agricultural production, the Government of Assam has constantly taking initiatives for creation of the same. Table 3 portrays the creation of irrigated area in Assam during the last 11 years.

Table 3: Creation of Irrigation Potentiality in Assam (2009-10 to 2020-21)

(*in hectares)*

Year	Irrigation Sector		
	Major & Medium	Minor	Total
2009-10	7162	29838	37000
2010-11	4426	16456	20882
2011-12	10678	15029	25707
2012-13	270	9485	9755
2013-14	8000	11713	19713
2014-15	16170	38774	54944
2015-16	278783	503862	782645
2016-17	279423	524912	804335
2017-18	272518	723513	996031
2018-19	273378	733813	1007191
2019-20	285703	738539	1024242
2020-21	284921	756900	1041821
CAGR	39.77	34.17	35.45

Source: Economic Survey, Assam (various issues)

It is apparent from the table that creation of irrigation potentiality under minor irrigation sector is more as compared to that of major and medium irrigation sector. However, the growth of irrigation potentiality created in major and medium irrigation sector is more as compared to the minor irrigation sector, which is reflected in table 3. The overall growth for the period under consideration is 35.45 percent annually.

The created irrigation potentiality needs to be utilized for realization of accelerated agricultural production. Table 4 and 5 reflects the utilization of created irrigation facility. It is apparent from the table 4 that the utilization of irrigated potentiality created is substantially more for *Kharif* crop season as compared to the *Rabi* and *Pre-Kharif* season. Moreover the utilization rate for the period 2015-16 to 2020-21 is less than 30 percent.

Table 4: Irrigation potential utilized during the period 2009-10 to 2020-21
(Out of the cumulative created potential through Government irrigation Schemes)

(*in hectares)*

Year	Kharif crops season			Rabi & Pre-Kharif Crops Season			Total		
	Major & Medium	Minor	Total	Major & Medium	Minor	Total	Major & Medium	Minor	Total
2009-10	70274	77495	147769	9907	11178	21085	80181	88673	168854
2010-11	44691	63649	108340	5874	15612	21486	50565	79261	129826
2011-12	61028	71650	132678	6647	18360	25007	67675	90010	157685
2012-13	60700	92677	153377	4822	23546	28368	65522	116223	181745
2013-14	60058	99199	159257	4057	25301	29358	64115	124500	188615
2014-15	48142	129734	177876	4153	37549	41702	52295	167283	219578
2015-16	68772	119147	187919	8923	32447	41370	77695	151594	229289
2016-17	60509	116912	177421	17781	35008	52789	78290	151920	230210
2017-18	73108	122294	195402	5658	43569	49227	78766	165863	244629
2018-19	64878	130233	195111	3683	42002	45685	68561	172235	240796
2019-20	73557	181170	254727	4725	38110	42835	78282	219280	297562
2020-21	64726	187655	252381	2279	36889	39168	67005	224544	291549

Source: Economic Survey, Assam (various issues)

Table 5: Utilisation Rate of Created Irrigation Potentiality for the period 2015-16 to 2020-21

Year	Irrigation Potentiality Created (in ha)	Irrigation Potentiality Utilized	Utilization Rate
2015-16	782645	229289	29.29
2016-17	804335	230210	28.62
2017-18	996031	244629	24.56
2018-19	1007191	240796	23.91
2019-20	1024242	297562	29.05
2020-21	1041821	291549	27.98

Source: Compiled from Economic Surveys of Assam and calculation done by author

3. IMPACT OF IRRIGATION

In the previous section we have discussed on the present scenario of irrigation in Assam. In this section we try to analyse the profitability of irrigated agriculture as compared to non-irrigated agriculture. In this case study we have considered 30 sample farmer households of one development block. The average size of the holding pattern is 0.612 hectare as shown in the table 6. As depicted in the table, maximum land holding size for Ganakpara and Fulbari are 1.87 hectare and 1.34 hectare respectively. Thus the sample farmers fall under the category of small and marginal farmers in terms of land holding pattern. .

