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Measuring The Efficiency of Social Assistance Recipients in the Family Hope Program Using the Data Envelopment Analysis Method

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Abstract— This study aims to measure the efficiency of aid distribution in the Family Hope Program (PKH) across six sub-districts in Medan Denai using the Data Envelopment Analysis (DEA) method. DEA allows a relative efficiency evaluation of multiple decision-making units (DMUs) by comparing inputs such as budget, number of officers, and recipients, against outputs like targeted beneficiary rate, distribution timeliness, and satisfaction level. The findings reveal that three sub-districts—Medan Tenggara, Tegal Sari Mandala I, and Tegal Sari Mandala II—achieved full efficiency with a score of 1. In contrast, Binjai, Denai, and Tegal Sari Mandala III were found to be inefficient due to higher input consumption not matched by proportional output. The study suggests that inefficient sub-districts can improve their performance by adopting the practices of efficient ones. These insights are expected to assist local governments in optimizing social assistance programs and ensuring better resource utilization.

Keywords— Efficiency, Data Envelopment Analysis, Social Assistance, PKH, Resource Allocation

I. INTRODUCTION

Poverty is a social problem that remains a major challenge in Indonesia. The government has made various efforts to reduce poverty and improve public welfare, particularly for families with vulnerable economic conditions.[1]. One of the strategic programs launched by the government to tackle poverty is the Family Hope Program (PKH) [2]. The Family Hope Program (PKH) is conditional social assistance provided to poor and vulnerable families who have been registered in the Integrated Social Welfare Data (DTKS) [3]. The main objective of this program is to improve people's standard of living through better access to education, health and social welfare services [4]. Through this assistance, it is hoped that beneficiary families can escape the trap of poverty gradually and sustainably.

Despite its significant potential to help the community, the implementation of the Family Hope Program (PKH) in Medan Denai District faces various challenges that hinder its effectiveness and efficiency. These issues include mistargeting of aid recipients, wasted resources, and differences in efficiency between sub-districts in the distribution and data collection process [5]. Furthermore, a lack of coordination between relevant agencies, limited accurate data, and weak field oversight have exacerbated the situation. One major issue is the inaccuracy of aid recipients. Many cases have seen social assistance provided to individuals or families who do not meet the criteria for

beneficiaries [6]. Inaccurate recipient data is a major contributing factor to this problem, with many residents who are no longer eligible still registered as recipients. The data used is often outdated, resulting in families who have moved out of poverty continuing to receive aid [7].

Differences in efficiency between sub-districts were also a key focus of this study. There was significant variation in the performance of social assistance distribution across sub-districts within Medan Denai District [8]. Some sub-districts performed well, while others struggled due to a lack of human resources and adequate training for field officers [9]. By understanding these differences, we can identify the causal factors and formulate capacity building strategies in low-performing sub-districts [10].

Taking all these problems into consideration, this study aims to measure the effectiveness and efficiency of social assistance recipients in PKH using the Data Envelopment Analysis method. The DEA method was chosen because of its ability to evaluate the relative efficiency of various units (in this case, sub-districts) in using resources to achieve a certain output, namely the distribution of social assistance [11]. DEA allows for simultaneous multi-input and multi-output analysis, thus providing a comprehensive picture of program performance compared to other units [12]. By using this method, it is hoped that it can provide a clear picture of program efficiency as well as recommendations for improving the distribution of social assistance in Medan Denai District in the future

Based on the results of the research conducted [13], It is known that the nutmeg processing agro-industry in the Banda Islands, Central Maluku, has generally not achieved optimal efficiency. Of the 30 artisans analyzed as Decision-Making Units (DMUs), only 5 were classified as efficient (with an efficiency score of 100%), while the remaining 25 were classified as inefficient. This inefficiency is caused by excessive use of inputs, such as raw materials and working capital, disproportionate to the output produced. The study used an input-oriented DEA model (CCR-I) approach, in which technical efficiency is assessed based on the artisans' ability to combine inputs to produce maximum output. Efficient artisans serve as a reference for inefficient artisans to improve their input allocation based on suggested projection values. The results of this study suggest that inefficient artisans should reduce input use according to recommendations and learn from the best practices carried out by efficient artisans, so that the entire Banda nutmeg agro-industry can develop optimally and sustainably.

