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Aims and Scope

Asia-Pacific Journal of Rural Development is a peer-reviewed journal that provides a platform for publication of articles in all areas of rural development. The aim of this journal is to provide a platform for policy makers and academicians to promote, share and discuss various new issues and developments in different areas of rural development. The journal publishes conceptual, empirical and review papers in the form of research articles, reports of ongoing research, analyses of current and topical practice, policy issues relating to rural development field notes and book reviews. The journal is peer-reviewed and adheres to a rigorous double-blind reviewing policy in which the identity of both the reviewer and author are always concealed from both parties.

Subject areas include any thematic areas related to sustainable integrated rural development aligned with Sustainable Development Goals (SDGs). The thematic areas are including but not limited to the following:

- Sustainable use of natural resources
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- Land and water resources management
- Agro processing and rural market
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- Education and skill development
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- Renewable energy for rural consumption
- Rural transportation
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Productivity and Resource Use Efficiency of Tiger Shrimp Farming in Some Selected Areas of Bagerhat District in Bangladesh

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Abstract

The study has been applied for measuring productivity, profitability and efficiency of shrimp (Penaeusmonodon) farming in Bangladesh. It was found that per hectare gross return (GR), net return and gross margin were Tk. 364,222, Tk. 215,931 and Tk. 260,095, respectively, and Benefit Cost Ratio was 2.46 for shrimp farming. All the explanatory variables had a positive and significant effect, except for cost of lime had a negative and insignificant effect on the GR of shrimp farming. Efficiency analysis indicated that most of the farmers inefficiently used their inputs. This study also identified some of the problems faced by the farmers associated with shrimp farming.

Keywords

Benefit cost ratio, marginal factor cost, marginal value product, resource use efficiency, shrimp farming

Introduction

Agriculture is the mainstay of the economy of Bangladesh. The economic development is inextricably linked with the performance of this sector. In an

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agro-based country like Bangladesh, fisheries sub-sector is one of the most important and promising sub-sectors having vital contribution towards her economic development. Bangladeshi people are popularly referred to as *Mache Bhate Bangali* (fish and rice makes a Bengali). The contribution of agricultural sector to gross domestic product (GDP) is about 16.33 per cent (BER, 2016). In 2014–2015, fisheries sub-sector contributed about 24.81 per cent to the broad agricultural sector GDP (BER, 2016). Bangladesh has about 2.75 lakh hectares of coastal tidal land under brackish water shrimp culture (BER, 2016).

Shrimp (*Penaeusmonodon*) farming plays a significant role in meeting the protein demand, earning foreign currency and socio-economic development of the rural poor by reducing poverty through employment generation. Shrimp culture started in Bangladesh in the coastal district of Satkhira in 1960s. Gradually, its culture expanded to the coastal belts of Khulna, Bagerhat, Satkhira, Cox's Bazar and Chittagong, and now, the area under shrimp culture has increased from 64,246 ha in 1984–1985 to 275,274 hectares in 2013 (DoF, 2002, 2014). About 80 per cent of the tiger shrimp comes from the south western region of Bangladesh, that is, greater Khulna region. In 2012–2013 the total foreign earnings from shrimp export were Tk. 3376.20 crore by exporting 50,333 MT shrimp (DoF, 2014). Most of the farmers in Satkhira District followed improved traditional method in shrimp farming which resulted in higher yield. The per hectare total cost (TC) of shrimp farming was Tk. 62613.26 in Satkhira District while Tk. 41815.69 in Khulna District. The per hectare net income in Satkhira District was Tk. 78374.60 and in Khulna District, it was Tk. 32447.49 which means that the net income in Satkhira District was 2.41 times higher than that of Khulna District. In all respect shrimp farming in Satkhira District was more profitable compared to Khulna District (Uddin, 1995). Shrimp farming and related activities helped the concerned people, directly and indirectly, to increase their household income which enables them to have more savings and investment resulting in better livelihoods and socio-economic conditions (Miah, Wahab, & Islam, 2002).

Shrimp farmers and other related people accrued socio-economic benefits from shrimp culture. Unplanned shrimp farming has affected the production of cereals crops and vegetables, trees, poultry and livestock in the coastal region of Bangladesh. Shrimp farming has also negative effects on biodiversity, productivity of estuarine water, agro-ecosystem, socio-economic conditions and friendly environment (Islam et al., 2002).

The marine water shrimp and freshwater prawn was commercially cultured in Khulna District of Bangladesh. Thousands of farmers in this area had converted their paddy fields to shrimp and prawn farms to accommodate a profitable shrimp culture practice (Nuruzzaman, 2006). The resources that were efficiently utilised by the farmers include lime, organic manures and pond area. However, the material inputs, namely feeds, stocking material, and fuel and electricity were excessively used. It was suggested that need-based training programmes and demonstrations should be conducted among farmers to encourage them to follow the recommended package of practices (Reddy, 2006). Shrimp and prawn together represent the second largest exportable items contributing to foreign exchange

earnings of Bangladesh. Shrimp farming was found to have significant impact on environment and economy. The productivity of shrimp was very low compare to the other shrimp producing countries of the world. One of the major causes of poor productivity was the extensive or traditional method of farming, whereas developed countries brought their farms under intensive or semi-intensive methods of farming. The farmers of the study area practiced galda-cum-rice pattern. The productivity of galda and transplanting *aman* (T-*aman*) rice was 505 kg/ha and 3497 kg/ha, respectively (Rahman & Hossian, 2013).

The present study was undertaken with the objectives to calculate the profitability and assess the resource use efficiency (RUE) of shrimp farming in the study area.

Methodology

Methodology in any systematic study deserves careful consideration. Proper methodology is the prerequisite of a good research. Two villages, namely Sungandhi and Korari of Rakhagachi union under Sadar upazila of Bagerhat District, which are the extensive shrimp producing areas were selected for the present study. Survey method was followed to collect production related data while, simple random sampling technique was used to select the shrimp farmers. A total of 105 years round shrimp farmers were selected from the selected villages. Both primary and secondary sources of data were used for the study. Data collection period was 1 April 2014 to 31 May 2014. Both descriptive and statistical analysis was used for analysing the data. Tabular technique of analysis was generally used to find out the socio-demographic profile of the respondent to determine the cost, returns and profitability of shrimp farm enterprises.

Profitability Analysis

Cost and return analysis is the most common method of determining and comparing the profitability of different farm household. In the present study, the profitability of shrimp farming is calculated by the following way:

Calculation of Gross Return

Per hectare gross return (GR) was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross return = Quantity of the product × Average price of the product + Value of by-product.

Calculation of Gross Margin

Gross margin is defined as the difference between GR and variable costs. Gross margin was calculated on total variable cost (TVC) basis. Per hectare gross margin was obtained by subtracting variable costs from GR, that is,

Gross margin = Gross return – Variable cost.

Calculation of Net Return

Net return or profit was calculated by deducting the total production cost from the total return or GR, that is,

Net return = Total return – Total production cost.

The following conventional profit equation was applied to examine farmer's profitability level of the shrimp producing farms in the study areas:

$$\text{Net profit, } \pi = \Sigma P_m Q_m + \Sigma P_f Q_f - \Sigma (P_{xi} X_i) - \text{TFC}$$

where

π = Net profit/Net return from shrimp farming (Tk/ha);
P_m = Per unit price of shrimp (Tk/kg);
Q_m = Total quantity of the shrimp production (kg/ha);
P_f = Per unit price of other relevant fish (Tk/kg);
Q_f = Total quantity of other relevant fish (kg/ha);
P_{xi} = Per unit price of *i*th inputs (Tk);
X_i = Quantity of the *i*th inputs (kg/ha);
TFC = Total fixed cost (Tk);
i = 1, 2, 3, … , n (number of inputs).

Undiscounted Benefit Cost Ratio

Average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted benefit cost ratio (BCR) was estimated as the ratio of total return to TC per hectare.

$$\text{BCR} = \frac{\text{Total return}}{\text{Total cost}}$$

Functional Analysis

The input–output relationships in *bagda* shrimp farming was analysed with the help of Cobb–Douglas production function approach. To determine the contribution of the most important variables in the production process of shrimp farming, the following specification of the model was used:

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e^{u_i}$$

The Cobb–Douglas production function was transformed into following logarithmic form so that it could be solved by ordinary least squares (OLS) method:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + ... + U_i,$$

where

Y = Gross income from year round shrimp (Tk/ha);

X_1 = Cost of shrimp fry (Tk/ha);
X_2 = Cost of Feed (Tk/ha);
X_3 = Cost of lime (Tk/ha);
X_4 = Cost of fertiliser and manure (Tk/ha);
X_5 = Cost of human labour (Tk/ha);
X_6 = Cost of water management (Tk/ha);
A = Intercept;
$b_1, \ldots, b_6$ = Coefficient of the respective variable;
U_i = Error term;
$i = 1, 2, \ldots, 6$.

Multicollinearity Test

Multicollinearity test was also done to test the correlation among the explanatory variables. By Klein's rule, multicollinearity would be regarded as a problem only if $R^2y < R^2i$ where R^2y is the squared multiple correlation coefficient between y and explanatory variables. R^2y is total explanatory power of the equation and R^2i represents the squared multiple correlation coefficient between xi and other explanatory variables (Maddala, 1989, pp. 223–226). Following this method R^2i's are estimated and compared with the R^2y's for selected explanatory variables for shrimp production function.

Measurement of Resource Use Efficiency

In order to test the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input were computed and tested for its equality to 1 that is,

$$\text{MVP/MFC} = 1.$$

The marginal productivity of a particular resource represents the additional to GRs in value term caused by an additional one unit of that resource, while other inputs are held constant. When the marginal physical product (MPP) is multiplied by the product price per unit, the MVP is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as GR (Y) at their geometric means.