Table 6: General Profile of the Sample Area

Particulars	Fulbari Village	Ganakpara Village	All
Farmers sampled	15	15	30
Total own land (ha)	9.78	8.58	18.36
Average size of holding (ha)	.652	.572	.612
Max size of land (ha)	1.34	1.87	1.87
Use of Irrigation (Kharif)	0	0	0
Use of Irrigation (Rabi)	15	15	15

Source: Data collected from field survey by the author

A reasonable number of literatures on agriculture and irrigation depict that use of irrigation has an impact on land use, use of nutrients, productivity and so on. To understand the impact of irrigation on overall agricultural practice, Boro Rice is considered as irrigated crop and Shali Rice as non-irrigated crop and thus tries to find out its impact on agricultural productivity, use of nutrients, cropping intensity and employment.

3.1General Impact of Irrigation: Cropping intensity means the number of crops raised in a particular piece of land in a particular year expressed in percentage term, that is, gross cropped area as percentage of net sown area. The overall cropping intensity for the sampled area is 166.0 (table 7), which is higher than both national (148.7) and state (147) average for the year during 2018-19 (RBI, online database).

Table 7: Impact of Irrigation compared to non-Irrigated crop in the sampled Area

Particulars	Fulbari		Ganakpara		Overall sample area	
	Irrigated agriculture	Non-irrigated agriculture	Irrigated agriculture	Non-irrigated agriculture	Irrigated agriculture	Non-irrigated agriculture
Cropping Intensity	174.3		159.1		166.0	
Consumption of Fertilizers (kg/ ha)	140.88	55.80	124.45	14.39	132.67	35.10
Area under HYV (%)	100.0	8.82	81.13	2.70	89.06	6.44
Labour Cost (INR)	12721.7	11267.5	11966.9	8822.5	12284.7	10188.3
Productivity (quintal/hectare)	72	36	60	30	60	33

Source: Field study conducted by author

However, cropping intensity of Fulbari village is 15.2 percent more than Ganakpara village. The reason behind the lower cropping intensity of the village is due to the fact that about 33.4 percent of the farmers in the village (which is 23.34 percent in the overall sampled area) did not cultivate during the Khariff season. Out 33.4 percent farmers 20 percent has no own cultivable land and rest 80 percent have a small amount of own land nearby to the *bill*, which inundated by flood.

Chemical fertilizer nutrient (NPK) is an important input of agriculture, which is basically, consumes more during the Rabi season. NPK consumption in the sampled area is 94.31kg per hectare for all paddy crops, which is higher (11.13 kg per hectare) than the average consumption of Assam during 2020-21. Consumption of NPK is more in Fulbari village that is depicted in table 7. High consumption of NPK is attributable to irrigated paddy cultivation, which consumes on an average 132.67 kg per hectare against 35.10 kg per hectare for non-irrigated paddy cultivation for the overall sampled area.

High yielding verities (HYV) seeds are generally used more in the irrigated agriculture. Percentage of area under HYV seeds shows the adaptability to the modern technology, which is related to irrigation besides others input of agriculture. Average percentage area under HYV in the sampled area is high in case of irrigated agriculture as shown in the table 7, against the use in non-irrigated agriculture.

Irrigation provides great bargaining power to agricultural labourer. This is possible because of steady demand for agricultural labourer in the irrigated regions, which is relatively less in rain fed agriculture (Narayanamoorthy and Deshpande, 2005). In the present study, it is found that labour cost in irrigated agriculture is high than the non-irrigated agriculture. The figure for irrigated agriculture is INR12284.7 against INR.10188.3 per hectare in non-irrigated agriculture as shown in table 7. So it is clear that irrigation creates an extra labour cost of INR. 2096.4 per hectare. On the other hand in terms of labour employment capability it provides the wage for 6 additional labour per hectare of land, considering labour wage rate of INR 350, the prevailed rate in the sample area.

Productivity of land is measured in terms of yield per acre. Rudra have also derived it by dividing gross value of output by the gross cultivated area. (Rao, 2005). For calculation of agricultural productivity, the methodology of Directorate of Economics and Statistics, Government of India has been considered and thus *yield per hectare* is adopted in this analysis. Due to irrigation facilities, farmers are able to use HYV seeds and chemical nutrients, which increase the productivity of land by 42.32 percent in case of irrigated agriculture as shown in the table 7. Yield of rice is high in case of irrigated agriculture in both of the sampled villages, which are respectively 45.05 percent for Fulbari village and 42.63 for Ganakpara village.