This research is expected to significantly contribute to understanding the effectiveness of the PKH program and assist local governments in formulating policies and strategies to improve the quality of social assistance distribution to the community. This will ensure the program is more targeted and provides maximum benefits to low-income families in Medan Denai District.

II. RELATED WORKS

A. Efficiency

Efficiency can also be defined as the ability to use a given amount of input to produce the best output, or to optimize the ability to use existing input to produce a given amount of output [14]. According to this definition, efficiency consists of two main components, namely the activities carried out and the results produced from these activities [15].

The concept of efficiency refers to the optimal use of resources to produce output. While achieving 100% efficiency is difficult, approaching that level is a desirable goal [16]. More importantly, this concept of efficiency emphasizes the effective management of inputs rather than the resulting outputs. The ratio of total output to total input is the basic measure of efficiency used in Data Envelopment Analysis (DEA) methods

$$Efficiency = \frac{output}{input} \qquad (1)$$

In this formulation, the symbols x and y are used to represent inputs and outputs in general, while i and j are used to represent specific inputs and outputs. For example, xi

refers to the i-th input and yj refers to the j-th output of a decision-making unit (DMU). The total number of inputs is represented by I and the total number of outputs is represented by J, provided that I and J are positive integers [17].

$Virtual\ Input = \sum_{i=1}^{I} u_i \ \ x_i$

By using the weight ui for the input xi during the accumulation process, we can describe the output as follows:

$Virtual\ Output = \sum_{j=1}^{J} v_j \ y_j$

By using the weights vj for the input yj during the accumulation process, the efficiency can be defined as follows based on the virtual input and output model above:

$$Efficiency = \frac{Virtual\ Output}{Virtual\ Input} = \frac{\sum_{j=1}^{J} v_j\, y_j}{\sum_{i=1}^{I} u_i\ x_i} \qquad (2)$$

Information:

v_j : The weight value of *output* y_j

y_j : Value *output* to-j

u_i : Weight value *input* x_i

x_i : Value *input* ke-i

B. Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a productivity analysis model that consists of several factors and is used to evaluate the level of efficiency [18]. The DEA method has the ability to handle a wide range of inputs and outputs in the analysis. This method identifies variables that have a direct influence on the efficiency of a decision-making unit (DMU).

DEA uses a technical mathematical approach to handle multiple variables with complex constraints, without limiting the selection of inputs and outputs based on the technology used [19]. First developed by Farrell in 1957, the DEA method was extended by Charnes, Cooper, and Rhodes in 1978 by developing a model called the CCR model [20]. In this model, the efficiency level is calculated using a weighted ratio between input and output, and a linear method is used to calculate the weight.

DEA is a method that utilizes linear programming to evaluate the relative efficiency of decision-making units (DMUs) [21]. This method examines the performance of DMUs with the same resources and producing the same output. In DEA, the model solution found reflects the level of productivity or efficiency of a unit compared to other units [22]. If there are n DMU units with m inputs and s outputs, the relative efficiency of the DMU can be calculated using the model equation developed by Charnes, Cooper, and Rhodes in 1978 as follows [23]:

$$max = \frac{\sum_{k=1}^{s} v_k y_{ki}}{\sum_{j=1}^{m} u_j x_{ji}} \qquad (3)$$

$$s.t. = \frac{\sum_{k=1}^{s} v_k y_{ki}}{\sum_{j=1}^{m} u_j x_{ji}} = 1 \qquad (4)$$

$$vk, uj \geq 0 \qquad (5)$$

informations:

X_{ji} = The j input value used by the i DMU

Y_{ki} = The kth output value used by the i DMU

U_j = weight for input j

V_k = weight for input k

III. METHOD

The methods applied in this study include literature study, needs analysis, data collection, system design, system implementation, system testing and system evaluation. The application of this method is visualized in the form of images using the waterfall approach which will be illustrated in Figure 1 below.

