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Impact of Ganga Kalyana Irrigation scheme on cropping pattern and farmers' income in Ballari district of Karnataka

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Abstract

Groundwater serves as a vital natural resource crucial for fulfilling India's water needs. Ballari district was purposively selected for the study to analyse the socio-economic performance of Ganga Kalyana Yojana scheme. Total samples of 120 farmers were chosen for the study of which 60 beneficiary and 60 non-beneficiary farmers were selected using probability proportion to size sampling. The finding of the study revealed that The overall income, comprising earnings from crop production, subsidiary enterprises, and wage incomes, experienced a significant upswing, rising from ₹ 2,21,924 to ₹ 3,86,023 and was statistically significant at 5 per cent level. Number of man-days employed for crop production on the farms before the Ganga Kalyan Yojana was 186, which increased to 250, there by indicating 34.40 per cent enhancement and was statistically significant at 5 per cent level. Employment under other occupations slightly increased from 111.54 man-days to 121 man-days indicating 7.50 per cent and labour hiring has reduced from 226.33 man-days to 73 man-days after the implementation of the scheme as farmers stopped working outside and started working in their own farms and was statistically significant at 5 per cent level. Overall, the findings highlight the scheme's effectiveness in promoting economic growth and self-sufficiency among the beneficiary farmers in the study area.

Keywords: Cropping pattern, difference in difference, Ganga kalyana, irrigation, impact,

Introduction

Water for irrigation purpose comes from various sources such as wells, ponds, canals, rivers, dams, reservoirs, rainfall etc. In Karnataka among all the sources of irrigation, the net area irrigated from the tube wells is highest of 26.49 lakh hectares (56.55%) during 2022-23 (Anon, 2024) ^[1]. Since 1973, Karnataka has been actively initiating, implementing, and adapting various socio-economic policies aimed at uplifting the marginalized sections of society, particularly in rural areas. The Union Government of India has also been extending financial support and grant-in-aid to assist the state government in this noble endeavor. Despite being one of the 28 states in India, Karnataka stands out as one of the most economically developed states, with an impressive average Gross State Domestic Product (GSDP) growth rate of 8.2 per cent during the fiscal year 2010-2011 and the Gross State Domestic Product (GSDP) of Karnataka for 2021-22 (at current prices) is projected to be Rs 17,02,227 crore. This is an annual increase of 0.1% over the actual GSDP of 2019-20, and 5.6% lower than the revised estimate of GSDP for 2020-21 (Rs 18,03,609 crore). The Ganga Kalyana irrigation scheme was launched during

1996-1997 as a State Government initiative to support small and marginal farmers; specifically of the backward classes of the society those like Scheduled Caste, Scheduled Tribe, OBC and Minorities in order to improve their economic wellbeing. The basic objective of the scheme is to provide irrigation facilities to the small and marginal farmers. The scheme has been classified as:

- Individual irrigation scheme
- Group / community irrigation scheme
- Lift irrigation scheme

The names indicate that individual irrigation scheme is for single farmer, group irrigation scheme is for group of farmers and lift irrigation scheme included both. The scheme originated as a loan scheme that provides farmer with a subsidized bore well and pump set to irrigate their land and improve their agricultural productivity. Upon successful implementation of the scheme, the beneficiary would be required to repay the provided loan. Now, the GKY provides full financial support for the drilling of a bore well and the installation of a pumpset to Scheduled Caste, Scheduled Tribe, Other backward classes and

Minorities farmers across the state and the scheme also provides another facility that if the selected farm is nearer to the perennial source of water (rivers) it utilizes this facility by lifting water through pipelines.

Farmers who are selected to participate in the GKY scheme fall into two broad categories namely, Individual Scheme and Group Scheme, each category requires the farmers to meet specific criterion in order to be considered for selection.