In this study, the MPP and the corresponding values of MVP were obtained as follows:

$$\text{MPP}xi \times \text{P}yi = \text{MFC},$$

where $\text{MPP}xi \times \text{P}yi = \text{MVP}$,
but $\text{MPP} = bi \times (Y/Xi)$
so, $\text{MVP} = bi \times (Y/Xi)\ \text{P}yi$,

where *bi* = Regression coefficient per resource,
Y = Mean output,
Xi = Mean value of inputs,
Pyi = Price of output
MFC = Price per unit of input.

Thus, when RUE = 1, resources are optimally used; when RUE < 1, resources are over utilised; when RUE > 1, resources are underutilised.

Results and Discussion

Estimation of Costs and Returns of Shrimp Farming

Total Variable Costs

Costs and returns were considered from farmer's point of view. In the study area, the TVCs varied from year to year. It was observed that the total per hectare variable cost for shrimp farming was Tk. 104,127 which comprised of 70.22 per cent of TC (Tables 1 and 3). Human labour is one of the most important variable inputs in the production process. Human labour is required for various activities and management of the selected farms such as farm preparation, raising dyke, weeding, sorting, grading and harvesting. It was revealed from Table 1 that the farmers in the study area used 103 man-days of human labour per hectare. All the farmers in the study area used fertilisers such as urea, TSP and manure. Farmers in the study area used 72 kg, 56 kg and 272 kg of urea, TSP and manure, respectively. Human labour cost is the major variable costs item for shrimp production. It was estimated Tk. 33,475 per hectare which was about 32.15 per cent of TVCs. In the study area, farmers used 27,146 number of shrimp fry which was accounting 19.81 per cent of TVCs of shrimp production. Besides these costs, the variable costs also include lime cost, feed cost, water management cost, miscellaneous cost and interest on operating capital.

Table 1. Per Hectare Variable Costs of Shrimp Farming

Variable Cost Items	Units	Quantity (Unit/Ha)	Price (Tk/Unit)	Cost (Tk.)	% of Total Variable Cost (TVC)
Human labour	Man-days	103	325	33,475	32.15
Shrimp fry	No.	27,146	0.76	20,631	19.81
Lime	Kg	105	15	1,575	1.51
Urea	Kg	72	20	1,440	1.38
TSP	Kg	56	25	1,400	1.34
Manure	Kg	272	2	544	0.52
Feed cost	Kg	698	45	31,410	30.17

(Table 1 Continued)

(Table 1 Continued)

Variable Cost Items	Units	Quantity (Unit/Ha)	Price (Tk/Unit)	Cost (Tk.)	% of Total Variable Cost (TVC)
Water management cost	Diesel in litre	116	68	7,888	7.58
Miscellaneous cost	–	–	–	1,281	1.23
Interest on operating cost (OC)	–	–	–	4,483	4.31
TVC	–	–	–	104,127	100

Source: Field survey, 2014.

Table 2. Per Hectare Fixed Costs of Shrimp Farming

Fixed Cost Items	Cost (Tk/Ha)	% of Total Fixed Cost (TFC)
Land use cost	38,361	86.86
Construction of guard shed, office and other housing cost	5,803	13.14
TFCs	44,164	100

Source: Field survey, 2014.

Total Fixed Costs

In the study area, it was estimated that per hectare TFC for year round shrimp farming was Tk. 44,164 which comprised of 29.78 per cent of TC (Tables 2 and 3). Land use cost for shrimp farming was estimated at the prevailing rental value per hectare in the study area. The rental value of per hectare land was estimated at Tk. 38,361 which occupied 86.86 per cent of TFC (Table 2). The per hectare average construction cost of guard shed, office and other housing cost were calculated at Tk. 5,803 for shrimp farming which shared 13.14 per cent of TFC (Table 2).

Total Costs

The TCs were calculated by adding up TVC and TFC. In the study, per hectare TC of shrimp farming was calculated at Tk. 148,291 (Table 3).

Table 3. Per Hectare Total Cost of Shrimp Farming

Cost Items	Cost (Tk/Ha)	% of Total Cost (TC)
TVC	104,127	70.22
TFC	44,164	29.78
TC (a + b)	148,291	100

Source: Field survey, 2014.

Profitability of Shrimp Farming

Gross Return, Net Return and Gross Margin

GR is the pecuniary value of total product. In the study area, per hectare average yield of shrimp was 422 kg and its money value was Tk. 297,670. Apart from these, few species of shrimps and fishes were also grown in shrimp farms. They are known as fin fish which includes pershey, tilapia, vetki, horina, chaka, tangra, etc. Per hectare average yield of fin fish was 472 kg and its money value was Tk. 66,552. Therefore, the GR for one year shrimp farming was accounted for Tk. 364,222 (Table 4). Per hectare net return was estimated at Tk.215,931 which indicates that shrimp production is profitable business for the shrimp farmers (Table 5). The gross margin analysis has been taken into account to calculate the relative profitability of shrimp farming. The gross margin of shrimp farming was estimated at Tk. 260,095 (Table 5).

Table 4. Per Hectare Return of Shrimp Farming

Items		Yield (Kg/Ha)	Price (Tk/Kg)	Gross Income (Tk/Ha)	% of Gross Income
(a)	Shrimp				
	A-grade	153	970	148,410	40.75
	B-grade	148	603	89,244	24.51
	C-grade	121	496	60,016	16.47
	Subtotal	422	–	297,670	81.73
(b)	Fin fish	472	141	66,552	18.27
	Gross return (GR) from shrimp and fin fish (a + b)	–	–	364,222	100

Source: Field survey, 2014.

Table 5. Gross Margin and Benefit Cost Ratio (Undiscounted) of Shrimp Farming

Sr. No.	Items	Amount (Tk/Ha)
A.	GRs	364,222
B.	TVC	104,127
C.	TCs (TVC + TFC)	148,291
D.	Net return (GR – TC)	215,931
E.	Gross margin (GR – TVC)	260,095
F.	Benefit cost ratio (BCR) = GR/TC	2.46

Source: Field survey, 2014.

Benefit Cost Ratio (Undiscounted)

It was evident from the study that the BCR of shrimp farming was accounted for 2.46 implying that Tk. 2.46 would be earned by investing Tk. 1 for shrimp production. So, the shrimp farming was found to be profitable for farmers (Table 5).

It was evident from the results that per hectare TVC for shrimp farming were more than per hectare TFCs for shrimp farming. Shrimp farming provides higher returns to the farmers. Shrimp cultivation is gaining popularity in the country gradually due to its high yield potentiality and high demand in the international market. Sample farmers showed their opinion that higher yield and income encouraged them to continue shrimp production.

Resource Use Efficiency of Shrimp Farming

Cobb–Douglas production function was chosen to estimate the contribution of key variables on the production process of shrimp farming. The estimated values of the model are presented in Table 6. It was evident from Table 6 that the costs of shrimp fry, feed, fertiliser, human labour and water management had a positive and significant effect, except for the cost of lime that had a negative and insignificant effect on the GR of shrimp farming.

Table 6. Estimated Values of Coefficients and Related Statistics of Cobb–Douglas Production Function

Explanatory Variables	Coefficient	Standard Error	*T*-value
Intercept	2.775***	0.586	4.739
Cost of shrimp fry (X_1)	0.133*	0.072	1.846
Cost of feed (X_2)	0.229**	0.092	2.492
Cost of lime (X_3)	–0.050 NS	0.077	–0.654
Cost of fertiliser and manure (X_4)	0.384***	0.081	4.713
Cost of human labour (X_5)	0.239**	0.118	2.026
Cost of water management (X_6)	0.123*	0.069	1.775
R^2		0.83	
Adjusted R^2		0.82	
Return to scale		1.06	
F-value		79.926***	

Source: Field survey, 2014.

Notes: (a) ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

(b) NS: Not significant.

The values of the coefficient of multiple determination of shrimp farming was found to be 0.83 which implied that about 83 per cent of the total variation in the GR could be explained by the included explanatory variables of the model. So we can say that the goodness of fit of this regression model is better since R^2 indicates the goodness of fit of the regression model. *F*-value for the shrimp farming was estimated at 79.926 which was highly significant at 1 per cent level. It means that the explanatory variables included in the model were important for explaining the variation in GR of shrimp production. The summation of all the production coefficients of shrimp farming is equal to 1.06. This means that the production function for shrimp farming exhibits increasing returns to scale. This means that, if all the variables specified in the model were increased by 1 per cent, GR would also be increased by 1.06 per cent (Table 6).

Total multiple correlation coefficients is much higher than partial multiple correlations, which indicate that there is no severe correlation among the explanatory variables (Table 7). Multicollinearity test revealed that there was no severe correlation among the explanatory variables. RUE indicated that all the resources were used for shrimp production except the overutilisation of lime (Table 8). So there is a positive effect of key factors in the production process of year round shrimp farming.

Table 7. Test of Multicollinearity of the Explanatory Variables for Shrimp Production Function

Particulars	Value of Total R^2 and Partial R^2	Comment
Total R^2	0.83	
Partial R^2		
Ln cost of shrimp farming	0.183	NSC
Ln cost of feed	0.244	NSC
Ln cost of lime	–0.066	NSC
Ln cost of fertiliser and manure	0.430	NSC
Ln cost of human labour	0.200	NSC
Ln cost of water management	0.176	NSC

Source: Field survey, 2014.

Note: NSC—No severe correlations.

Table 8. Estimated Resource Use Efficiency in Shrimp Production

Variables	GM	MVP	MFC	MVP/MFC	Comment
Shrimp fry	25,657.39	1.45	0.76	1.91	Underutilised
Feed	638.89	99.85	45	2.22	Underutilised
Lime	99.31	–141.19	15	–9.41	Over utilised
Fertiliser and manure	374.32	286.22	47	6.09	Underutilised
Human labour	74.94	890.54	325	2.74	Underutilised
Water management	103.84	330.53	68	4.86	Underutilised

Source: Field survey, 2014.

