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Incorporating Cost of Irrigation Water in the Currently Underestimated Cost of Cultivation: An Empirical Treatise

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ABSTRACT

This study highlights that even though water for irrigation substantially contributes to production of principal crops, the cost of cultivation discounts its role, since it does not incorporate the cost of irrigation water in the cost of cultivation methodology followed by Directorate of Economics and Statistics/Commission for Agricultural Costs and Prices (DES-CACP). The study suggests modifications in data and methodology in estimating cost of cultivation of crops considering the field data from Karnataka. Estimating the net returns from the DES Cost of Cultivation Scheme data for TE 2008-10 according to market prices, economic prices and natural resource valuation (including cost of water), the study highlights that the extent of under estimation of cost of cultivation varies from 16 per cent to 49 per cent of the cost of cultivation in the case of groundwater irrigated crops and 4 per cent to 14 per cent in the case of canal irrigated crops. The minimum support price (MSP) offered did not include the cost of irrigation water of the principal crops cultivated in Karnataka. The study also suggests focusing on removal of market imperfections in addition to an MSP which properly accounts for cost of irrigation water, to enable farmers to reap a favourable proportion of consumer's rupee.

Keywords: Cost of cultivation, Irrigation water cost

JEL: Q15, O13, Q16

INTRODUCTION

Pump irrigation in India accounts for 70-80 per cent of the value of irrigated farm output (Shah *et al*., 2003) and 80 per cent of irrigated agriculture in India is supported by groundwater.[1] Groundwater accounts for more than 60 per cent of India's irrigated area (Gandhi and Namboodiri, 2009). It is reported that "In India irrigation water cost is not properly accounted by the CACP/FMS. It is crucial to revise the methodology followed by CACP by properly accounting for cost of groundwater" (Anonymous, 2014). With this backdrop following the framework of Theme II of this Conference, the paper addresses the limitations in the methodology of CACP in accounting for irrigation cost and offers solutions to improve the methodology and examines the extent to which minimum support price (MSP) for crops accounts for cost of irrigation water considering the published data on cost of cultivation by the

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Directorate of Economics and Statistics and the panel data of farmers of Karnataka for the triennium ending (TE) 2008-10.

The cost of cultivation reported by Directorate of Economics and Statistics/CACP is an average figure covering both rainfed and irrigated situations. This discounts substantial investments made by farmers on groundwater irrigation structures. This is also reflected in the level of private investment in agriculture (75 per cent) more than the public investment (25 per cent) in India. Substantial proportion of crop production is from irrigated areas. Thus, the cost of cultivation varies *inter alia* with source of irrigation – surface water (canal, tank) and groundwater (well/borewell/tubewell); method of irrigation (conventional vs micro irrigation); hydrogeological areas (hard rock areas vs alluvial areas); seasons, depth of irrigation wells, probability of well failure, availability of electricity to pump water, rainfall, recharge, cropping pattern, evapo transpiration, degree of cumulative interference among irrigation wells, reciprocal externalities, probability of initial and premature well failure.

Need for Improvement in Cost of Cultivation Methodology

With 80 per cent of irrigated agriculture in India supported by groundwater, investment on groundwater wells/pumps/conveyance is largely the private investment by farmers and such investments need to be properly accounted in the cost of cultivation. The hard rock areas constitute 65 per cent of India's geographical area, and due to low recharge and groundwater overdraft, the probability of well failure is increasing. Deccan Plateau is no exception to this phenomenon. The farmers frequently invest on borewells/tubewells due to high probability of well failure. The life and age of irrigation wells is drastically falling and in many areas, wells function for less than two or three years as against 10 or 20 years before. There are also initial failures. Therefore, investment on groundwater needs to be divided into variable cost and fixed cost components. At present, the DES/CACP methodology treats investment on groundwater irrigation as a fixed cost through depreciation, which ignores investment on infructuous wells. Hence, the existing method under estimates cost of groundwater as the life of irrigation pumpset is considered in depreciation, instead of average life of irrigation well/s which varies from farm to farm. Thus, investment on initially failed, prematurely failed wells need to be considered to properly account for cost of irrigation water. In hard rock areas, where probability of well failure is increasing, farmers frequently invest on borewell/tubewell frequently due to high probability of well failure. The life and age of irrigation wells is drastically falling.

Manual on Cost of Cultivation Surveys

According to the *Manual on Cost of Cultivation Surveys* (2008)[2], the cost of irrigation is thus treated: "Breakup of cost of irrigation in terms of cost of purchased irrigation water and cost of irrigation from owned resources is standard practice in other countries, while in India under comprehensive scheme it is analysed as total estimates of cost of irrigation. Thus there is no distinction made between irrigation from owned resources and purchased resources". Further the cost of owned/hired irrigation, "…may be evaluated on the basis of actual amount paid. In case of own irrigation the cost estimates can be based on operational cost per hour". The Manual indicates that many countries did not account for irrigation cost, even though farms were irrigated. Considering the cost of cultivation of irrigation (in cotton), the Manual reports that " … cost of insecticides and irrigation was very low in India".