Under the Individual Bore well Scheme, farmers with 0.8 - 2 hectares in a specific geographical area, and an annual income below ₹ 96,000, are eligible for a single bore well. In contrast, the Community Bore well Scheme caters to communities with larger land holdings. For land sizes ranging from 3.2 to 6 hectares, three beneficiaries meeting the income criteria can collectively avail two bore wells. Similarly, for land sizes between 6 to 8 hectares, five eligible beneficiaries can access three bore wells. These initiatives aim to provide equitable access to water resources, ensuring efficient agricultural practices for both individual farmers and community groups in the region.

The unit cost for the individual irrigation scheme is ₹ 3.5 lakhs and for group irrigation scheme it is ₹ 4.53 lakhs for a group of farmers holding the land of 3.2-6 ha of land and the cost is ₹ 5.59 lakhs for group of farmers holding 6-8 ha. Ganga Kalyana Yojana has been in operation in various forms in the last 30 years. Irrigation facilities have been responsible for the change in cropping pattern and increase in cropping intensity, change in farm income. Several research works have estimated the cost, returns and profits of individual crops where minor irrigation has been adopted. Therefore, the present study explores the impact of this irrigation scheme on cropping pattern and income of small and marginal farmers of farming community.

Data and Methodology

Ballari district of Karnataka was purposively selected for the study to analyse the socio-economic performance of Ganga Kalyana Yojana scheme. The total sample size of study was 120, 60 beneficiary and 60 non-beneficiary farmers were selected using probability proportion to size sampling. For meeting the requirement of the specific objectives of the study, necessary data were collected from the sample farmers through personal interview method with the help of well-structured schedule.

Difference in Difference technique

Difference-in-Differences (DiD) is a quantitative method often used to estimate and compare change in outcome before and after of scheme for beneficiary and non-beneficiary farmers. The advantage of using the double difference method is that it nets out the effects of additive factors that have fixed (time-invariant) impacts on income indicator, or that reflect common trends affecting beneficiary and non-beneficiary equally such as changes in prices (Ravallion, 2005) [6]. The Double-Difference method, which is also known as Difference-in-Difference method (Duflo *et al.* 2004, Verner *et al.* 2005) [2, 9] has the following formula:

$$DD = \left[\frac{1}{p} \sum_{i=1}^p (Y_{1ia} - Y_{1ib}) \right] - \left[\frac{1}{c} \sum_{j=1}^c (Y_{0ja} - Y_{0jb}) \right]$$

Where,

DD = Income difference between the respondents

P = Number of beneficiary farmers

C = Number of individual control group (non - beneficiary farmers)

Y_{1ia} = Income variable of beneficiary after the scheme

Y_{1ib} = Income variable of participant before the scheme

Y_{0ja} = Income variable of non-beneficiaries after scheme

Y_{0jb} = Income variable of non-beneficiaries before the scheme

Paired 't' test

The level of significance of difference was tested using paired t-test as specified:

$$X_1 = X_i - \bar{X}$$

$$Y_i = (Y_1 - \bar{Y}_i)$$

Then t is defined as

$$t = (\bar{X} - \bar{Y}) \sqrt{\frac{n(n-1)}{\sum_{i=1}^n (X_i - \bar{X})^2}}$$

Where,

$\bar{X}_1$ and $\bar{Y}_1$ = two paired sample of participant farmers and non- participant farmers income respectively

n = sample size

n - 1 degree of freedom

Cropping intensity

Cropping intensity refers to raising of a number of crops from the same field during one agriculture year.

Cropping system

Cropping system may be defined as the order in which the crops are cultivated on a piece of land over fixed period.

Results and Discussion

Transaction cost involved in availing the benefit of the GKY scheme

Table 1 presents a comprehensive analysis of the transaction costs associated with availing the benefits of the Ganga Kalyana Yojana (GKY) scheme. Transaction costs included cost involved in participating and deriving benefits from Ganga Kalyana Yojana (GKY) scheme. The components of transaction costs are (1) Time Spent in Availing the Benefit of the Scheme (36.5 man-days): The average time investment required by beneficiaries to avail the benefits of the GKY scheme is 36.5 man-days. This significant temporal commitment highlights the opportunity cost involved, as beneficiaries could have allocated this time to their agricultural or other income-generating activities. The value of this time investment is estimated at ₹ 10,950, equivalent to 81.77 per cent of the total. (2) Transportation Charges (Auto, Bus Fares, Petrol, etc.): beneficiaries incur an average transportation cost of ₹ 700, constituting 5.22 per cent while traveling to access GKY scheme benefits. This cost includes expenses related to auto-rickshaws, bus fares, and petrol. The transportation cost can vary based on the distance between beneficiaries' residences and government