Problems of Shrimp Farming

Although shrimp farming was highly profitable in the study area, however there are several problems to its higher production faced by the farmers. The problems were broadly classified under three categories such as economic, technical and social. Thereafter, the problems were ranked on the basis of their percentages. High price of input (55.20%) ranked first as a problem of shrimp production. Besides this, insufficient water in dry season (40%), attack of shrimp diseases (39%), lack of sufficient fund (38.10%) and lack of extension services (35.20%) ranked as 2nd, 3rd, 4th and 5th, respectively, major problems of shrimp production faced by the farmers. Multiple ownership (3.80%) was the least important problem faced by the farmers (Table 9).

Conclusion and Policy Recommendations

It may be concluded that shrimp farming is highly profitable. If modern inputs and production technology can be made available to farmers in time, yield and production will be increased which can help farmers to increase income and improve livelihood standards. It can help in improving the nutritional status of rural people. Most of the farmers were reported that high price of input was the main constraint for their shrimp production. And this problem occupies first position according to its ranking. But we think there is some inconsistency of their answer. Our opinion is that attack of shrimp diseases and the insufficient water in

Table 9. Major Problems Faced by the Sample Farmers

Problems	No. of Respondent	Type of Problems	%	Rank
High price of input	58	Economic	55.20	1st
Insufficient water in dry season	42	Technical	40.00	2nd
Attack of shrimp diseases	41	Technical	39.00	3rd
Lack of sufficient fund	40	Economic	38.10	4th
Lack of extension services	37	Technical	35.20	5th
Lack of scientific knowledge and technology	27	Technical	25.70	6th
Low price of output	26	Economic	24.80	7th
Lack of marketing facilities	18	Economic	17.10	8th
Over flooding in rainy season	17	Technical	16.20	9th
Theft of shrimp from farm	17	Social	16.20	9th
Capture of shrimp and shrimp farm by force	12	Social	11.40	10th
Pushing poison to shrimp	9	Social	8.60	11th
Multiple ownership	4	Social	3.80	12th

Source: Field survey, 2014.

the dry season were the main constraints hampering shrimp production. Government is already giving subsidy to purchase the modern inputs for shrimp production. So, price of input was not a severe problem for the farmers. If proper vaccine were given and direct entry of water at the right time were provided then the production will be increased significantly and thus the farmers will be benefited. There is an ample opportunity to improve per hectare yield of year round shrimp production. To enhance the productivity, efficiency and effectiveness of shrimp farming, the following recommendations are made as a part of the present study which acts as a formulating strategy for enhancing shrimp production in Bagerhat District:

1. Though the government is already given subsidy on fertiliser such as urea and other inputs required for shrimp farming, fair prices of inputs should be ensured so that the farmers can get them at a reasonable price.
2. Availability of saline water is an important factor for shrimp production. Government can solve this problem by keeping the diesel price at a reasonable level so that farmers can supply sufficient water in the shrimp farm in dry season.
3. Physiology- and soil-related research should be conducted to identify the real causes of shrimp viral diseases and its outbreak. To overcome this problem, scientific use of chemicals should be ensured and supplementary supply of artificial irrigation should be arranged in dry season.
4. Bank loan and institutional credit should be made available on easy terms and conditions to the shrimp farmers.
5. Scientific method of cultivation should be introduced to increase production. The farmers should be provided with training, adequate services, information and necessary facilities to cope with new and changed situation.
6. Application of feed and fertiliser in relation to stocking density needed to increase the production of shrimp. Fair prices of outputs should be ensured.
7. Attention should be given to improve transportation and marketing facilities of the study area.
8. Law and order enforcing agencies should be vigilant in the study area to minimise the social tension and improve the situation of shrimp farming areas.

Declaration of Conflicting Interests

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Article

The 'Reality' of Participation During Community Partnership in Management of Forest Resource: Evidences from Bankura District, Eastern India

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Abstract

The notion of 'participation' and its association with the concept of planning and governance has increasingly become important both in rural and urban governance. However the impact of the participation has been different in different settings. The present study is an attempt to examine the participatory processes in planning within an already existing participatory programme in India, namely the Joint Forest Management (JFM) Programme, empowering forest communities within rural forest dwelling units with management functions, through a participative approach. In recent times, within the framework of JFM, Microplan has to be prepared for each village, under the National Afforestation Programme of the Ministry of Environment and Forests, Government of India. The study aims to address the nature and extent of participation and the factors which have affected the outcome of participatory processes in a representative case site, within broader context of participatory governance.

Keywords

Joint Forest Management, Microplan, community partnership, non-timber forest product, participation

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Introduction

The notion of 'participation' and its association with the concept of planning and governance has increasingly become important. While there is a broad consensus on the effectiveness of this approach (Chambers, 1997; Singh, 2009), some scholars consider it utopian and point to the gap that exists between the theoretical and the operational scenario of participation (Cooke & Kothari, 2001; Hickey & Mohan, 2004). The present study is an attempt to examine the participatory processes directly emerging from the context of governance. The study considers this theme with reference to West Bengal, a state in eastern India, which has made a significant impact in pursuing participatory initiatives. The study aims to address the nature and extent of participation and the factors which have affected the outcome of participatory processes in a representative case site, within broader context of participatory governance.

'Participatory planning' has been pursued in both the urban and rural areas of West Bengal. Participatory programme which deserves a special attention is the Joint Forest Management (JFM) programme. JFM is a programme of empowering forest communities with management functions, through a participative approach. The JFM programme was initiated in 1970s as an experimental project, the success of which led to its inclusion in the National Forest Policy of 1988.

In recent times, within the framework of JFM, Microplan has to be prepared for each village, under the National Afforestation Programme of the Ministry of Environment and Forests, Government of India. This is a plan for management of forest areas assigned to the community under JFM. Microplans are developed through participatory planning.

The study adopts a case study method as case studies enable a contextual and in-depth analysis of data. In West Bengal, Bankura district occupies a prominent place in implementation of the JFM programme as it is one of the few districts in the state with a large number of Forest Protection Committees (Sau, 2008). Three villages of the Khatra Range in Bankura district prepared Microplans. The village Chakadoba was one of the three villages of the Khatra Forest Range in Hirbundh Block of Bankura that prepared a Microplan for management and conservation of its forest resources. This village has been selected for studying participation in planning within JFM programme.

Background of the Study

Defining Participation

The word participation has been used with different connotations in different contexts. Lexically, 'participation' is the act of sharing in the activities of a group. However, in the context of development studies, participation is public involvement in development.

A few definitions of participation in planning and governance put forward by some of the major international organisations or at the international summits have been noted below.

The importance of participation received recognition at the Rio Summit Declaration in 1992 as one of its 27 principles (Papadokis, 2006).

Principle 10 states that 'Environmental issues are best handled with participation of all concerned citizens, at the relevant level'.

An important definition of participatory governance came from the United Nation's Department of Economic and Social Affairs:

'Participatory governance provides citizens with access not only to information, but also to decision-making and power to influence public choices. It means access not only for a privileged few, but for all, including those who are still too often excluded from the benefits of development, particularly the poor, the marginalised and vulnerable group' (United Nations, 2007).

The accepted definition of participation within the World Bank (1992):

'Participatory development is a process through which stakeholders influence and share control over development initiatives, and the decisions and resources which affect them.'

There is thus a range of definitions of participation when one considers the involvement of the community in planning or governance activities.

Academic Debate on Participation

According to the International Institute of Environment and Development, traditionally, under 'top-down planning', information gathering system took the form where the community had no say in the content or the type of information collected for a particular project or activity. Field experiences showed that in many instances, pre-determined conclusions or restricted information have failed to answer the reality of problems faced by the different sections of the community. This is particularly true for the vulnerable sections of societies whose voices are not heard and who are frequently left out of decision-making. The participatory approaches were thus designed with the belief that these had the potential for eliminating many of the problems of top-down approach of planning. It had the quality of being transparent, allowed cross-checking and provided space for the vulnerable to voice their opinions. However, the concept of participation and its potential to reverse the problem of expert-oriented top-down planning is a contested approach as there are different perceptions of participation. The practices of participation both at the single project level as well as at the wider policy level have not only increased the number of interpretations of the term, participation, but have also brought criticisms of the participatory approaches. In contemporary times, broadly following three schools of thoughts on participation have emerged:

1. The first school of thought led by Robert Chambers believes that the process of participation with its tools like participatory rural appraisal (PRA), participatory learning and action can reverse the problems of expert-oriented decision-making through 'top-down' approaches of development. According to Chambers (1997), participatory methods promoted 'power-sharing in the research and planning phases of

development' through the incorporation of the perspectives of local residents (Chambers, 1997).

2. The second school of thought is associated with the development scholars such as Bill Cooke and Uma Kothari (2001) who were of the opinion that the concept of participation is overrated. It has its own set of problems which can get 'tyrannical' at times. They were of the opinion that the theoretical ideals of participation often do not function as a tool for liberation and distribution of power. Instead, efforts towards participation often maintain existing power relationships of the bureaucrats, funders and multinational companies. Participatory techniques are masking the power behind the rhetoric and techniques of participation. This masking, therefore, represents the 'tyranny' of participation (Cooke & Kothari, 2001).
3. The third school with scholars such as Samuel Hickey and Giles Mohan offers a middle path on the future of participation. Their work extends from the debate of participation between Chambers (1983; 1997) and Cooke and Kothari (2001) and seeks to modify the process of participation. Participation, according to them, can produce genuine transformation for the marginalised, if used properly (Hickey & Mohan, 2004).