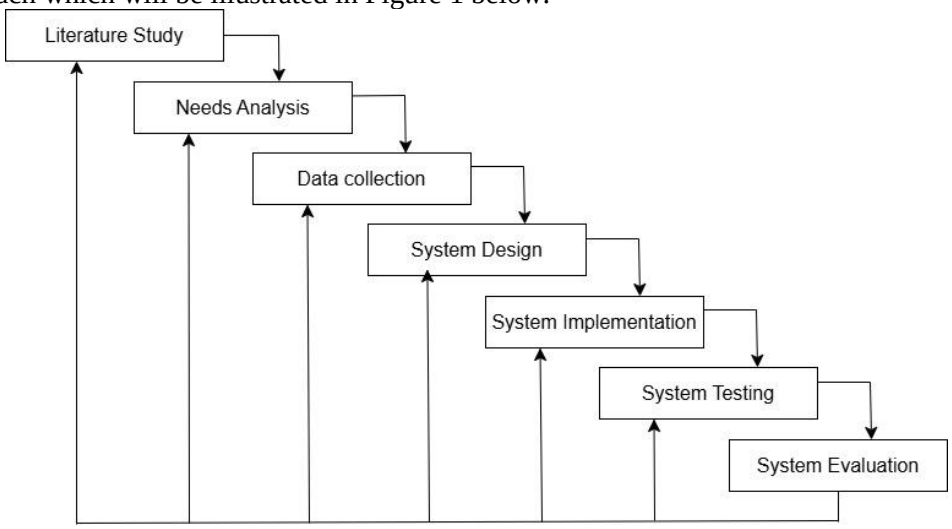

Figure 1. Research Flow Diagram

A. System Scheme

System scheme for the study of Measuring the Implementation of Social Assistance Recipients in the Family Hope Program Using the Data Envelopment Analysis (DEA) Method. This scheme describes the data flow and processes in the system to be developed which can be seen in the following image:

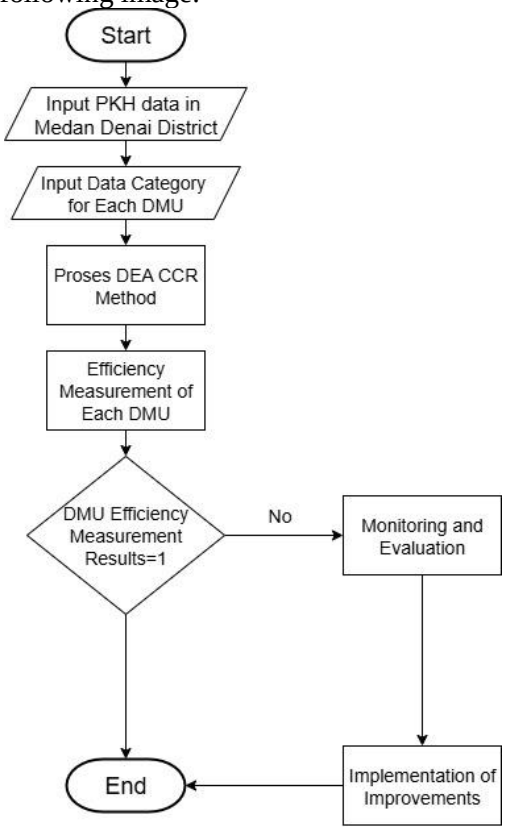

Figure 2. System Scheme

IV. RESULT AND DISCUSSION

A. Data Collection

Based on the results of the questionnaire distribution, researchers successfully collected data from the six sub-districts that were the objects of the study. The data obtained reflected the community's perceptions and experiences regarding the implementation of PKH.

Table 1. Number of Recipients and Respondents of Questionnaires per Sub-district

Sub-district Name	Number of PKH Recipients	Number of Questionnaire Respondents	Percentage of Total Questionnaires
Binjai	521	360	±69%
Denai	201	171	±85%
Medan Tenggara	261	261	100%
Tegal Sari Mandala I	61	61	100%
Tegal Sari Mandala II	541	404	±75%
Tegal Sari Mandala III	690	467	±69%

Based on Table 1 above, from a total of 2,275 aid recipients who were targeted to fill out the questionnaire, 1,724 respondents were obtained. The participation rate varied between sub-districts, with the highest participation in Southeast Medan and Tegal Sari Mandala I (100%), while other sub-districts were in the range of 69-85%. Overall, the average questionnaire return rate reached around 77%, which is quite representative as analysis material.