service centers. (3) Photos Cost: The cost of obtaining necessary photographs for documentation purposes is estimated at ₹ 63.09 which accounts for 0.47 per cent while this cost is relatively minor, it contributes to the overall transaction expenses incurred by beneficiaries. (4) Cost incurred on food: beneficiaries spend an average of ₹ 1092 which accounts for 8.15 per cent (5) Expenditure involved in obtaining documents: beneficiaries expend an average of ₹ 585.71, which accounts for 4.37 per cent to acquire various documents and certificates required to access GKY scheme benefits. This cost accounts for miscellaneous

expenses related to documentation, which can be a significant part of the overall transaction cost. Total Transaction Cost: The cumulative transaction cost, considering all the components discussed above, stands at ₹ 13,390.8. This figure represents the comprehensive financial burden borne by beneficiaries in the process of availing the GKY scheme's benefits. The results are line with results reported by Sravanti (2012) ^[8] studied the utilization of benefits from governmental programmes by farmers in Andhra Pradesh.

Table 1: Transaction cost involved in availing the benefit of the GKY scheme

Sl. No	Parameters	Average cost (in ₹)
1	Time spent in availing the benefit of the scheme (36.5 man- day)	10,950 (81.77)
2	Transportation charge (auto, bus fares, petrol etc)	700 (5.22)
3	Photos cost	63.09 (0.47)
4	Cost incurred on food	1092 (8.15)
5	Expenditure involved in obtaining documents (borewell drilled details, ground water depletion certificate)	585.71 (4.37)
	Total Transaction cost	13,390.8 (100.00)

Note: Figures in parentheses indicates percentage to the total

Comparative cropping pattern of beneficiary and non-beneficiary farmers in the study area

Table 2 shows that the comparative cropping pattern of beneficiaries and non-beneficiary farmers in the *kharif* season, the total irrigated land area under cultivation was from 1.30 ha among non-beneficiaries and irrigated land area was 1.61 ha among beneficiaries, representing a 23.84 per cent increase after the scheme. Several *kharif* crops were brought under irrigation. During the *rabi* season, the net cultivated land area decreased from 0.79 ha among non-beneficiaries to irrigated land area 0.49 ha among beneficiaries, indicating a 37.97 per cent difference after the scheme. In the *Summer* season, bajra and maize were grown due to the irrigation facility provided by the scheme, constituting a significant portion of the crops in the study area. noteworthy is the significant increase in cropping intensity among beneficiary farmers, which soared to 216.77 per cent, compared to the 160.76 per cent cropping intensity of non-beneficiary farmers. The results are line with results reported by Jainapur (2007) ^[4] studied on performance evaluation of minor lift irrigation schemes in Northern Karnataka.

Cropping pattern of beneficiary farmers of GKY in the study area

It is evident from the table 3 that there was decline in total dry land area under cultivation from 1.40 ha. There was no area was under irrigation before the scheme. it increased to 1.61 ha. in the post project period showing increase of about 15.00 per cent. Further, many *kharif* dry crops were brought under irrigation. In *rabi* season, net cultivated dry land area decreased from 1.30 ha. While no area was under irrigation before the scheme, it increased to 1.61 ha. after the scheme showing about 62.30 per cent decrease. Among *summer* crops, maize and bajra were grown because of provision of irrigation facility available from the scheme and these crops held major part among the crops grown in the study area. Many of the farmers changed the cropping pattern from seasonal to annual crops. Cropping intensity increased

marginally from 192.85 per cent before the scheme to 216.77 per cent after the implementation of the scheme but crop diversification showed improvement. The results are line with results reported by Poddar *et. al* (2006) ^[5] studied on evaluation of GKY of government of Karnataka.