As the impact of participation had been different under different scenarios, it becomes necessary to understand the ground level realities of participation. Hence, the study is taken up as the participation is not only a process but is governed by a number of political, social and economic factors which create differences between the theory and practice of participation, in any area.

Materials and Methods

The study intends to understand the nature, extent and factors affecting preparation of participatory plan within an existing participatory programme in rural West Bengal.

West Bengal, a state in eastern India, had been the cradle of a number of decentralisation programmes beginning from the JFM programme to giving a fresh lease of life to the Panchayat system in rural areas.

JFM which is presently an international acclaimed project, was selected for the present study as the state of West Bengal is the birthplace of the programme. In the case of selecting participatory planning under JFM, the researcher's choice was limited as Microplan was completed only in a few villages. Though in theory, Microplanning had to be prepared with participation in each village under JFM programme, but only in a few areas, it had been prepared. In West Bengal, Bankura district occupies a prominent place in JFM programme as it has the highest number of Forest Protection Committees in West Bengal. Under the National Afforestation Programme of the Ministry of Environment and Forest, GOI, a Microplan was prepared by three villages of the Khatra Range in Bankura district. The village Chakadoba was one of these villages and was chosen for the study.
The respondents were chosen keeping in mind the following issues:

- Those who were affected by, or significantly affect, a participatory process as a participant in preparing or implementing plan.
- Those who possess information, resources and expertise needed for strategy formulation and implementation by guiding the entire step by step process of plan preparation.
- Those who control implementation instruments by designing, monitoring and arranging funds.

There were 73 respondents. A total of 51 respondents were interviewed on the process of participation. There were also 2 focus group discussions (FGDs) with 10–12 village respondents in each. Table 1 illustrates the summarized plan of data collection, from the respondents of the study.
The respondents were divided as following:

1. Formal institutions
   a. Category A
      Forest Department Officers: 3 respondents (Conservator of Forest; Divisional Forest Officer, Bankura (South) Division; Block Development Officer [BDO], Hirbundh Block).
   b. Category B
      Field level staff: 3 respondents (Officers: Khatra Forest Range and Chakadoba Beat Office).
   c. Category C
      Others: 2 respondents (representatives of IBRAD, a NGO who worked in the Block).
2. Community: 43 respondents (villagers representing different socio-economic profiles of Chakadoba).

This study is qualitative in nature and thus has relied on the collection of qualitative data and analysis. The best-suited approach was found to be phenomenological perspective which deals with the individuals experience with a particular phenomenon which in this case is the engagement in the participatory planning project in that area.

Results

Profile of the Study Area

Chakadoba is a village in Hirbandh Forest Beat of Khatra Forest Range[1] of Bankura district with an area of 50 hectares.[2] The study area receives an annual rainfall of 800–1200 mm while the maximum temperature ranges between 35°C and 40°C, the minimum rarely falls below 15°C. However 80 per cent of the rainfall is concentrated in only 4 months creating water shortage. The region is identified as one of the drought prone areas of West Bengal. There are no drainage canals flowing through the area. In the neighbourhood, there is Kasai River and the Mukutmanipur dam. The nature of soil is red gravelly soil while the vegetation is 'tropical deciduous Sal'.

Table 1. Summarised Plan of Data Collection

Chakadoba	**In-depth interviews** with conservator of forests and academicians of Institute of Biosocial Research and Development (a NGO) facilitating Microplan preparation.	4
	Structured interviews:	47
	1. With range officer, Khatra Forest Range; beat officer, Chakadoba–Basudevpur; divisional forest officer, Bankura (South) and block development officer, Hirbundh block.	4 43
	2. With the community members.	
	Focus group discussions with the community members.	2

Source: The authors.

According to 2011 Census, there were 59 households with 258 people. The percentage of male in the population was 53 while that of female was 47. The average literacy was 54 per cent, that is, 140 people were literates while the percentage of literates among female population was 40.

Agriculture is thus the primary occupation. Farming takes the form of paddy cultivation. However uneven distribution of rainfall, intermittent drought spell between two successive rainfalls, low water retention capacity of the soil and undulating land structure have made cultivation difficult here. During the lean season, the villagers collect various products such as fuel wood, twigs and Sal leaves from the jungle. Small-scale animal husbandry is also done. They also keep animals such as cow and goat for livelihood purpose. At the same time, the dry climate is very suited to animal resource development and seed production. Besides this, during lean season, there is a seasonal migration of labour to the neighbouring town of Burdwan. However, this tendency has reduced since the introduction of JFM scheme which has assured some income from the forests.

Chakadoba settlers have a history of exploiting the forest products for economic benefits. Chakaboba's physiography and environment had never provided a vast array of economic opportunities to its settlers. Land has been undulating, lateritic and porous with poor subsoil moisture. This had become a potent threat to the crops. This made the population highly vulnerable to poverty. Hence, the population had relied on gathering forest products. However, this did not eradicate poverty. Poverty led to further pressure on forest resources and this had degraded the forest. However, it was only in 1998, with the introduction of JFM, that avenues of partnership with the Forest Department opened up and people started using the forest in a regulated manner leading to an economic upliftment of the villagers. The forest which was extremely degraded turned out to be a lush green vegetation belt. Regeneration of Sal (Shorea robusta) and Akashmoni forest in the region or planting of multipurpose tall seedlings of different species improved the quality of plantation. Introduction of fruit bearing species such as jackfruit, tamarind, *ber* (jujube), *jamun* (java plum), wood apple, *amla* (Indian gooseberry) and *dumur* (ficus racemosa) had opened way for minor sustenance to the community. In lieu of protecting the forest, the beneficiaries, that is, Forest

Protection Committee members of Chakadoba started receiving 25 per cent of the net sale of the harvested produce. This improved the relationship of the community with the Forest Department.

Unique Problems of the Area

1. *Scarcity of water has led to economic problems*: The region is located in the 'drought prone zone' of West Bengal and suffers from scarcity of water. The village does not have piped water supply or electricity. Agriculture is also hampered due to scarcity of water. Fluctuating rainfall with intermittent drought spells between two successive rainfalls makes the crop vulnerable to low yields. If the drought spell lengthens then the crop output falls further. Irrigation is suffering as there is no electricity to pump water from nearby sources and irrigate the fields. This has led to economic deprivation among the community members as the primary occupation is agriculture and Agricultural Labourers and Cultivators comprise 56 per cent of the population (Ministry of Home Affairs, 2011).
2. *Degradation of the forests*: The community during lean and dry season depends on the forest to gather forest products. This had been their secondary occupation and has added to the family income. Income from cultivation is dependent on water supply which again is a scarce resource. This practise of gathering forest products had severely degraded the forest of the area.
3. *Unrest and other administrative problems*: Chakadoba village has a Panchayat and is one of the five Gram Panchayats under Hirbundh Block of Bankura district. However, an interview with the BDO revealed that over there, the Panchayat was a 'non-functioning entity' and political problems has led to the collapse of the lowest tier. The Panchayat has become non-functional with no meetings, discussion and other activities. There are no Gram Sansad planning activities or its implementation, making the deprivation worst. In such a situation, the Forest Department had become closer to the community through the introduction of an assured income through the JFM scheme.

Analysis of the Perception of Stakeholders on Participation

This subsection deals with the results of in-depth semi-structured interviews, structured interviews and FGDs which were conducted on the respondents of the study to understand the nature of participation during the Microplan preparation at Chakadoba village of Bankura district. The analysis is carried on in a way that each theme is analysed from multiple perspectives of the respondents' category.

Attendance Level

Attendance level is an important criterion of participation. During the first orientation meeting, around 74 per cent of the village inhabitants attended the

meeting. They were also the members of the Forest Protection Committee under JFM programme.

People's Participation in the Planning

The study refers to participation in planning in terms of the following indicators:

1. Attendance level in the first workshop and then subsequent ones.
2. Participation in PRA Programme preparing resource maps, mental maps, Venn diagram of local resources, identifying needs and planning proposals in the meetings and so on.

Discussed below is the variation in perspectives among the respondents category on each theme.

Category B Respondents (Field Officers') Perspective

According to the Field Officers, the participation was due to the following reasons:

- Bureaucratic pressure.
- Dissatisfaction with the existing planning system.
- Good relationship and trust between forest department and the community.

Community's Perspective

According to the respondent villagers, participation was 'high'. The reasons for the high level of involvement of community are:

1. Good relationship had developed between the community with the Forest Department due to provision of several livelihood options to the villagers and through entry point activities like building roads.
2. Dissatisfaction with the existing planning system: The area did not have any planning system nor was the Panchayat system functional.
3. The Forest Department had taken initiative to ensure participation of the people in Microplan preparation: The Forest Department officials were present in all the Forest Protection Committee Meetings, where the plan was drawn up. However, there were also a few problems due to presence of Forest Department officials in plan preparation meetings. As pointed by the director of IBRAD, a NGO who prepared the Microplan manual and organised training for the Forest Department officials, the Beat Officer is the Member Secretary of the JFM Committee (JFMC) and exercised considerable dominance over the working of the JFMC. Often the community members' demand were influenced by the Beat Officer's opinions.

Unique Features of the Chakadoba Microplan

Forest Department's Perspective

The Forest Department's perspective on the unique features of Microplan is given in Box 1.

Box 1. Features of Microplan

Features of Microplan Noted by the Forest Department Officials	
1.	While the working plan takes a 10 years vision, Microplan is prepared with 2–5 years' time frame.
2.	There is more flexibility in planning as this is essentially a local plan. The proposals change, depending on the actual fund flow to implement it.
3.	A resolution from Financial Policy Committee (FPC) can change the Microplan.
4.	FDA has been set up exclusively for the Microplan such that there is quick transfer of the fund from the central government to the village level organisation. It was set up to expedite this flow of fund.
5.	It was easier for the Forest Department to prepare the Microplan as the field was already set due to the formation of FPC from among the villagers. The JFM practice was already generating income and in 2003 when the Microplan started, the villagers were ready to cooperate as they had developed faith in this system.