B. Manual Calculation of Data Envelopment Analysis Method

In this manual calculation, the researcher used data from 6 sub-districts in Medan Denai District. The data can be seen in the table below:

Table 2. Data on Sub-districts in Medan Denai District

Sub-district Name	Number of Aid Recipients (V1)	Number of Field Officers (V2)	Budget Funds (V3)	Number of Recipients On Target (U1)	Speed Time Distribution (U2)	Recipient Satisfaction Level (U3)
Binjai (D1)	521	4	1.042.000.000	359	0.98	4.26
Denai (D2)	201	14	402.000.000	165	0.99	4.58
Medan Tenggara (D3)	261	2	522.000.000	259	0.95	4.56
Tegal Sari Mandala I (D4)	61	1	122.000.000	59	0.98	4.91
Tegal Sari Mandala II (D5)	541	3	1.082.000.000	398	0.97	4.40
Tegal Sari Mandala III (D6)	690	4	1.380.000.000	461	0.96	4.41

In table 2 above, the next step is to determine the attributes of PKH recipients in 6 sub-districts in Medan Denai District as DMU. For each sub-district, it is transformed into

D1 to D6. The attributes of the Number of Assistance Recipients, the Number of Field Officers, the Budget Funds are each as input V1, V2 and V3. For the Attributes of the Number of Targeted Recipients, the Speed of Distribution Time and the Level of Recipient Satisfaction as output U1, U2 and U3. Based on this, this data will present input and output data from six selected sub-districts (DMU) used in efficiency analysis using the DEA method.

C. Calculating Weight Ratio

From the results of the weight ratio calculation using linear programming LINDO, the weight value of each DMU is obtained. The weight ratio of each DMU is as follows:

Table 3. Variable Weight Data

Type	Variable Name	Weight					
		D1	D2	D3	D4	D5	D6
U1	Number of Recipients On Target	0.001934	0.004977	0.003833	0	0.002391	0. 001892
U2	Speed Time Distribution	0	0.010062	0.007749	0	0.049920	0
U3	Recipient Satisfaction Level	0	0	0	0.203666	0	0
V1	Number of Aid Recipients	0	0	0	0	0	0.000120
V2	Number of Field Officers	0	0	0	0	0.333333	0. 229266
V3	Budget Funds	0.000960	0.002488	0.001916	0.008197	0	0

In Table 4.16, the variable weighting data represents the calculated value of LINDO outputs in six sub-districts. Each DMU has a different weighting depending on the contribution of each variable to achieving efficiency.

D. Calculating Virtual Input and Output Values

After the weight of each DMU variable is obtained, the next step is to calculate the virtual input and output values. The calculation of virtual input and output uses the following formula:

Virtual Input = $\sum_{i=1}^{I} u_i \; x_i$

Virtual Output = $\sum_{j=1}^{J} v_j \; y_j$

Table 4. Virtual Input and Output

No	DMU	Virtual Input	Virtual Output	Efficiency
1	Binjai	1.00032	0.694306	0.694
2	Denai	1.000176	0.83116638	0.831
3	Medan Tenggara	1.000152	1.00010855	1.000
4	Tegal Sari Mandala I	1.000034	1.00000006	1.000
5	Tegal Sari Mandala II	0.999999	1.0000404	1.000
6	Tegal Sari Mandala III	0.999864	0.872212	0.872

Table 4 displays the results of the efficiency evaluation of six sub-districts receiving the Family Hope Program (PKH) in Medan Denai using the Data Envelopment Analysis (DEA) method. This table includes virtual input and output values calculated from a combination of input variables (number of recipients, officers, and budget) and output

variables (targeting accuracy, distribution speed, and satisfaction) with certain weights. The results indicate that three sub-districts—Medan Tenggara, Tegal Sari Mandala I, and Tegal Sari Mandala II—achieved full efficiency with a score of 1, while the other three—Binjai, Denai, and Tegal Sari Mandala III—were not yet efficient because their efficiency scores were below 1, indicating suboptimal use of inputs to produce maximum output.