Comparative income level among beneficiary farmers and non-beneficiary farmers

The comparison of income levels between non-beneficiary and beneficiary farmers, as presented in table 4.22, reveals some striking differences. Non-beneficiary farmers reported an annual crop production income of ₹ 2,23,753, whereas their beneficiary counterparts experienced a substantial boost in crop production income, reaching ₹ 3,86,023. This noteworthy increase signifies a significant positive change of 75.52 per cent in crop production income among the beneficiaries and was statistically significant at 5 per cent level. In terms of income from other occupations, non-beneficiary farmers earned ₹ 62,102, whereas beneficiary farmers witnessed a remarkable surge in their income from other occupations, reaching ₹ 69,396, marking a substantial increase of 11.74 per cent and was statistically significant at 5 per cent level. However, it's worth noting that non-beneficiary farmers had a wage income of ₹ 51,368, while beneficiary farmers experienced a decrease in wage income, with earnings of ₹ 30,685, reflecting a -40.26 per cent decline, likely due to reduced wage hiring amid increased farm activities on their own farms and was statistically significant at 5 per cent level. When considering the overall income, which includes crop production, other occupations, and wage income, non-beneficiary farmers had a total income of ₹ 3,27,223. In contrast, beneficiary farmers, despite the decline in wage income, achieved a total income of ₹ 4,55,419, showcasing a notable positive change of 39.18 per cent in total income among the beneficiaries and was statistically significant at 5 per cent level, underscoring the positive impact of the Ganga Kalyan scheme on their livelihoods.

Table 2: Comparative cropping pattern of beneficiary and non-beneficiary farmers in the study area (Area in ha)

Crops	Non-beneficiaries (n=60)						Beneficiaries (n=60)						% difference
	Dry land		Irrigated		Total		Dry land		Irrigated		Total		
Kharif	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
Bajra	0.00	0.00	0.60	46.15	0.60	46.16	0.00	0.00	0.20	12.42	0.20	12.42	
Ground nut	0.00	0.00	0.20	15.38	0.20	15.38	0.00	0.00	0.11	6.83	0.11	6.83	
Cotton	0.00	0.00	0.50	38.46	0.51	38.46	0.00	0.00	0.90	55.90	0.90	55.90	
Maize	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	11.18	0.18	11.18	
Sugarcane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	13.66	0.22	13.66	
Total	0.00	0.00	1.30	100.00	1.30	100.00	0.00	0.00	1.61	100.00	1.61	100.00	23.84
Rabi													
Jowar	0.00	0.00	0.48	60.75	0.48	60.75	0.00	0.00	0.18	36.73	0.18	36.73	
Sunflower	0.00	0.00	0.31	39.24	0.31	39.24	0.00	0.00	0.20	40.81	0.20	40.81	
Paddy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.12	0.03	6.12	
Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.32	0.08	16.32	
Total	0.00	0.00	0.79	100.00	0.79	100.00	0.00	0.00	0.49	100.00	0.49	100.00	-37.97
Summer													
Maize	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	76.97	1.07	76.97	
Bajra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	23.02	0.32	23.02	
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	100.00	1.39	100.00	-
Gross cropped area					2.09						3.49		
Net cropped area					1.30						1.61		
Cropping intensity (%)					160.76						216.77		

Table 3: Cropping pattern of beneficiary farmers of GKY in the study area (Area in ha)