Source: Field survey (2009–2010).

Community's Perspective

Previously, there had been no planning initiative for the development of the village. The Panchayat system was virtually non-functioning as political turmoil had isolated the area from the district headquarter. In view of such a situation, Microplan was a welcome approach as it meant that they will be heard and some development of the village will take place.

Role of Stakeholders

Ideally for the preparation of Microplan, all general body members of JFMC and community groups such as self-help groups, Panchayat members, Range Officers and Beat Officers should have been present at least at the introductory meeting. For this area of study, after discussion with the community members, it was found out that 70 per cent of the JFMC members attended it. However the involvement of Panchayat in this exercise was not present.

Chakadoba community shared a good rapport with the Forest Department. Forest Department through its JFM practice had already assured extra income for the local people. Further creation of assets under the Microplan also improved the quality of living, which improved the relationship further. Table 2 illustrates the community's perception of the role of the stakeholders in preparing the participatory Microplan of the study area.

Table 2. Community's Perspective on the Role of the Stakeholders

Institutions	Role
Forest department	Active
Members of JFM	Active
Self-help group members	Passive
Panchayat	Non functional

Source: Field survey (2009–2011).

Challenges of Microplan Preparation

There were several problems of Microplan preparation, this being initiated for the first time. The two perspectives on problems of Microplan preparation are noted further.

Institutional (Category-B) Perspective

The main challenges according to the institution are:

1. Breakdown of the administrative machinery: In an interview with the Divisional Forest Officer, it was found out that this was a politically disturbed area and administrative machinery at the local government level had virtually collapsed.
2. Non-involvement of Panchayat members: In Microplan preparation, Panchayat members could have played a special role by monitoring the group activities, mediate in case of conflict or form a communication link between the project and the group. This role however was played here by the Forest Department particularly by the Range and the Beat Officer who addressed the problems that cannot be solved at the local level.
3. Frequent fall outs among the community: As Forest Department worked in close association with the villagers, their influence on the villagers were more than that of the Panchayat members.

Community's Perspective

According to the community, the following were the main challenges to the Microplan preparation:

1. Interference of Field Officers while preparing Microplan
2. High handedness of Executive Committee members: Most of the villagers attended the introductory meeting and the subsequent consultation. However for most, as reported by the villagers, the presence was ceremonial. They insisted that tokenism in participation had to be removed. Only Executive Body members of the Forest Protection Committee which was constituted of the members of the village or Forest Department officials decided the priorities for local development.
3. Inadequate orientation of Microplan preparation
4. Mistrust on the activities of Executive Committee: There was mistrust among the villagers on the working of the Executive committee of Financial Policy Committee (FPC) whose accounts, earning from forest products, were non transparent.

Impact of Participation

Internal Impact

The community had also benefitted due to Microplan preparation. The improvement of conditions of specific areas of planning, since the implementation of the Microplan have been voted by the community are as follows.

1. *Stakeholders' awareness level about Chakadoba has increased*: As per the findings of the study, preparation of Microplan has made the community of Chakadoba more aware of the needs, problems and constraints of Chakadoba village. The respondent villagers pointed out that the Microplanning exercise has sharpened their way of thinking about Chakadoba but both the institution and the community feel that much more is yet to be achieved.
2. *Community's expectation from the Microplan and the Forest Department has increased*: Microplanning exercises have raised the expectation of the community towards fulfillment of the proposals which were identified in the Microplan, and this was clearly pointed out by the community respondents during field survey. This participation in planning has been accepted as a welcome approach and enhanced the skill of the community towards organised thinking. The present situation analysis brings the stakeholders on the crossroads to question which issue is to be addressed first so that those who are at margins of this rural society can be included into the planning process.
3. *Strengthened ties between the Forest Department and the community*: From introducing the plan to the community, scheduling meeting, preparation of natural resource maps and transect walk, all encouraged wide local input and constant collaborations between Forest officers and community. This has strengthened their bonding. Later on funding the projects, identified in Microplan and implementing them, have strengthened the JFM structure there.

However, poor record keeping and documentation of Microplan raises doubt on the quality of proposals and implementation**.** While content analysing the Microplan, one can ascertain that it is a collection of handwritten tabulated records of the existing conditions and the demands for future development of the area. However there was no attendance list, attached minutes or attested copies of the community of the public validation report. This puts us on the question on the democratic approach of the plan: Whether it was prepared by taking into consideration the participation of the entire community or a select few?

External Impact

Improvement in household income through participation in JFM activities or as daily wage labourers in infrastructural work increased the availability of biomass through proper conservation and afforestation techniques or better infrastructure were noted. Chakadoba was almost inaccessible by metalled road had no piped water supply, no deep tube well, irrigation canal, electricity, school and health service. Today with the fund allocated for the development activity documented in the Microplan, they have a pump set for the agricultural field, the bund has been renovated, irrigation canal has been constructed, 1 km unmetalled road has come into existence and a community centre which is their meeting place has been constructed. Another feature about the Microplan exercise at Chakadoba is that all the assets created after the Microplan exercise is maintained by the JFMC.

Factors Affecting Microplan Preparation

There were several factors which have enhanced or constrained participation. On the basis of field survey, the factors are listed below in Table 3. Table 4 illustrates the summarized output collected from field study, from the selected category of respondents.

Table 3. Positive and Negative Factors Affecting Participation, Chakadoba

Positive Factors	Negative Factors
1. Good relationship of the community with the forest department as it has ensured secured income under JFM scheme. 2. Smaller scale of operation of plan. 3. Use of PRA technique ensuring greater involvement of the community.	1. Absence of effective administration. 2. Difference of opinion among the members of executive body of JFM and the general body members.

Source: Field survey (2010).

Table 4. Summarised Field Output, Chakadoba

Planning Issue	Responses of the Institutional Representatives	Responses of the Field Officers	Responses of the Community
Reason for participation	Government directive	Government directive	Dissatisfaction with the Panchayat system; wanted an improvement in physical and social infrastructure; good relationship with the forest department as the JFM policy gave the community an assured income.
Features of the plan	Public participation, flexibility	Smaller time frame to address immediate need, extensive public participation	Gave an opportunity to be heard; gave importance to women; flexible; wide local inputs through resource map, preparing social maps
Challenges of plan preparation	Breakdown of administrative machinery; no help from Panchayat	Absence of data; no help from Panchayat	Inadequate sensitisation of people; high handedness of the executive body members of FPC; non transparent accounting by FPC.

(Table 4 Continued)

(Table 4 Continued)

Planning Issue	Responses of the Institutional Representatives	Responses of the Field Officers	Responses of the Community
Impact of the plan	Relationship improved between the forest department and people, data was now available for next planning cycle	Availability of better data base, improved relationship between community and forest department	Better conflict management, better team building and greater income

Source: Field survey (2009–2011).

Discussion

Did Microplanning Create Empowerment?

Empowerment refers to the expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control and hold accountable those institutions that affect their lives. Though there are different definitions but there seem to be a general consensus about the essential dimensions of empowerment and good governance such as participation of individual citizens, transparency of information sharing, efficiency of local authority in achieving their pro-poor development agenda, equity or impartial treatment by the local authority and gender sensitiveness

The study revealed that if the potential of this community is to be used, it has to be empowered. But there are few obstacles to it which are illustrated further. Besides this, there are a few issues pertaining to empowerment in Chakadoba. They are as follows:

1. *Motivation level to participate*: It is difficult to assess the motivational level of the community to undertake a participatory planning exercise which will create a sense of ownership of the assets. However, aspirations of return from the JFM activity have been the main driving force in dominating the behaviour of the community more than mere emotional attachments to the forest.
2. *Empowerment and power relation*: Often the power relation reverses empowerment when participants face each other from unequal power positions be it material condition, class distinction or knowledge and information. This to a certain extent has taken place in Chakadoba. While preparing the Microplan, the Forest Department partially changed their attitude, became accessible and came in close contact with the community. However, there exists power relation between bureaucrats and community, FPC Executive committee members and General Body members, between male and female and so on.
3. *Facilitators could have played a better role towards empowerment*: The Forest Officers were the facilitators of the Microplan. But it was found during the field survey that they tended to exercise a dominating influence

Table 5. Participation Status: Chakadoba, Bankura (As Perceived Through FGD)

Criteria	Response of the Respondents	Remarks
Participation of citizens	High	71 per cent of the community members attended.
Transparency of information sharing	Medium	Though community members were aware of the activity of FPC but lack of sharing of the financial information, particularly the sale of non-timber forest products, created mistrust.
Status of women	Poor	83 per cent of the women have not completed primary education. The average family size is four. In FGD, the women were pointed to be the greatest 'looters' of forest products.

Source: Focus group discussion at Chakadoba (January 2009–2010).

of the planning meetings, either directly or indirectly through the Executive committee members.

Table 5 is used to illustrate the status of participation against a few criterions of participation. Each of the criteria was put before the community during FGD and they gave their response to it. The respondents were asked to categorise each criteria into high, medium and low. Accordingly 'high', 'medium' and 'low' status has been granted to each of these criteria.

According to Table 5, putting the participatory situation of Microplan preparation against these criterion, almost all the criterion have been achieved at a moderate level except accountability and gender sensitiveness where much has to be done about. Women's participation either in operation of JFM programme or in Microplan exercise has been very poor.

Revisiting Theory

This section discusses the key issues that the study calls into question where a gap has been observed between the theoretical concepts of participation, as pointed out in the existing literature and the actual picture of participation as noted by the researcher during the study.