E. Calculating Efficiency Value

The next step is to determine the input and output values of each DMU, then use the following mathematical equation to determine the efficiency of each DMU:

$$Efficiency = \frac{Virtual\ Output}{Virtual\ Input} = \frac{\sum_{i=1}^{I} U_i X_i}{\sum_{j=1}^{J} v_j y_j} = 1$$

Table 5 Efficiency Value

No	DMU	Efficiency Value
1	Binjai	0.69
2	Denai	0.83
3	Medan Tenggara	1
4	Tegal Sari Mandala I	1
5	Tegal Sari Mandala II	1
6	Tegal Sari Mandala III	0.87

Of the 6 DMUs, there are 3 DMUs that produce a value of 1 or efficient for PKH assistance recipients in Medan Denai District from the previous search, the following is a data table of PKH assistance recipients in 3 sub-districts in Medan Denai District that are efficient:

Table 6. Efficient DMU Efficient Ratio

Code	DMU	Input and Output Variable Values						Efficiency Ratio	Status
		V1	V2	V3	U1	U2	U3		
DMU 3	Medan Tenggara	261	2	522.000.000	259	0.95	4.56	1	efficient
DMU 4	Tegal Sari Mandala I	61	1	122.000.000	59	0.98	4.91	1	efficient
DMU 5	Tegal Sari Mandala II	541	3	1.082.000.000	398	0.97	4.40	1	efficient

In table 4 above, there are 3 of the 6 sub-districts in Medan Denai district that produce an efficiency value equal to 1. These sub-districts are Medan Tenggara Sub-district, Tegal Sari Mandala I Sub-district and Tegal Sari Mandala II Sub-district.

Table 7. Inefficient DMU Efficiency Ratio

Code	DMU	Input and Output Variable Values						Efficiency Ratio	Status
		V1	V2	V3	U1	U2	U3		
DMU 1	Binjai	521	4	1.042.000.000	359	0.98	4.26	0.69	Not efficient
DMU 2	Denai	201	14	402.000.000	165	0.99	4.58	0.83	Not efficient
DMU 6	Tegal Sari Mandala III	690	4	1.380.000.000	461	0.96	4.41	0.87	Not efficient

Based on table 5, the Inefficient DMU Efficiency Ratio shows that there are 3 out of 6 sub-districts in Medan Denai sub-district that produce inefficient values or produce values less than 1. These sub-districts are Binjai Sub-district, Denai Sub-district and Tegal Sari Mandala III Sub-district. They have not been able to optimize the use of their inputs to produce maximum output.

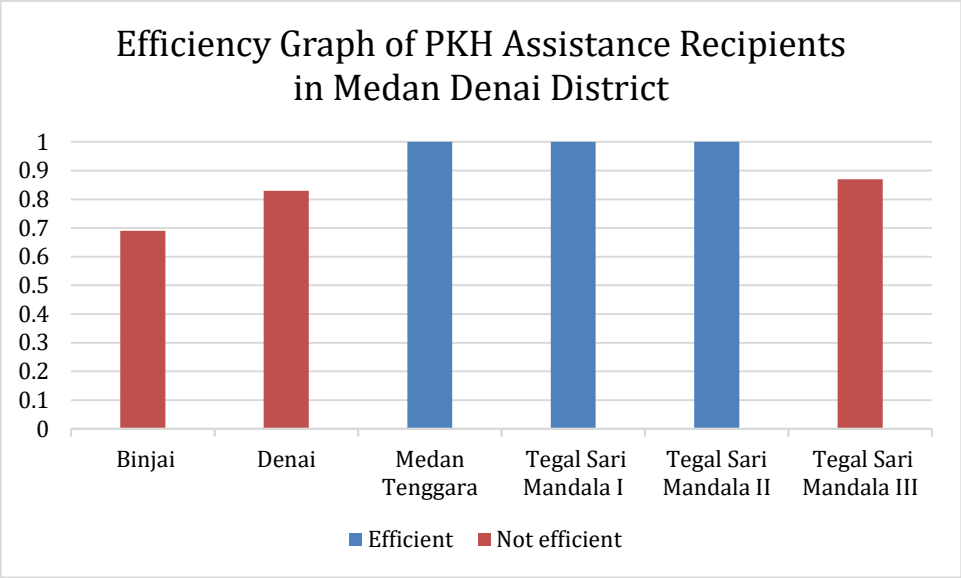

Figure 3. Efficiency Graph of PKH Recipients in Medan Denai District

The graph above shows the efficiency level of each sub-district in distributing Family Hope Program (PKH) assistance in Medan Denai District. The efficiency score ranges from 0 to 1, with 1 indicating full efficiency. The blue line represents sub-districts that have achieved optimal efficiency, meaning they are able to utilize aid inputs optimally to produce outputs aligned with the program's objectives. Sub-districts such as Medan Tenggara, Tegal Sari Mandala I, and Tegal Sari Mandala II fall into this category, with efficiency scores reaching 1.