Examining the individual record type (RT) forms, the manual indicates that RT 440: Irrigation structures Inventory (Yearly) and RT 441: Irrigation structures Changes (Monthly) record information on irrigation. However, upon examining the individual RT forms, information on irrigation are recorded in other RTs also (Table 1). However the way the relevant information is used in accounting for irrigation or cost of water is ambiguous in the Manual. The key RTs are 440 and 441 which have no information on status of well/s (whether functioning or non-functioning) and the remaining years of the well. The concept of 'remaining years' is utopian since none can predict the remaining years, given the high probability of well failure in hard rock areas. This information needs to be complemented with 'age of functioning well as on the date of data collection', and 'life of initially failed well, life of prematurely failed well' (Table 1).

Premature failure can be defined as a well which yielded water below its pay back period. The RT 441 needs to incorporate year of drilling, year of failure, yield of the well at the time of drilling, current yield of the well, cost of drilling, casing, depth at which pump is placed, whether new pump is used and the cost of the pump set, if old pump is used, to be mentioned in order to properly account for cost of irrigation water. The RT forms need to be modified to include investment on all irrigation wells drilled/constructed on the farm, year, cost of drilling, casing, irrigation pump set, HP, repair charges, yield of the well, number of hours of running the pump every day, whether pumpset is sold and new pumpset purchased, the additional investment made and so on. In addition, investment on drip/sprinkler/ micro irrigation, emitters, volume of water emitted per hour and on each day, frequency of irrigation per month or week, number of months/weeks of crop duration need to be recorded. If there are water storage structures, the dimension of structure and water volume pumped to storage structure every day needs to be recorded (Table 1).

Depreciation Underestimates Cost of Groundwater

The RT forms record the number of years of irrigation pump set (IP set) pump house, but not the number of years served by tubewell/well. The present method *assumes that the life of irrigation well is the same as that of the irrigation pumpset*. However, due to groundwater overdraft, wells function for lower number of years than expected, while irrigation pumpset/s can continue to be used for long. Thus, since life of tubewell/well is dwindling, investment on drilling, casing becomes a variable cost, while that on IP set, pumphouse, conveyance, micro irrigation structures can be fixed cost with different years of life/age. As investment on drilling, casing is also rising due to rising probability of well failure, variable cost of groundwater may exceed 50 per cent to 75 per cent of the total cost of water and may vary across hydro-geological formations.

TABLE 1. INFORMATION ON IRRIGATION RECORDED IN RT FORMS

Record type number (1)	Field data pertaining to irrigation obtained by Field Assistant (2)	Modifications suggested in RT forms (3)
210 – land inventory (yearly)	Source of irrigation (col 7) : well, tubewell, tank, canal, pond, canal and well, canal and tubewell	Source for each plot for each season needs to be recorded. Information on conveyance, drip, sprinkler, micro irrigation, year of installation, emitters, water applied needs to be obtained
211 changes in land (monthly)	Any change in source of irrigation such as (col 16) as mortgaged, leased, sold, and the corresponding month (col 17)	Information on functioning or non functioning status of well is not recorded
410 building inventory (yearly)	Year of construction of pump house, age, remaining life, value at construction, value at present, salvage	Such information is not recorded for irrigation well/s but is only for pumphouse
411 building changes (monthly)	Whether pumphouse has undergone any change such as new pumphouse construction, or destroyed etc	Such information is not recorded for irrigation well/s
440 irrigation structure inventory (yearly)	No. of shallow well, tubewell, ip sets, pikota, mhot, swing baskets, sprinkler, drip system, HP capacity, command area, year of construction, age, remaining years, value at construction, value at present, salvage	With high probability of well failure, remaining years is vague for all wells. How to record value at present is also vague including salvage for wells
441 irrigation structure changes (monthly)	Whether the well, IP set, as above have undergone any change	What change is not mentioned: Whether well is functioning or failed needs to be recorded
710 crop operation hours (collected daily)	Number of hours of use of tubewell, IP set, for different farm operations for each crop, parcel, plot, season (for farm owner)	No record of volumetric water pumped is made. How number of hours is accounted in cost of cultivation is ambiguous
711 crop operation payments (collected daily)	For each parcel, plot, season, crop, for irrigation, number of hours of tubewell, IP set hired if any and the hire charges paid	How these are accounted in cost of cultivation is ambiguous
730 special activity operations hours (collected daily)	Use of tubewell, IP set for operations such as spinning, weaving, fishing, weaving bamboo, making buttermilk, ghee, other milk products	
740 machine upkeep operation hours (collected daily)	Number of hours of time spent on upkeep of tubewell, IP set	
741 machine power provided outside farm (collected daily)	Hours of hiring out tubewell, ip sets and value realised if any	