Crops	Before GKY						After GKY						% change
	Dry land		Irrigated		Total		Dry land		Irrigated		Total		
Kharif	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
Bajra	0.50	35.71	0.00	0.00	0.50	35.71	0.00	0.00	0.20	12.42	0.20	12.42	
Ground nut	0.60	42.86	0.00	0.00	0.60	42.86	0.00	0.00	0.11	6.83	0.11	6.83	
Cotton	0.10	7.14	0.00	0.00	0.10	7.14	0.00	0.00	0.90	55.90	0.90	55.90	
Maize	0.20	14.29	0.00	0.00	0.20	14.29	0.00	0.00	0.18	11.18	0.18	11.18	
Sugarcane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	13.66	0.22	13.66	
Total	1.40	100.00	0.00	0.00	1.40	100.00	0.00	0.00	1.61	100.00	1.61	100.00	15.00
Rabi													
Jowar	0.40	30.77	0.00	0.00	0.40	30.77	0.00	0.00	0.18	36.73	0.18	36.73	
Sunflower	0.90	69.23	0.00	0.00	0.90	69.23	0.00	0.00	0.20	40.81	0.20	40.81	
Paddy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	6.12	0.03	6.12	
Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	16.32	0.08	16.32	
Total	1.30	100.00	0.00	0.00	1.30	100.00	0.00	0.00	0.49	100.00	0.49	100.00	-62.30
Summer													
Maize	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	76.97	1.07	76.97	
Bajra	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	23.02	0.32	23.02	
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	100.00	1.39	100.00	-
Gross cropped area					2.70						3.49		
Net cropped area					1.40						1.61		
Cropping intensity (%)					192.85						216.77		

Impact of GKY on income of beneficiary farmers of GKY in the study area

Table 4 illustrates the income levels of beneficiaries under the Ganga Kalyan (GKY) scheme. The overall income, comprising earnings from crop production, subsidiary enterprises, and wage incomes, experienced a significant upswing, rising from ₹ 2,21,924 to ₹ 3,86,023 and was statistically significant at 5 per cent level. This translates to a substantial increase of 73.94 per cent in the study area. Specifically, the income generated from subsidiary enterprises displayed remarkable growth, surging from ₹ 36,347 to ₹ 69,396 and was statistically significant at 5 per cent level. Marking an impressive increase of 90.92 per cent. In contrast, income derived from wage earnings showed a decline, decreasing from ₹ 54,949 to ₹ 30,685 and was statistically significant at 5 per cent level. This dip can be attributed to farmers reducing their reliance on wage hiring due to the upsurge in farm activities on their own

farms. As a result of these changes, the total income of the beneficiaries in the study area increased from ₹ 3,13,220 to ₹ 4,55,419 and was statistically significant at 5 per cent level, representing a notable growth of 45.40 per cent following the implementation of the GKY scheme.

The result of double difference impact analysis is shown in the table 6. As indicated in the table, the mean income difference of the beneficiary and non-beneficiary farmers was ₹ 1,42,199 and ₹ 48,718 respectively and was statistically significant at 5 per cent level. A positive mean double income difference of about ₹ 93,481 was realized between the beneficiary and non-beneficiary farmers. The findings implied that there was an impact of the GKY scheme on beneficiary farmers income in the study area. The results are in line with results reported by Sarma *et al.* (2015) [7] conducted study on impact analysis of beef cattle agribusiness on income: A double difference approach.

Comparative employment levels of beneficiary farmers and non-beneficiary farmers in the study area

The employment levels of beneficiary farmers and non-beneficiary farmers, were presented in table 7. Non-beneficiary farmers were actively engaged in crop production activities, contributing an average of approximately 154.45 man-days per household. However, with the implementation of the Ganga Kalyan scheme, beneficiary farmers significantly elevated their involvement in crop production, dedicating a substantial 250 man-days per household to this endeavour and were statistically significant at 5 per cent level. In terms of other occupations, non-beneficiary farmers devoted 131.3 man-days per household, while their beneficiary counterparts, empowered by the scheme, participated in other occupations for an average of 121 man-days per household. This signified a discernible -7.85 per cent in man-days allocated to other occupations among the beneficiaries and was statistically significant at 5 per cent level.

Interestingly, when it came to wage earning activities, non-beneficiary farmers were actively employed for an average of 209.66 man-days per household. In contrast, beneficiary farmers experienced a significant reduction in wage earning activities, averaging 77 man-days per household. This substantial decline of -63.27 per cent in man-days dedicated

to wage earning among the beneficiaries can be attributed to a decrease in wage hiring, likely resulting from an increase in farm activities on their own farms and was statistically significant at 5 per cent level.