3.2 Comparative Cost-Benefit Analysis of Irrigated and Non-Irrigated Agriculture:

Section 3.1 discusses impact of irrigation on general agricultural practices of the sampled area. To understand the monetary impact of irrigation, cost-benefit analyses of irrigated agriculture as compared to non-irrigated agriculture are discussed here. Cost of cultivation consists of cost on fuel, maintenance cost of the system, labor payments, purchase of seed, fertilizers & manure, transportation cost, charge on land (if hired), machine charge and average fixed cost of the system. On the other hand return consists of market value of production; rent from land leased out and machine charge (if hired). To find the market value of product, prevailing market price of medium rice in the local market has been considered (INR 1500 per quintal). Summary of the findings are tabulated here:

Table 8: Cost-Benefit of Irrigated and Non-irrigated Crop in the sample Area

Particulars	Irrigated Crop	Non-irrigated Crop
Cost of Cultivation (INR/ ha)	35524.8	13835.1
Proceeds from cultivation (INR/ha)	41862.5	22932.0
Profit (Rs/ha)	6337.7	9097.0

Source: Author's calculation based on field study

As shown in table 8, cost of cultivation for irrigated crop is 156.7 percent higher than non-irrigated crop. On the other hand proceed from irrigated agriculture is 88.5 percent more than that of non-irrigated agriculture in the sampled area. Thus it implies that cost and benefit are both higher in case of irrigated agriculture compare to non-irrigated crop, which realized a less profit per hectare of land.

To understand the tendency of a farmer having irrigation practice, Olubode et al. (2005) developed an index for irrigation service, which is named as Relative Irrigation Cost Index (RICI). RICI reveals the tendency of farmers to abandon or continue with irrigated cropping i.e. the farming system. It is computed on the average. Lower the value of the index; farmers are more attracted towards continuing of the irrigation practices. The formula for RICI is as follows:

$$\text{RICI} = \frac{\text{Irrigation cost per hectare}}{\text{Total production cost per hectare}}$$

In the present study irrigation cost per hectare of land is found INR 16648.7 per hectare, which comprises of cost on fuel, maintenance cost of the system, charge of machine, average fixed cost of the system. Cost of production for irrigated crop in the sampled area is INR 35524.4 per hectare. The RICI in the present study is found .468, which implies that relative irrigation cost is allowed to bear irrigation practices in the sampled area.

However, RICI is perceived to be inadequate for measuring the tendency of farmers to abandon or continue irrigated cropping since, for most farmers in the developing nations, ends justify the means i.e. they consider profit to be far more important than cost. It is then modified to incorporate profits from irrigated and rain-fed cropping, as specified below:

$$\text{Relative Irrigation Profit Index (RIPI)} = \frac{\text{Profit from irrigated cropping}}{\text{Profit from rain fed cropping}}$$

The higher the value of the index than 1, irrigation practice is more profitable to farmers. So, it implies that more profit from irrigated cropping that compare to non-irrigated profit assumes a better chance to continuing irrigation projects. In the present study the purpose behind the selection of this index is to look into the prospects and problem of irrigation practices. However for the simplicity of the study, only paddy cultivation is taken into consideration. Non-irrigated crop (*Shali Rice*) is taken as a dummy for rain fed cropping. In the present study, profit from irrigated cropping is INR 6337.7 per hectare against INR 9097.0 per hectare for non-irrigated crop. Therefore, relative profit index for the sampled area is calculated at .697, which implies that irrigation practice is not economically benefited to the farmers in the sampled area.

For analysis of the problem detail item-wise expenditure on both irrigated cropping and non-irrigated cropping are considered, which is shown in table 9. It is observed from table 9 that cost of production for non-irrigated agriculture is less than the irrigated agriculture. Keeping irrigation cost separately, the other cost is also high in case of irrigated cropping. The following are some findings on this count.