'Theoretical participation' vis-a-vis ground level participation can be addressed from a variety of perspectives as the available literature has shown. While Robert Chambers in his work argues on the importance of 'putting the last first', scholars like Cooke and Kothari (2001) uses real life events to explain how participation is an utopian dream and can get 'tyrannical' at times.

To examine the fact, two questions may be raised. First, if given an ideal situation of pro-participatory environment, can participation transform the ills of

the existing set up? Secondly, is it at all possible to create an ideal participatory set-up where the institution is opening space for participation and the community is willing to participate voluntarily for the good of the society, in general.

But this study shows that it is not necessary that if participation is pursued, it will essentially address all the problems of democratic governance. There exists a power hierarchy and the society and community cannot be considered homogenous units. Considering the case of Chakadoba, it emerged that even if resource maps and other tools were employed, the absence of facilitators led to the dominance of a section that were close to the institutional representatives.

Much of the existing literature (Chambers, 1997; United Nations, 2007) observes that participation leads to empowerment. The study however shows that this is not always the case. With empowerment comes the question of existence of power relations. During the study, it was observed in Chakadoba village that the Forest Protection Committee members are entitled to 25 per cent of the proceeds of the sale of the timber products. But the maintenance of the FPC account was not a transparent affair. In the FGD, it was revealed that this FPC was controlled by a few influential people who were close to the Forest Department officials. Another interesting feature was when the researcher conducted a discussion between the Forest Department Officers and the villagers, the officers sat on the chair while *madur* or mat was rolled out for the villagers while the Executive Body members of the JFMC sat on a *khatiya* or cot. This was an interesting example of the existing hierarchy of power and for true participation to occur, immediate change and reversal in role, relationship and power has to take place.

Further, the involvement of women was also negligible in the affairs of the FPC. It was a male-dominated committee. When the survey was conducted, one self-help group, with women, was already formed but was not yet functional. During the FGD too, the women sat at one corner and never commented spontaneously. Many participatory projects rests on the assumption that simply identifying different stakeholders and getting them around the table will reach a consensus that is 'fair' to all. Such an assumption only holds if all actors were deemed to have equal bargaining power, which they did not. In its absence, the correct procedure is to change the behaviour and attitude of those who are used to dominating and give chance to the marginalised and disempowered to voice their opinion. This to a certain extent has taken place in Chakadoba. While preparing the Microplan, the Forest Department partially changed their authoritative attitude and came in contact with the community which had placed their demand. May be not all the demands were translated into action but the whole exercise had elevated the status of the villagers to become negotiators of their demands. This plan gave them increased bargaining power though as a whole, power geometry exists within the community in terms of wealth, education and so on. Facilitating measures may be important in negotiations but granting the bargaining power to the marginalised which is required to overcome the structural dominance enjoyed by the more powerful groups is not enough. Participation requires a wider process of social transformation and structural change.

Conclusion

Microplan being the first participatory plan in Chakadoba, there remains doubt on the nature of participation. However, due to this exercise, the village has become more accessible, the standard of living has increased and through even attending meeting, the awareness level of the villagers has increased. All the assets created under Microplanare are maintained by the FPC. The FGD participants agreed that it has increased their sense of belonging towards this asset, the village. The faith once lost of being neglected by government has been restored and they have come forward to protect the forest. The respondents pointed that the community realised that it is the forest which sustains them and if they work as collaborators, their benefit will be doubled. The JFM practise has given them an assured income. The community showed increased motivation towards preparing the next Microplan. Chakadoba residents, while preparing the resource map or the mental map have learnt about their place. Several incidents of voluntary labour like providing free labour for developmental work or getting together to save the forest during forest fire speaks of the group binding skill of the community. But what cannot escape from one's notice is the existence of a heterogeneous group of locally influential but conflicting individuals, each trying to influence the working of the Forest Protection Committee and the Microplan preparation. While some are close associates of the Forest Department officials, others are comparatively more educated as per the village standard and have completed their college education; some have larger land holdings, while others are providing water from their private tube well to the villagers. Without the presence of any authorised legal body, it is difficult to address the question of equity.

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Notes

1. Each Forest Division in a district is divided into Forest Range and there after Forest Beat. Each Forest Beat in a Forest Range has approximately 800–1200 Hectares. Bankura District has forest divisions such as Bishnupur, Bankura (North) and Bankura (South). Bankura (South) in turn has 13 Forest ranges of which Khatra Forest range is one.
2. Chakadoba village is in Hirbundh Block of Bankura district. Until 1991 census, the village was in Khatra-II Block of Bankura District.

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Article

Vulnerability Assessment of Farmer's Livelihood to Flood in An Giang Province

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Abstract

This study, conducted in An Giang Province of Vietnam, assesses the vulnerability and adaptability of local farmers to the flood in different conditions. Livelihood Vulnerability Index (LVI) proposed by Hahn, Riederer, and Foster (2009, *Global Environmental Change*, *19*(1), 74–88) was applied for livelihood vulnerability analysis of different flooding zones (upper, middle and lower zones) in low flooding condition. Research results showed that LVI of different flooding zones are decreasingly dependent on major components of social networks, knowledge and skills, natural resources, finance and incomes, livelihood strategies, and natural disaster and climate variability. In which, LVI of Phu Huu commune in An Phu district which locates in the upper zone is 0.397 higher than LVI of two communes located in the lower parts of the river: Vinh An commune, Chau Thanh district (middle zone; LVI: 0.299) and Vinh Phuoc commune, Tri Ton district (lower zone; LVI: 0.357). Adaptive capacity of Phu Huu commune (0.415) is also higher than Vinh An (0.304) and Vinh Phuoc (0.355) communes. It reflects the direct correlation between LVI and adaptive capacity. The research recommends some solutions to reduce the vulnerability on livelihoods due to floods in the context of climate change.

Keywords

Livelihood Vulnerability Index (LVI), vulnerability, flood, Vietnam, adaptation

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Introduction

An Giang is a province in the Mekong downstream area frequently affected by annual flood. Flood brings large amount of silt to build up and improve soil fertility, field sanitation and washing toxicity (Tien, 2001) creating jobs and income for people in the flooding season such as fishing, vegetables and travel services. Besides, the floods also cause damage to agriculture and harm to livelihoods of people in floodplains; specifically, from October to November. Mekong water combined with local heavy rain causes big flood in most of the districts in the province. Large areas covered by water from 1.5 m to 4.5 m causing huge damage to infrastructures, public and private properties and people's lives (Irrigation Department of An Giang Province, 2016). However, only few studies have been done to assess the vulnerability of flood due to people's livelihoods changes in flooding areas (at the upstream, middle and downstream) in a comprehensive way considering all aspects (human, natural, financial, physical and social ones) under the increasing effect of climate change for appropriate solutions to reduce the vulnerability of people's livelihoods in flooding areas. Therefore, this study is conducted as a basis reference that proposes recommendations to improve people's livelihood effectively and sustainably.

Research Objectives

The key objectives of the research are:

1. To assess vulnerability and adaptability of local farmers to flood in different conditions.
2. To propose strategic solutions to reduce vulnerability on farmer livelihoods from flooding in the context of climate change.

Research Methods

Constructing Livelihood Vulnerability Index

This study adopted the Sustainable Livelihood Framework (SLF; Birkmann, 2006) to guide the assessment of livelihood vulnerability to floods. The vulnerability context is a major determinant of sustainability of livelihood assets as it directly influences livelihood strategies, institutional process and livelihood outcomes of community (Chambers & Conway, 1992; DFID, 2000). The effects of floods and climate variability have been considered under the vulnerability context of SLF. The level of vulnerability of community determines the impacts of floods and climatic conditions on people's livelihood assets, strategies and outcomes. This study aimed at calculating level of vulnerability to the impacts of those extreme floods and climate variability in three different floods communes such as upstream commune (Phu Huu), middle stream (Vinh An) and downstream (Vinh Phuoc) of An Giang Province, Mekong Delta of Vietnam by applying a Livelihood Vulnerability Index (LVI) developed by Hahn et al. (2009). The components that

are the indicators of vulnerability of community to flood impacts are presented in Table 1. These components are classified under five different livelihood assets in SLF: human, physical, social, natural and financial. The sub-components have been developed as indicators under a single component which are shown in Table 1.

Table 1. Capitals, Major Components and Sub-components Comprising the Livelihood Vulnerability Index

Capitals	Major Component	Sub-component (Indicator)
Human	Health	Per cent of HHs with family member with illness Per cent of HHs with family member get illness due to flood
	Knowledge & skills	Per cent of HHs head unlettered Per cent of HHs head just passed primary school Per cent of HHs head that no receive any training to cope with flood
	Livelihood strategy	Average agriculture livelihood diversity Per cent of HHs dependent on agriculture as major source of income Per cent of HHs reported no non-farm activities as affected by flood Per cent of HHs with no jobs (during flood season) Per cent of HHs exploring natural resources (during flood season) Per cent of HHs do fishing (during flood season)
Natural	Land	Per cent of HHs with landless Per cent of HHs with small land (0.1–0.5 ha)
	Natural resources	Per cent of HHs that not cultivate the 3rd crop Per cent of HHs that depend on (exploit) natural resources Per cent of HHs that depend on (do) fishing during flood
	Natural disasters and climate variability	Average number of most severe flood in the past 15 years Average of death/injury as result of most severe flood in the past 15 years Per cent of HHs did not receive a warning about flood Mean standard deviation of monthly average of average water level in Tan Chau from 2000 to 2015 Mean standard deviation of precipitation by month (average 15 years)

(Table 1 Continued)

(Table 1 Continued)

Capitals	Major Component	Sub-component (Indicator)
Social	Socio-demographic	Dependency ratio Per cent of female head HHs Average family member in a HHs Per cent of poor HHs
	Social network	Per cent of HHs receive helps due to flood Per cent of HHs that have not been member of any organisations
Physical	Housing & prod. means	Per cent of HHs that with housing affected by flood (partially to totally submerged) Per cent of HHs that with non-solid house Per cent of HHs that report no access to production means
Financial		Per cent of HHs borrow money Per cent of HHs with net HHs income lower USD 1000 Per cent of HHs with non-income within flood season

Source: The authors.