Conversely, the orange line indicates sub-districts that have not yet achieved full efficiency. Sub-districts such as Binjai, Denai, and Tegal Sari Mandala III remain below optimal efficiency. This inefficiency is caused by the high number of inputs, both allocated funds and staff, not being matched by optimal outputs. Several indicators reflecting this inefficiency include the low number of recipients reaching their intended targets, delays in aid distribution, and suboptimal levels of public satisfaction. Their efficiency scores are below 1, indicating room for improvement in the management of the aid program.

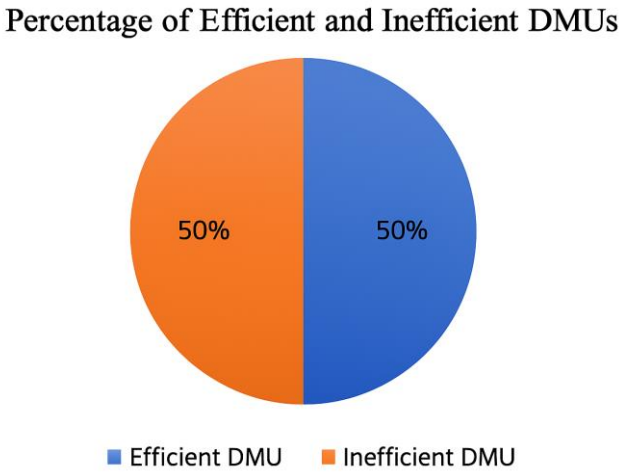

Figure 4. Percentage of Efficient and Inefficient DMUs

The graph above shows the efficiency level of PKH assistance distribution in each sub-district within the Medan Denai District, with efficiency values ranging from 0 to 1. A value of 1 indicates full efficiency, depicted by the blue bars. Sub-districts such as

Medan Tenggara, Tegal Sari Mandala I, and Tegal Sari Mandala II have achieved maximum efficiency, meaning they are able to optimally utilize inputs in the form of funds and personnel to produce appropriate outputs, such as timely distribution, targeted recipients, and high community satisfaction.

Meanwhile, the orange bars indicate sub-districts that are less efficient, such as Binjai, Denai, and Tegal Sari Mandala III. This inefficiency is caused by the high number of inputs, both allocated funds and the number of personnel, but not matched by optimal outputs. Several indicators reflecting this inefficiency include the low number of recipients who are properly targeted, delays in the aid distribution process, and suboptimal levels of community satisfaction. This indicates opportunities for improvement in the management and implementation of the assistance program to make it more efficient and have a real impact on the community.

V. CONCLUSION

Based on the efficiency analysis using the Data Envelopment Analysis (DEA) method conducted on six sub-districts in the Medan Denai District, it was found that three sub-districts—Medan Tenggara, Tegal Sari Mandala I, and Tegal Sari Mandala II—achieved full efficiency, each with an efficiency score of 1. These areas demonstrated the optimal use of resources, including budget allocations and the number of field officers, to produce maximum outcomes such as accurate targeting of recipients, timely aid distribution, and high levels of community satisfaction. Their ability to manage inputs effectively serves as a benchmark for other regions. The remaining three sub-districts—Binjai, Denai, and Tegal Sari Mandala III were categorized as inefficient, with efficiency scores below 1. The inefficiency was primarily due to the excessive use of resources that failed to translate into proportionate benefits. Factors such as unoptimized human resources, delays in aid distribution, and lower satisfaction levels among recipients contributed to their underperformance. These findings underscore the critical importance of continuous monitoring, accurate data updating, and strategic planning in the implementation of social assistance programs. The use of DEA has proven effective in identifying performance gaps and providing a quantitative foundation for future improvements. It is hoped that the insights gained from this study will assist policymakers and stakeholders in enhancing the effectiveness, accountability, and impact of the Family Hope Program (PKH) across all regions, ensuring that resources reach the right beneficiaries and bring measurable social benefits.

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