Cost on Labour Payment: Labour payment cost shares 73.6 percent of total cost per hectare in case of non-irrigated agriculture, which is 4.6 percent for irrigated crop. But in comparison with non-irrigated cropping, labour payment cost is 20.6 percent more in irrigated cost. So it seems that more labour cost in irrigated cultivation causes increase in the total cost of production per hectare.

Cost on fertilizers and Manure: Timely availability of water through STW irrigation induced timely doses of chemical nutrient. In the present study, the cost of fertilizers and manure comprises 7.8 percent of the total cultivation cost in non-irrigated cropping, whereas it is 6.8 percent in case of irrigated cropping. But, overall comparison indicates that cost of fertilizers is 122.1 percent more in irrigated cropping than non-irrigated cropping.

Table 9: Component wise comparative cost of cultivation of Irrigated and Non-irrigated Crop

(in INR)

Item of Expenditure	Non-irrigated Crop	Irrigated Crop
Cost on Fuel (in INR)	0.0	11002.1
Maintenance cost of the system (in INR)	0.0	686.2
Labor Payment (INR)	10188.3	12284.6
P seeds (INR)	153.2	261.2
Fertilizers &Manure (INR)	1083.0	2405.7
Transportation cost (INR)	1176.8	1891.3
Charge on land (INR./ha)	1233.7	2032.9
Machine charge (INR./ha)	0.0	3214.1
Average fixed cost of the system (INR./ha)	0.0	1746.3
Average Cost of Cultivation (INR /ha)	13835.1	35524.4

Source: Author's calculation based on field study

Transportation cost: In the present study it is observed that transportation cost is INR 1891.3 per hectare in case of irrigated agriculture and it is INR 1176.8 per hectare for non-irrigated agriculture. Thus it is observed that transportation cost in irrigated cropping is 60.7 percent more than non-irrigated cropping.

Charge on leased land: An important feature of leased market is observed in the sampled area. Generally leased market is contracted on a yearly basis. But in the sampled area, it is observed that due to availability of irrigation through STW, seasonal leased market is formed up. Out of 30 sampled farmers 9 farmers leased in a total amount of 4.02 hectare land for Rabi season. Rental on the land leased in varies from 4 *maund* rice per *bigha* to 5 maund for the season, which is usually 7 maund rice for the whole agricultural year. Although the rent on leased in land increases cost of production, it cannot ascertain that this may induce loss to the farmers. Out of 9 leased in farmers only 2 has incurred loss, which is due to the fact that other cost of production is also higher in their farm. The rental cost of land leased in per hectare is higher in case of irrigated agriculture than non-irrigated agriculture, which is clear from the table 9.

Irrigation Cost: Irrigation cost comprises of cost on fuel, cost on maintenance of the system, machine charge (if it is hired) and average fixed cost of the system. It is generally difficult to calculate the expected life of the system, since depreciation starts from the second year of operation as known from the farmers of the sampled area. In a study on 'Bamboo Boring' Planning Commission (2004) calculated expected life of STW to be 10 years. Since depreciation starts from the second years onward, the resell value of

the product is assumed in the study to be zero. Irrigation cost for the sample area shares 46.8 percent of total production cost, which increase the cost of production per hectare of land in compare to non-irrigated agriculture.

3.3 Problems faced by farmers:

In the field study, interaction has been made with the farmers about the problem faced by them in general and problem of irrigated agriculture in particular. Farmers of the sample villages face a number of problem in realizing better productivity and profitability. These are:

a. Information gap: Information or knowledge gap regarding agriculture is observed as a major problem in the sampled area. People are unaware about the modern pest management technique for which they are unable to diagnosis diseases of crop. Besides extension service, which is considered as a crucial input of agricultural development, fails to serve properly. Out of a sample of 30 farmers 30 percent viewed extension service as poor. 53.3 percent farmers reckoned the service as average, while 13.4 percent viewed it as good. Only 3.3 percent viewed it as very good service. Most of the farmers either does not know him or receive advice from him. Some farmers know the VLEW (Village Level Extension Worker), but does not follow the advice as those are not up to date.

b. Problem regarding realization of less production in irrigated agriculture: About 80 percent of the total respondent viewed soaring fuel prices as a real problem in realizing more profit. Three farmers of the sampled area viewed that deep tube well (DTW) systems can minimize their cost of production since they are generally engaged with rice cultivation. Besides 100 percent of the total respondent has no knowledge on soil health.