The cost of groundwater thus, varies from farm to farm and crop to crop, season to season, depending upon each farmer's economic investment experience in well drilling, casing, pump, conveyance and micro irrigation costs, volume of water pumped, are influenced inter alia by cumulative interference. Thus, additional data are required on year of drilling, year of failure, driller, license number to drill, certified yield of well at drilling, monthly yield of well-recording the number of seconds taken to fill a bucket of known volume, investment on drilling, drilling depth, casing for each well, investment on pump, type, ISI or not, accessories, pump house, pump HP, map with distance from the nearest well/s (interference), whether same pump or new pump is fitted to the irrigation well, number of hours of pump run for each crop, number of irrigations per month, volume of groundwater pumped; for drip/sprinkler irrigated crops, number of emitters, volume of water emitted per hour, number of hours of irrigation (Table 1).

METHODOLOGY

The time series and panel data from 450 farmers belonging to 45 taluks in Karnataka for the three years 2008-10 is the latest data base. Using the relevant codes, farmers were divided into rainfed, borewell irrigated, canal irrigated conditions. The data were provided by Directorate of Economics and Statistics through the Comprehensive Scheme for study of Cost of Cultivation (CCS), Karnataka. Hence the cost of irrigation, net returns according to market prices, economic prices and incorporating cost of irrigation have been worked out as under:

In the first step, the crop wise Cost A2 plus imputed value of family labour per ha which includes cost of seeds, fertilisers, manure, human labour (hired, attached and family), animal labour (hired and family), machine labour (hired and family), cost of canal irrigation[3] (as water rate if any paid to Government), plant protection chemicals, interest on working capital @12.5 per cent for the duration of crop, land revenue, taxes, cesses, depreciation on implements and farm buildings. Since the farmers are not paying for electricity in the case of tube (bore) well irrigated crops, the pumping expenditure is estimated.[4]

In the second step, crop wise gross returns per ha which includes value of main product and bi-product is considered. In the third step, the net returns according to market prices is worked out as gross returns minus cost A2 plus imputed value of family labour. In the fourth step, the net returns according to economic prices is worked out. The net returns according to economic prices includes the value of fertiliser subsidy[5] as a cost. And, in the case of tube (bore) well irrigated crops, the net returns according to economic prices, includes the pumping expenditure as irrigation subsidy. The fifth step includes computation of net returns according to natural resource valuation such as the (1) value of N_2 fixed in the case of leguminous crops as a benefit, (2) the value of greenhouse gas (GHG) emissions as a cost[6] and (3) the value of water used in irrigation as a cost. The value of N_2 in the case of leguminous crops is considered as Rs. 42.574 per kg of N_2 fixed. The cost of GHG emission is the cost of CO_2 emitted considered as Re. 0.4632 per kg which is the environmental cost per kg of CO_2 emitted by crop equal to Re. 0.4632. Thus the amount of carbon emitted by each crop in kgs per ha is multiplied by Re. 0.4632 to obtain the environmental cost due to GHG emission. In order to obtain the value of water used in canal irrigation/borewell irrigation, as the case may be, the source(s) of information and procedure followed is as under.

Cost (Value) of Canal Water

The cost (value) of canal (surface) water used in irrigation needs to be estimated, since the source is from an irrigation dam or reservoir. In the study conducted in the Department of Agricultural Economics (Negara *et al*., 2003) the value of canal water for irrigation is estimated as Rs. 1007 per acre of irrigation. As this study was conducted in 2003, and the data for computing the cost of cultivation and returns belonged to triennium ending 2008-2010, the value of canal water was compounded at the social discount rate of 2 per cent, which worked to Rs. 1112 per acre. As paddy is the most commonly cultivated crop in Kabini command, the cost or value of canal water is considered as Rs. 1112 per acre (Rs. 2780 per ha) to obtain the net returns using natural resource valuation technique valuing for canal water for paddy. For sugarcane, the cost or value of canal water is considered as [400*1112)/100] = Rs. 4448 per acre (Rs. 11,120 per ha). For semi-dry crops, the cost or value of canal water works to [(35*1112)/100=] Rs. 389 per acre (Rs. 973 per ha).