Calculating the Livelihood Vulnerability (LVI)

The information was collected by interviewing 180 households in upstream commune (Phu Huu and An Phu district), middle stream (Vinh An and Chau Thanh district) and downstream (Vinh Phuoc and Tri Ton district) and LVI. According to Hahn et al. (2009), LVI is applied to assess the impact of flood damage to the livelihoods of people in flooding areas. LVI has two approaches: (a) LVI is represented as a compound index including seven major factors (household characteristics, livelihood strategies, social networking, health, food, water, natural disasters and climate change), each main factor including a few indicators or additional factors; (b) seven key elements combine into the three 'contributing agents' including exposure, sensitivity and adaptability (as defined by the Intergovernmental Panel on Climate Change [IPCC]). Each additional factor measured in different system should be standardised as an index according to the following equation:

where S_d is the original value of the additional factors for the local d,
$S_{\min}$ and $S_{\max}$ are minimum and maximum value, respectively.

Once standardised, additional factors are averaged to calculate the value of each element by the following equation:

$$M_d = \frac{\sum_{i=1}^{n} index_{sdi}}{n}$$

where M_d is one of the main factors for local d,
$index\,S_{di}$ additional factors are recorded as i,
n: number of additional factors in each major factor.

Once values of the key elements are identified, local LVI (communal level) is calculated according to the equation:

$$index_{sd} = \frac{S_d - S_{\min}}{S_{\max} - S_{\min}}$$

Sd is the original value of the additional factors for the local d,
$S_{\min}$ and $S_{\max}$ minimum and maximum value

LVI is about [0, 1], LVI the closer to 1, the higher vulnerable rate.

LVI–IPCC: LVI of *p* commune is calculated by using IPCC.

$LVI - IPCC_p = (e_p - a_p) \times S_p$ (value ranges from –1 to 1)

IPCC: CF_p is defined as the main components of the level of exposure, sensitivity, adaptive capacity for each *p* commune.

$$LVI_d = \frac{\sum_{i=1}^{n} W_{mi} M_{di}}{\sum_{i=1}^{n} W_{mi}}$$

where M_{pi}: main factors of *p* commune, index recorded as *i*

WM_i: the degree of each component

LVI_d: local livelihood vulnerability index (communal level) *d*,

W_{Mi} is determined by the number of additional factors creating key elements.

$$CF_p = \left(\sum_{i=1} WMiM_{pi} \; / \; \sum_{i=1} WMi \right)$$

Key components of the level of influence (e) include climate change; capacity of adaptation (a) include the household characteristics, livelihood strategies and social networks; sensitivity level (s) include the main components of knowledge, skills and healthcare, and natural resources such as land and finance.

Results and Discussion

Flood Occurrence over the Years in the Period of 1926–2015 in An Giang Province

The annual flood season in the upstream lasts for about six months; at the same time, the level of inundation varies between 0.3 to 3 meters depending on the topography of each place. Floods are divided into three levels including high, medium and low levels according to upstream flood levels, corresponding to the water level at Tan Chau Station at more than 4.5 m, 4–4.5 meters and less than 4 meters, respectively. Large flood occurs when at the same time having a large amount of water pouring in from upstream, large long-lasting rains and the impact of surges in place. The daily increase and decrease flood levels for about 10–20 centimetres for big floods and 5–7 centimetres in normal floods (Duong, 2006). According to the data recorded by meteorological radio of An Giang Province from 1926 to 2015, there has appeared 22 times of greater floods and 31 times of small floods. In particular, 2015 was a special year having the smallest flood of all

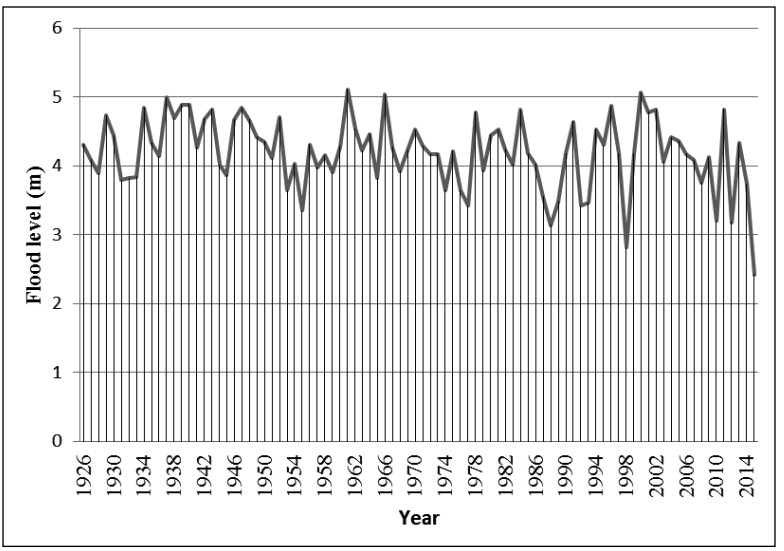

Figure 1. Flood Peak of Tan Chau from 1926 to 2015

Source: Meteorological Station of An Giang (2016).

the years (Figure 1). Small floods have caused considerable disturbance to the crop calendar, affecting agricultural production and causing difficulties to the livelihood of the people who depend on floods for fishing, fishing gear production and other means of participating in fishing during floods.

Assessment on Vulnerability to Flood Changes on the Livelihoods of Farmers in An Giang Province

The analysis of sources and LVI of 10 key components, 30 subcomponents and 5 financial sources (Table 2 and Figure 2) showed that LVI of different zones (upper, middle and downstream) are decreasingly dependent on major components of social networks, knowledge and skills, natural resources, finance and incomes, livelihood strategies, and natural disaster and climate variability. In which, LVI: 0.397 of Phu Huu commune in An Phu district which locates in the upper zone is higher than LVI of two communes located in the lower part of the river. These two communes are Vinh An commune (LVI: 0.299), and Chau Thanh district (middle zone) and Vinh Phuoc commune (LVI: 0.357). Tri Ton district (lower zone) and adaptive capacity of Phu Huu commune (0.415) is also higher than Vinh An (0.304) and Vinh Phuoc (0.355). It reflects the direct proportion between LVI and adaptive capacity. Within five financial sources, human, financial and social sources have high vulnerability index in all three regions; physical sources have the lowest vulnerability index.

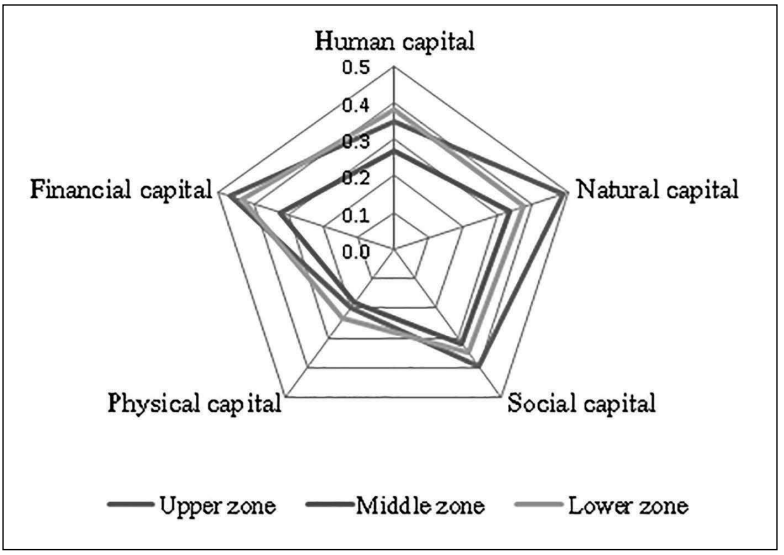

Figure 2. Vulnerability Diagram of Five Capitals of SLF of Phu Huu, Vinh An, Vinh Phuoc communes (2016)

Source: The authors.

Table 2. Summary of the LVI Result for All Sub-component Values, Major Component and Capitals for Phu Huu (PH), Vinh An (VA) and Vinh Phuoc (VP) (see Table A1 in the Appendix)

	LVI		
Capitals	**PH**	**VA**	**VP**
Human (H)			
Weighted average of h1, h2,h3: Human vulnerability (H)	0.471	0.341	0.437
Natural (N)			
Weighted average n1, n2,n3: Natural vulnerability index (N)	0.356	0.274	0.289
Social (S)			
Weighted average s1, s2: Social vulnerability index (S)	0.430	0.332	0.387
Physical(P)			
LVI (P)	0.200	0.178	0.233
Financial (F)			
LVI (F)	0.465	0.322	0.434
Overall LVI (weighted H, N, S, P, F)	**0.397**	**0.299**	**0.357**

Source: Household Interview (2016).

Table 3. Vulnerability Triangle of the Contributing Factors of the LVI–IPCC for Phu Huu, Vinh An and Vinh Phu Communes.

Major Component	Phu Huu	Vinh An	Vinh Phuoc	Contributing Factors	Phu Huu	Vinh An	Vinh Phuoc
Socio-demographic	0.245	0.164	0.239	Adaptive capacity	0.415	0.304	0.355
Livelihood strategy	0.400	0.277	0.322				
Social networks	0.800	0.667	0.683				
Health	0.100	0.017	0.050	Sensitivity	0.337	0.269	0.307
Knowledge & skills	0.584	0.517	0.733				
Land	0.367	0.384	0.350				
Natural resources	0.466	0.342	0.370				
Financial	0.465	0.322	0.434				
Natural disasters and climate variability	0.286	0.189	0.217	Exposure	0.286	0.189	0.217
LVI–IPCC = {(Exposure – Adaptive Capacity) Sensitivity}					**–0.043**	**–0.031**	**–0.042**

Source: The authors.