More than 53 percent of the total sample population opined that lack of operational cost in the first phase of agricultural activity made agriculture less profitable since the farmers have to take loan from local money lender at higher interest rate of 4-5 percent per month.

Besides, 66.7 percent of the total respondent viewed lack of own irrigation system as a constraint in realizing more profit from the irrigated agriculture, while 30 percent pointed lack of appropriate own cultivable land for irrigated paddy cultivation as a problem in more profit realization.

4. CONCLUSION

It is thus clear that irrigation through STW has a positive impact on productivity, labour employment and consumption of chemical nutrients. But it is also found that due to the increasing price of fuel and absence of institutional finance, high productivity of irrigated agriculture fails to realize a better profit as compared to non-irrigated agriculture. Institutional finance by commercial bank and government should be made available to the farmers; since it is observed that lack of finance results in less profit from the agricultural practices. Moreover extension service has a scope to improve since it is found that the service is not satisfactory. Agricultural training to VLEWs to update their knowledge in the field of agriculture has an alternative to improve their agricultural knowledge. Moreover a frequent visit to their respective area of operation by the extension workers will serve the purpose fruitfully. On the other hand, agricultural training to farmers also seems to be helpful in updating their knowledge on agricultural management, which will helpful to them in identifying diseases and better control of pest.

Notes:

1. For example, as per the rainfall data of rainrarvest.org, average annual rainfall in Assam is higher (2818 mm) than that of Gangetic West Bengal (1439 mm), Uttar Pradesh (1025mm), Haryana (617mm), Punjab (617mm) and Madhya Pradesh (1017 mm).
2. Dutta (2002) pointed a number of reasons for ineffective utilization of major and medium irrigation, which are, lack of proper maintenance of the distributary network, faulty design of the canals, encroachment of the command area, problem of floods, absence of land leveling works, absence of mechanical maintenance, erratic and irregular supply of electricity, conveyance loss, lack of coordination among various departments, lack of involvement of the farming community in management, mechanical defect and absence of sub-canal.

References:

[1] Chaterjee N (1995): *Irrigated Agriculture*, Rawat Publications, Jaipur
[2] Dutta MK (2002): Problem and Prospects of Utilization of Irrigation Potential in Agriculture of Assam, unpublished thesis
[3] Ghosh, S., Verma, H.C., Panda, D.K., Nanda, P. and Kumar A. (2012), Irrigation, Agriculture, Livelihood and Poverty Linkages in Odisha, *Agricultural Economics Research Review*, 25(1), pp 99-105
[4] Government of Assam, *Economic Survey of Assam 2004-05*, Directorate of Economics and Statistics, Guwahati
[5] Government of Assam, *Statistical Hand Book Assam*, Directorate of Economics and Statistics, Guwahati
[6] Joshi BH (1999): *Development of Agricultural Economics through Water Management*, Raj Publishing House, Jaipur
[7] Narayanamoorthy A; Deshpande RS (2005), *Where Water Seeps! Towards a New Phase in India's Irrigation Reforms*, Academic Foundation, New Delhi
[8] Nigam J (2006), 'Irrigation Development in Assam' in Gautam HC and Bezbaruah MP (eds) *Rural Transformation in North-East India*, department of commerce and Department of Economics, Guwahati
[9] Olubode A O.O, Idowa E.O. and Van S HD (2005), Irrigation Projects Reform Case Studies: An Assessment of Performance, 8th International River Symposium 2005, 6-9 September, Brisbane, Australia
[10] Planning Commission (2004): *Economics of Bamboo Boring, A study of the North-East Region of Bihar*, April 2004
[11] Rao H CH (2005), *Agricultural growth, Farm Size and Rural Poverty Alleviation in India*, Academic Foundation, New Delhi