Cost of Groundwater Irrigation

In order to obtain the cost of groundwater irrigation, amortisation of investment on drilling and casing is performed to obtain the variable cost of irrigation over the average life of irrigation well. In addition, amortisation of investment on pumps, pump house and accessories is performed to obtain fixed cost. The cost of groundwater irrigation is the amortised cost of irrigation given by amortised cost on borewell + amortised cost on ip set + amortised cost on conveyance structure + Amortised cost on storage structure if any + repairs cost of IP set

$$\text{Amortised cost of Borewell} = (\text{compounded cost of BW}) \times \frac{(1+i)^{AL} \times i}{(1+i)^{AL} - 1]}$$

Here, AL= Average age or life of borewell i = discount rate, taken at 2 per cent (Diwakara and Chandrakanth 2007). The historical investment/s on wells/borewells is/are compounded to the present, in order to have the total investment on all wells as if made at present. Using the detailed methodology (Diwakara and Chandrakanth 2007), the cost of groundwater irrigation in different agroclimatic zones of Karnataka averaged to around Rs. 200 per ha cm or Rs. 200 per acre inch for the TE 2008-2010.

Efficiency of Farms Cultivating Crops

Technical efficiency connotes the input-output relationship reflecting cultivation on the production frontier. An efficient farm utilises fewer resources than other farms per unit of output. A farm is inefficient when it fails to obtain maximum output per unit of input. A farm is allocatively efficient, by equating marginal returns with marginal factor costs of respective inputs. Economic efficiency is obtained multiplying technical and allocative efficiency. It is argued that a farm can be technically or allocatively efficient, without being economically efficient. Thus, it need not always be the case that an economically efficient farm is both technically and allocatively efficient (Okoruwa *et al*., 2009). Using the above data set on cost of cultivating crops in Karnataka, attempt was made to estimate the technical, allocative and economic efficiencies for different crops using the Data Envelopment Analysis of Tim Coelli.[7] This software provided the extent of technical, allocative and technical efficiencies.

Empirical Results

The DES publishes Cost of Cultivation of Crops averaging both rainfed and irrigated conditions, irrespective of source of irrigation. This overall cost of cultivation of crops is provided for Karnataka (Table 2). Considering the costs and net returns according to market prices, economic prices and natural resource valuation which includes value of nitrogen fixed by leguminous crops as benefits and the cost of GHG liberated as cost, in all crops, the net returns are positive. This is precisely because the cost of irrigation has not been considered.

TABLE 2. COSTS AND NET RETURNS FROM CROPS IN KARNATAKA, TE 2008-10

(*Rs. /ha*)

Crops (1)	Cost of cultivation = (Cost A2 + imputed value of family labour) (2)	Net returns at market prices (NRMP) (3)	Net returns at economic prices (NREP) (4)	Net returns (4) plus value of N_2 fixed by leguminous crops (5)	Net returns (5) minus value of GHG liberated by crop (6)
Paddy	25840	15919	12229	12229	11512
Maize	15671	9163	7010	7010	6945
Ragi	18008	5089	2244	2244	2212
Jowar	9256	2161	633	633	605
Wheat	11921	4902	2042	2042	2014
Bajra	6406	2516	1428	1428	1404
Gram	11368	5869	3825	6550	6527
Redgram	11736	5436	3576	4656	4614
Cowpea	5029	4614	4378	5655	5637
Horsegram	5956	1571	904	3033	3033
Green gram	7491	3251	2670	4798	4784
Black gram	6115	3376	2001	3874	3851
Soyabean	14673	7680	5480	7608	7590
Groundnut	15005	3589	2561	3923	3905
Sunflower	9172	5493	3802	3802	3783
Safflower	9893	3805	2273	2273	2171
Seasame	6094	4016	3197	3197	3197
Cotton	18872	8699	4343	4343	4264
Onion	15111	17471	15876	15876	14950

Note: NRMP = Gross Income minus (Cost A1+IVFL); NREP = NRMP minus (Fertiliser subsidy), NRNP = net returns at economic prices + nitrogen value – GHG emission cost - groundwater cost or canal water cost.

Thus, for crops cultivated under borewell irrigation, an attempt has been made to incorporate the cost of groundwater irrigation in the natural resource valuation as groundwater is a natural resource (Table 3). Here according to economic prices, using the net returns from market prices, subsidy on both fertilisers and electricity provided to pump groundwater have been deducted. The net returns are different compared with Table 2, since the yield on irrigated land is considered for estimating the benefits and costs of pumping groundwater are considered along with other costs mentioned in methodology. The proportion of cost of groundwater resource ranges from 17 per cent of cost of cultivation in tomato to 35 per cent in sugarcane and 40 per cent in paddy. The net returns incorporating cost of groundwater is negative for most of the crops excepting for gram, redgram, cowpea, onion, sugarcane and tomato (Table 3). Considering the crops cultivated under canal irrigation, the cost of canal irrigation accounts for 4 per cent to 14 per cent of the cost of cultivation for most of the crops. The net returns subsuming the cost/value of surface water is positive for all the crops in Karnataka (Table 4). This must be due to relative inexpensive surface water in relation to groundwater.