Employment opportunity of beneficiary farmers of GKY in the study area

Table 8 reveals changes in the employment opportunities for beneficiary farmers. Substantial increase in employment opportunities was noticed in the study area after the implementation of scheme. Number of man-days employed for crop production on the farms before the Ganga Kalyan Yojana was 186, which increased to 250, thereby indicating 34.40 per cent enhancement and was statistically significant at 5 per cent level. Employment under other occupations slightly increased from 111.54 man-days to 121 man-days indicating 7.50 per cent and labour hiring has reduced from 226.33 man-days to 77 man-days after the implementation of the scheme as farmers stopped working outside and started working in their own farms and was statistically significant at 5 per cent level. These results are line with results reported by Manker *et al.* (2013) [3] conducted study on impact of National Horticultural Mission (NHM) on its beneficiaries.

Table 4: Comparative income level among beneficiary farmers and non-beneficiary farmers in the study area

Sl. No.	Particulars	Total income (₹)			
		Non-beneficiary (n=60)	Beneficiary (n=60)	t-statistics	% difference
1.	Crop production/year	2,23,753	3,86,023	8.01*	72.52
2.	Other occupation	62,102	69,396	7.67*	11.74
3.	Wage income	51,368	30,685	-14.41*	-40.26
5.	Total income	3,27,223	4,55,419	5.95*	39.18

Note: * significant at 5 per cent level of significance

Table 5: Impact of GKY on income of beneficiary farmers of GKY in the study area

Sl. No.	Particulars	Total income (₹)			
		Before GKY	After GKY	t-statistics	% Change
1.	Crop production/year	2,21,924	3,86,023	16.19*	73.94
2.	Other occupation	36,347	69,396	19.81*	90.92
3.	Wage income	54,949	30,685	-17.63*	-44.15
5.	Total income	3,13,220	4,55,419	13.84*	45.40

Note: * significant at 5 per cent level of significance

Table 6: Double difference estimates of impact of Ganga Kalyan Yojana on farmers total income

Variable	Before	After	Mean Difference	t-statistics
Beneficiary	3,13,220	4,55,419	1,42,199	13.61*
Non-beneficiary	2,78,504	3,27,223	48,718	15.50*
Double Difference	-	-	93,481	8.66*

Note: * significant at 5 per cent level of significance

Table 7: Comparative employment levels of beneficiary farmers and non-beneficiary farmers in the study area

Particulars	Man days/household			
	Non-beneficiary (n=60)	Beneficiary (n=60)	t-statistics	% difference
Crop production	154.45	250	24.45*	61.87
Other occupation	131.3	121	-5.80*	-7.85
Wage earning	209.66	77	-67.61*	-63.27

Note: * significant at 5 per cent level of significance

Table 8: Employment opportunity of beneficiary farmers of GKY in the study area

Particulars	Man days/household			
	Before GKY	After GKY	t-statistics	% Change
Crop production	186	250	43.32*	34.40
Other occupation	111.54	121	43.39*	7.50
Wage earning	226.33	77	-55.22*	-67.75

Note: * significant at 5 per cent level of significance

Conclusion

The Ganga Kalyana Irrigation scheme brought significant changes in cropping patterns among beneficiaries and non-beneficiaries. Beneficiaries notably increased cropping intensity to 216.77 per cent, surpassing non-beneficiaries at 160.76 per cent. These changes highlight the scheme's positive impact on agricultural practices and productivity. The impact analysis of the Ganga Kalyan Yojana (GKY) on beneficiaries in the study area revealed substantial differences. The mean income difference between

beneficiary and non-beneficiary farmers was significant, with beneficiary farmers having a higher income difference of ₹ 1,42,199 compared to ₹ 48,718 for non-beneficiary farmers, at a 5 per cent significance level. Notably, a positive mean double income difference of approximately ₹ 93,481 was observed among beneficiary and non-beneficiary farmers. Since the findings of the study showed many positive gains of Ganga Kalyana Irrigation Scheme, it is important that the Government of Karnataka further strengthen the scheme by expanding to all small and marginal farmers by addition of borewell recharge components in the scheme.

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