TABLE 3. COSTS AND NET RETURNS FROM BOREWELL IRRIGATED CROPS IN KARNATAKA, TE 2008-10

(*Rs./ha*)

Crops (1)	Cost A2 + imputed value of family labour (2)	Net returns at market prices (NRMP) (3)	Net returns at economic prices (NREP) (4)	NREP (4) + value of N fixed by leguminous crops (5)	Net returns (5) - value of GHG by crop (6)	Groundwater cost as per cent of cost of cultivation (7)	Net returns including groundwater cost (8)
Paddy	29382	21382	19885	19885	17986	40.5	-2014
Maize	15999	12491	3478	3478	3400	43.86	-9100
Ragi	21021	8670	4703	4703	4671	19.22	-329
Jowar	9470	3171	623	623	595	34.55	-4405
Wheat	20775	5372	-364	-364	-410	37.57	-12910
Bajra	7187	3139	1244	1244	1221	45.5	-4779
Gram	13224	7479	3061	5786	5763	31.21	763
Redgram	11966	6047	2875	3955	3913	33.4	1087
Cowpea	7875	9632	8889	10166	10166	43.24	4166
Horsegram	6246	3193	2613	4741	4741	49	-1259
Green gram	7602	4955	3851	5979	5965	44.11	-35
Soyabean	19917	11808	8064	10533	10515	23.15	4515
Groundnut	15305	6003	3293	4655	4637	28.16	-1363
Sunflower	12760	7318	3612	3612	3570	28.15	-1346
Cotton	20755	15800	10443	10443	10364	34.64	-636
Onion	29503	23684	20020	20020	19093	22.37	10593
Sugarcane	72747	107457	86920	86920	83122	35.48	43214
Tomato	49946	57026	47250	47250	47046	16.68	37046

Note: NRMP = Gross Income minus (Cost A1+IVFL); NREP = NRMP minus (Fertiliser subsidy+ Electricity subsidy).

TABLE 4. COSTS AND NET RETURNS OF CANAL IRRIGATED CROPS IN KARNATAKA, TE 2008-10

(*Rs./ha*)

Crops (1)	Cost A2 + imputed value of family labour (IVFL) (2)	Net returns based on market prices (NRMP) (3)	Net returns based on economic prices (NREP) (4)	Net returns (4) + value of N fixed by leguminous crops (5)	Net returns (5) - value of GHG liberated by crop on farm (6)	Canal water cost (value) as per cent of cost of cultivation (7)	Net returns including canal water cost (8)
Paddy	34586	26586	18141	18141	16242	7.44	13462
Maize	16710	14140	6953	6953	6875	5.50	5902
Ragi	15084	9404	3907	3907	3875	6.06	2902
Jowar	9010	2599	1145	1145	1117	9.75	144
Wheat	11642	8146	3969	3969	3922	7.71	2949
Bajra	8010	3666	1809	1809	1786	10.83	813
Gram	12553	6856	4069	6794	6771	7.19	5798
Redgram	10880	6778	4216	5296	5254	8.21	4281
Horsegram	5894	3107	3107	5235	5235	14.17	6390
Greengram	7307	4400	4255	6384	6370	11.75	5425
Groundnut	17501	5691	4454	5816	5797	5.27	4483
Sunflower	10978	6504	3561	3561	3477	8.14	2504
Sugarcane	74330	64164	48119	48119	44413	13.01	33293
Cotton	20007	13723	8802	8802	8723	4.64	7750
Onion	19574	25737	23501	23501	22574	4.74	21601

Note: NRMP = Gross Income minus (Cost A1+IVFL); NREP = NRMP minus (Fertiliser subsidy).

Hence for the crops cultivated using groundwater irrigation, the cost of cultivation rises due to increase in the cost of groundwater due to reciprocal negative externalities resulting from cumulative interference among irrigation wells and other factors. Given the increasing cost of groundwater resource due to Ricardian flow scarcity, farmers increasingly incur investments on the existing infructuous wells as well as new borewells/tubewells. These investments need to be duly accounted for in the cost of cultivation.

Extent to which MSP Offered Subsumes Cost of Cultivation

Since the estimated cost of production is the basis for MSP, it is in order to estimate the extent to which the cost of production is duly covered by the MSP. Considering the crops irrespective of rainfed or irrigated as reported by CACP, the extent MSP subsumes the cost of production is a crucial determinant of benefit for the farmers (Table 5). Considering the market prices, economic prices and natural resource valuation, for rainfed crops, the MSP comfortably accounts for the cost of cultivation except for crops such as ragi, jowar, bajra, groundnut, soyabean, safflower and sesamum (Table 5). Thus, considering the cost of cultivation of crops irrespective of rainfed or irrigated substantially underestimates the costs incurred by farmers as they do not include costs of irrigation.

Accordingly, when the cost of cultivation of crops under borewell irrigation, (Table 6) are considered, the MSP does not cover the cost of production according to economic prices as well as according to natural resource valuation for most of the crops considered. The extent of cost not subsumed by MSP varies from 38 per cent in paddy and sugarcane to more than 100 per cent in wheat, bajra and green gram. This points out that farmers cultivating crops using groundwater, incur losses if they cultivate food crops. This points to the need to shift to low water commercial crops by these farmers. Cultivation of food crops like paddy and even commercial crops like sugarcane using groundwater, adds substantially to the cost of production, and is not covered by MSP. In addition, these practices result in secular overdraft affecting the aquifer and other farmers through the cone of depression. Therefore such farmers need to be educated regarding the water use efficiency - in terms of realizing the highest economic net return per rupee of cost of groundwater, rather than 'more crop per drop' as agronomists propose. If farmers continue overpumping groundwater they would incur colossal losses over time as these are water intensive crops and upon reaching secular overdraft, leads to irreversibility of the aquifer, as currently being experienced in Eastern dry zone of Karnataka.

TABLE 5. EXTENT TO WHICH MSP OFFERED DIFFERS FROM COST OF PRODUCTION IN KARNATAKA FOR TE 2008-10 FOR CROPS IN RAINFED CONDITION IN KARNATAKA

		At market prices		At economic prices		At NR valuation	
Crop	MSP (Rs./qtl)	Estimated cost of production using CCS data (Rs./qtl)	Per cent deviation of CCS cost of production from MSP	Estimated cost of production using CCS data (Rs./qtl)	Per cent deviation of CCS cost of production from MSP	Estimated cost of production using CCS data (Rs./qtl)	Per cent deviation of CCS cost of production from MSP
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Paddy	950	713	24.95	815	14.21	834	12.21
Maize	853	672	21.22	764	10.43	767	10.08
Ragi	932	1278	-37.12	1480	-58.80	1482	-59.01
Jowar	853	882	-3.40	1028	-20.52	1031	-20.87
Wheat	1100	852	22.55	1056	4.00	1058	3.82
Bajra	853	845	0.94	989	-15.94	992	-16.30
Gram	1863	1328	28.72	1567	15.89	1251	32.85
Redgram	2433	1696	30.29	1965	19.24	1814	25.44
Green gram	2817	1116	60.38	1203	57.29	888	68.48
Black gram	2647	1332	49.68	1632	38.35	1229	53.57
Soyabean	1407	1454	-3.34	1672	-18.83	1463	-3.98
Groundnut	2167	2456	-13.34	2624	-21.09	2544	-17.40
Sunflower	2260	1834	18.85	2173	3.85	2176	3.72
Safflower	1710	2061	-20.53	2380	-39.18	2401	-40.41
Seasamum	2833	2808	0.88	3186	-12.46	3186	-12.46
Cotton	2500	2610	-4.40	3213	-28.52	3224	-28.96

Source: DES, Minimum Support Price, *Annual Report, 2010-11*.

In the case of crops cultivated using canal irrigation (Table 7), the MSP does not subsume the cost of production in the case of crops such as paddy, ragi, jowar, bajra, cotton, sugarcane. Hence there is a need to revisit the methodological part of estimating MSP to appreciate whether all the costs are considered.

TABLE 6. EXTENT TO WHICH MSP OFFERED DIFFERS FROM COST OF PRODUCTION IN KARNATAKA FOR TE 2008-10 FOR CROPS IN BOREWELL IRRIGATED CONDITION IN KARNATAKA

		At market prices		At economic prices		NR valuation	
Crop (1)	MSP (Rs./qtl) (2)	Estimated Cost of production using CCS data (Rs./qtl) (3)	Per cent deviation of CCS cost of production from MSP (4)	Estimated cost of production using CCS data (Rs./qtl) (5)	Per cent deviation of CCS cost of production from MSP (6)	Estimated cost of production using CCS data (Rs./qtl) (7)	Per cent deviation of CCS cost of production from MSP (8)
Paddy	950	734	22.78	771	18.84	1318	-38.72
Maize	853	339	60.29	530	37.93	796	6.71
Ragi	932	949	-1.91	1129	-21.14	1356	-45.54
Jowar	853	851	0.29	1080	-26.54	1532	-79.48
Wheat	1100	1298	-18.04	1625	-47.77	2410	-119.05
Bajra	853	851	0.33	1075	-25.95	1788	-109.48
Gram	1863	1571	15.71	2095	-12.45	2682	-43.92
Redgram	2433	1927	20.81	2438	-0.18	2972	-22.13
Green gram	2817	4498	-59.70	5151	-82.89	7451	-164.53
Soyabean	1407	1214	13.72	1442	-2.50	1658	-17.88
Groundnut	2167	1134	47.68	1334	38.41	1742	19.58
Sunflower	2260	2200	2.65	2839	-25.62	3694	-63.44
Cotton	2500	2232	10.73	2808	-12.31	3999	-59.96
Sugarcane	117	83	28.91	111	5.05	161	-37.76

Source: Same as in Table 5.

TABLE 7. EXTENT TO WHICH MSP OFFERED DIFFERS FROM COST OF PRODUCTION IN KARNATAKA FOR TE 2008-10 FOR CROPS IN CANAL IRRIGATED CONDITION IN KARNATAKA

		At market prices		At economic prices		At NR valuation	
Crop (1)	MSP TE (Rs./qtl) (2)	Estimated cost of production using CCS data (Rs./qtl) (3)	Per cent deviation of CCS cost of production from MSP (4)	Estimated cost of production using CCS data (Rs./qtl) (5)	Per cent deviation of CCS cost of production from MSP (6)	Estimated cost of production using CCS data (Rs./qtl) (7)	Per cent deviation of CCS cost of production from MSP (8)
Paddy	950	734	22.74	914	3.79	1013	-6.63
Maize	853	556	34.82	795	6.80	830	2.70
Ragi	932	728	21.89	993	-6.55	1042	-11.80
Jowar	853	1045	-22.51	1214	-42.32	1330	-55.92
Wheat	1100	685	37.73	931	15.36	991	9.91
Bajra	853	939	-10.08	1157	-35.64	1274	-49.36
Gram	1863	1286	30.97	1572	15.62	1115	40.15
Redgram	2433	637	73.82	787	67.65	782	67.86
Green gram	2817	1433	49.13	1461	48.14	820	70.89
Groundnut	2167	1804	16.75	1932	10.84	1929	10.98
Sunflower	2260	1568	30.62	1989	11.99	2134	5.58
Cotton	2500	2703	-8.12	2804	-12.16	2919	-16.76
Sugarcane	117	84	28.21	101	13.68	118	-0.85

Source: Same as in Table 5.

Uneconomical to Cultivate Food Crops using Groundwater Irrigation

If and only if, the cost of production does not consider the major differences in source of irrigation such as borewell/tubewell irrigation and canal irrigation, then, MSP covers market prices and economic prices for a majority of the crops. However as groundwater irrigation is contributing to more than 60 per cent of output, MSP under estimates the cost as it does not subsume the costs of groundwater irrigation. Therefore, for crops under borewell/tubewell irrigation, as the MSP does not subsume the cost of groundwater irrigation, farmers suffer economic losses cultivating food crops. However whether they gain by cultivating commercial crops, need to be separately analysed to find out whether the prevailing market prices subsume the costs of irrigation.

Efficiency of Farms

The technical, allocative and economic efficiency for different crops cultivated under rainfed, borewell irrigated and canal irrigated conditions indicated that in most of the crops (Table 8), farmers are technically, allocatively efficient, but not economically efficient. The economic efficiency exceeded 50 per cent only in the case of blackgram and safflower under rainfed conditions, onion under borewell irrigated and ragi, bajra and onion under canal irrigated conditions. The poor reflection of economic efficiency is also because the market prices do not reflect the true cost of cultivation which do not subsume the cost of irrigation water.

TABLE 8. TECHNICAL, ALLOCATIVE AND ECONOMIC EFFICIENCY OF CROPS CULTIVATED UNDER RAINFED, BOREWELL AND CANAL IRRIGATED CONDITIONS IN KARNATAKA TE 2008-10

	Rainfed conditions			Borewell irrigation			Canal irrigated condition		
Crop (1)	Technical efficiency (2)	Allocative efficiency (3)	Economic efficiency (4)	Technical efficiency (5)	Allocative efficiency (6)	Economic efficiency (7)	Technical efficiency (8)	Allocative efficiency (9)	Economic efficiency (10)
Paddy	0.60	0.39	0.23	0.60	0.20	0.12	0.54	0.39	0.20
Wheat	Not cultivated as rainfed crop			0.585	0.327	0.166	0.74	0.53	0.39
Maize	0.47	0.52	0.22	0.63	0.16	0.11	0.72	0.69	0.48
Jowar	0.26	0.01	0.00	0.77	0.24	0.18	0.78	0.33	0.25
Ragi	0.50	0.41	0.20	0.61	0.57	0.34	1.00	0.61	0.61
Bajra	0.68	0.61	0.40	0.70	0.32	0.21	0.93	0.55	0.51
Redgram	0.41	0.25	0.10	1.00	0.16	0.16	0.79	0.23	0.19
Bengalgram	0.47	0.07	0.03	0.62	0.48	0.30	0.83	0.30	0.26
Greengram	0.64	0.58	0.36	0.84	0.41	0.30	0.63	0.25	0.18
Blackgram	0.79	0.77	0.57	Not cultivated under borewell			Not cultivated in canal irrigation		
Cowpea	0.91	0.50	0.48	Not cultivated under borewell			Not cultivated in canal irrigation		
Horsegram	0.60	0.60	0.33	0.97	0.48	0.45	0.77	0.55	0.49
Soyabean	0.75	0.46	0.36	0.89	0.50	0.42	Not cultivated in canal irrigation		
Groundnut	0.32	0.14	0.05	0.70	0.29	0.20	0.801	0.534	0.43
Sunflwer	0.54	0.69	0.34	0.65	0.54	0.32	0.785	0.478	0.379
Safflower	0.83	0.66	0.54	Not cultivated under borewell			Not cultivated in canal irrigation		
Sesamum	0.65	0.60	0.39	Not cultivated under borewell			Not cultivated in canal irrigation		
Cotton	0.77	0.70	0.49	0.83	0.35	0.31	0.53	0.38	0.15
Sugarcane	Not cultivated as rainfed crop			0.70	0.38	0.28	0.72	0.60	0.49
Onion	0.24	0.09	0.02	0.85	0.62	0.53	0.90	0.77	0.71
Tomato	Not cultivated as rainfed crop			0.68	0.38	0.28	0.50	0.78	0.43

MSP is Not Sacrosanct

It is in order to note that in addition to MSP, removal of market imperfections, providing market information, market intelligence are crucial as opined by Deshpande.[17] Noting that MSP has only been active in four states and does not live up to the expectation in others, Deshpande[18] infers that "….. Minimum Support Price has not been quite an effective policy tool during the decade of nineties, especially as a variable in the process of decision-making, as a lever to absorb the market fluctuations, as an incentive to adopt the new technology and application of new inputs, as a leading price to dictate market prices and wholesale prices, and finally as a cushion to the farmers to protect from the market imperfections. ….only 30 per cent of the farmers are aware of the (MSP) policy and from among these only 19 per cent are aware of the procurement agencies". This underscores the importance of removing market imperfections which scores high over offering MSP which in addition has the transaction cost component and requires effective governance.

CONCLUSION

Considering the cost of cultivation of principle crops in Karnataka for the TE 2008-10, the study concludes that the cost of cultivation grossly underestimates the cost of groundwater irrigation across all the crops. The under estimation is largely due to methodological limitation of DES-CACP as the RT forms have little information on crucial aspects of well/borewell/tubewell irrigation including the investment on drilling, casing, IP set, year of drilling, year of failure, daily volume of water extracted, frequency of irrigation to different crops over the duration of crop, across conventional, drip, sprinkler, micro irrigation. In addition, the Manual on cost of cultivation surveys has little methodological treatment regarding estimation of groundwater cost in terms of amortisation of investments, accounting for reciprocal negative externality due to cumulative interference of irrigation wells in hard rock areas. The extent of under estimation varied from 35 per cent in sugarcane and 40 per cent in paddy of the respective cost of cultivation on a conservative basis. In the case of canal irrigation also, the MSP offered does not cover the costs incurred in the case of paddy, ragi, jowar, bajra, cotton, sugarcane, even though the estimated cost of canal irrigation ranged from 4 per cent to 14 per cent of the cost of cultivation. Thus, there is a need to revisit the methodology of cost of cultivation of crops as well as MSP offered, as they do not account for the major cost of water for irrigation for the principle crops cultivated in Karnataka. In addition to MSP, it is in order to focus on removing market imperfections to enable the farmers to reap a large proportion of consumer's rupee.

NOTES

1. http://www.iwmi.cgiar.org/Publications/Success_Stories/PDF/2010/Issueper cent206per cent20-per cent20Influencing_irrigation_policy_in_India.pdf.

2. http://mospi.nic.in/mospi_new/upload/manual_cost_cultivation_surveys_23july08.pdf, p. 65.

3. The water rate fixed by the Water Resources Development Organization, Government of Karnataka is Rs. 100 per acre of paddy, Rs. 400 per acre of sugarcane, Rs. 35 per acre for semi arid crops (such as groundnut, Jowar, maize, ragi, pulses) according to the Water Resources Development Organization, Bangalore.

4. Cost of pumping groundwater = working hours of Irrigation pumpset * Horse power of the Irrigation pumpset * 0.75 KWH * Rs. 3.5 per KWH.

5. Provided by National Institute for Agricultural Economics and Policy research, IARI, New Delhi that the subsidy per kg of N_2 = Rs. 19.347; that per kg of P_2O_5 as well as K_2O = Rs. 42.563.

6. The estimates of Nitrogen fixation and GHGs were obtained from Pardis, (2014).

7. http://www.uq.edu.au/economics/cepa/deap.php.

8. http://shreeindia.info/rsdeshpande.com/wp-content/uploads/2014/03/MSP-Ch-06-Revised-Final.pdf.

9. Ibid.

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