Vulnerability Index LVI–IPCC of Three Research Areas Including Upstream, Midstream and Downstream

Results calculated in accordance to LVI–IPCC (level of influence, adaptability and sensitivity) based on the sub-components of household characteristics, livelihood strategies and social networks in three communes in Phu Huu, Vinh An and Vinh Phuoc (Table 3) indicate that people in Phu Huu (upstream commune) have greater level of influence, sensitivity and adaptability than those in Vinh An and Vinh Phuoc; while people in Vinh An commune (midstream) have lowest level of influence, sensitivity and adaptive capacity.

Conclusion and Recommendations

Flood is a natural phenomenon and occurs annually in the Mekong Delta of Vietnam. Complicated and irregular floods caused difficulties to people's livelihood in An Giang Province. People in upstream area of Phu Huu commune have the highest vulnerability (with LVI of 0.397) followed by millstream area of Vinh Phuoc commune (0.357) and downstream area of Vinh An commune (0.299). Besides, the results also indicated that one area that is more vulnerable will have higher adaptability. For instance, adaptability of Phu Huu is higher than Vinh An and Vinh Phuoc commune (0,415 compared to 0,304 and 0,355, respectively).

To reduce vulnerability, early flood warning systems should be developed to decrease flood damage to people's livelihoods. Also, to prepare for the flood season, it is necessary to strengthen propaganda and dissemination of knowledge. Local authorities should organise training courses on flood adaptation. Moreover, the government should have insurance policies for people living in flooded areas to ensure their livelihood and reduce the vulnerability of climate change conditions.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Appendix

Table A1. Summary of the LVI Result for All Sub-component Values, Major Component and Capitals for Phu Huu (PH), Vinh An (VA) and Vinh Phuoc (VP)

Capitals	Major Component	Sub-component	Observation			Max	Min	LVI		
			PH	VA	VP			PH	VA	VH
Human (H)	Health	Per cent of HHs with family member with illness	13.3	3.3	6.7	100	0	0.133	0.033	0.067
		Per cent of HHs with family member get illness due to flood	6.7	0.0	3.3	100	0	0.067	0.000	0.033
	LVI (h1)							0.100	0.017	0.050
	Livelihood strategies	Average agriculture livelihood diversity	0.25	0.25	0.25	1	0.2	0.063	0.063	0.063
		Per cent of HHs dependent on agriculture as major source of income	86.7	76.7	80.0	100	0	0.867	0.767	0.800
		Per cent of HHs reported no non-farm activities as affected by flood	50.0	26.7	36.7	100	0	0.500	0.267	0.367
		Per cent of HHs exploring natural resources (during flood season)	16.7	10.0	13.3	100	0	0.167	0.100	0.133
		Per cent of HHs do fishing (during flood season)	43.3	16.7	23.3	100	0	0.433	0.167	0.233
		Per cent of HHs with no jobs (during flood season)	36.7	30.0	33.3	100	0	0.367	0.300	0.333

(Table A1 Continued)

(Table A1 Continued)

Capitals	Major Component	Sub-component	Observation			Max	Min	LVI		
			PH	VA	VP			PH	VA	VH
	LVI (h2)							0.400	0.277	0.322
	Knowledge & skills	Per cent of HHs head unlettered	26.7	16.7	53.3	100	0	0.267	0.167	0.533
		Per cent of HHs head that no receive any training to cope with flood	90.0	86.7	93.3	100	0	0.900	0.867	0.933
	LVI (h3)							0.584	0.517	0.733
Weighted average of h1, h2,h3: Human vulnerability (H)								0.471	0.341	0.437
Natural (N)	Land	Per cent of HHs with landless	40.0	26.7	33.3	100	0	0.400	0.267	0.333
		Per cent of HHs with small land (0.1- 0.5 ha)	33.3	50.0	36.7	100	0	0.333	0.500	0.367
	LVI (n1)							0.367	0.384	0.350
	Natural resources	Per cent of HHs that not cultivate the 3rd crop	83.3	66.7	80.0	100	0	0.833	0.667	0.800
		Per cent of HHs that depend on (exploit) natural resources	13.3	6.7	10.0	100	0	0.133	0.067	0.100
		Per cent of HHs that depend on (do) fishing during flood	73.3	16.7	26.7	100	0	0.733	0.167	0.267

(Table A1 Continued)

(Table A1 Continued)

Capitals	Major Component	Sub-component	Observation			Max	Min	LVI		
			PH	VA	VP			PH	VA	VH
	LVI (n2)							0.466	0.342	0.370
	Natural disasters and climate variability	Average number of most severe flood in the past 15 years	0.4	0.4	0.4	15	0	0.027	0.027	0.027
		Average of death/injury as result of most severe flood in the past 15 years	21.0	15.0	17.0	135	0	0.156	0.111	0.126
		Per cent of HHs did not receive a warning about flood	16.7	6.7	10.0	100	0	0.167	0.067	0.100
		Mean standard deviation of monthly average of average water level in Tan Chau from 2000 to 2015	114.5	89.4	96.3	149.6	76.4	0.520	0.178	0.272
		Mean standard deviation of precipitation by month (average 15 years)	100.2	100.2	100.2	129.9	62.1	0.562	0.562	0.562
	LVI(n3)							0.286	0.189	0.217
Weighted average n1, n2,n3: Natural vulnerability index (N)								0.356	0.274	0.289
Social	Socio-demographic	Dependency ratio	36.7	23.3	30.0	100	0	0.367	0.233	0.300
		Per cent of female head HHs	6.7	3.3	0.0	100	0	0.067	0.033	0.000

(Table A1 Continued)

(Table A1 Continued)

Capitals	Major Component	Sub-component	Observation			Max	Min	LVI		
			PH	VA	VP			PH	VA	VH
		Average family member in a HHs	4.4	3.3	4.8	10	1	0.378	0.256	0.422
		Per cent of poor HHs	16.7	13.3	23.3	100	0	0.167	0.133	0.233
	LVI (s1)							0.245	0.164	0.239
	Social networks	Per cent of HHs receive helps due to flood	66.7	46.7	53.3	100	0	0.667	0.467	0.533
		Per cent of HHs that have not been member of any organisations	93.3	86.7	83.3	100	0	0.933	0.867	0.833
	LVI (s2)							0.800	0.667	0.683
Weighted average s1, s2: Social vulnerability index (S)								0.430	0.332	0.387
Physical (P)	Housing and production means	Per cent of HHs that with non-solid house	10.0	16.7	23.3	100	0	0.100	0.167	0.233
		Per cent of HHs that with housing affected by flood (partially to totally submerged)	13.3	3.3	6.7	100	0	0.133	0.033	0.067
		Per cent of HHs that report no access to production means	36.7	33.3	40.0	100	0	0.367	0.333	0.400

(Table A1 Continued)

(Table A1 Continued)

Capitals	Major Component	Sub-component	Observation			Max	Min	LVI		
			PH	VA	VP			PH	VA	VH
	LVI (P)							0.200	0.178	0.233
Financial (F)	Finance and incomes	Per cent of HHs borrow money	40.0	36.7	46.7	100	0	0.400	0.367	0.467
		Per cent of HHs with net HHs income lower 1000 USD	56.3	43.3	46.7	100	0	0.563	0.433	0.467
		Per cent of HHs with non-income within flood season	43.3	16.7	36.7	100	0	0.433	0.167	0.367
	LVI (F)							0.465	0.322	0.434
Overall LVI (Weighted H, N, S, P, F)								**0.397**	**0.299**	**0.357**

Source: The authors.

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Article

Impacts of Vermi-compost Manure on MV Paddy Production in Bangladesh: A Case Study of Jessore District

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Abstract

The study estimates impacts of vermicompost manure on modern varieties (MV) of paddy produced in Bangladesh. Primary data were used in this study. The findings of the study indicated that on an average, the sampled farmers who used vermicompost comparatively used less proportion of chemical fertilizers such as urea, triple super phosphate, zypsum, zinc and manure except muriate of potash. The yield of MV boro and the net profit of per hectare was significantly much higher (about 1.91 times) in the farms that used vermicompost compared to those farmers who did not use it. The household income of the farmers who used vermicompost with irrigation has risen significantly (about 1.19 times). The farmers had experienced constant return to scale in MV boro paddy farms in both techniques. The farm area, seed, pesticide, irrigation, urea cost and vermicompost cost were the main factors that significantly affected the MV boro paddy production in farms that used vermicompost. On the other hand, the farm size, urea, chemical fertilizers, manure and labour had significant impact on MV boro paddy production under the farms that did not use vermicompost. Vermicompost normally retains the moisture as well as organic matter in topsoil. As a result, comparatively lesser amount of chemical fertilizers and irrigations are required for per hectare MV boro paddy production. There was inefficient and non-optimal use of resources in both the farms which hindered production of maximum level of output in the study area.

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Keywords

Vermicompost manure, soil fertility, yield, net profit, resource use efficiency, Bangladesh

Introduction

Bangladesh is one of the countries in the world with very high population density. Rapid population growth, increased food demand and urbanisation are the main causes that place tremendous pressure on agricultural land making it an increasingly scarce resource (Bhuiyan, 2001). As a result, agricultural land per capita is decreasing over the years in Bangladesh (Akteruzzaman, 1998; Alexander, Rashid, Shamsuddin, & Alam, 1998). Food insecurity is a critical concern since the independence. Despite a noticeable improvement in paddy production in the recent years, it still falls short of attainable levels. The government of Bangladesh imports a large amount of rice to meet up the domestic demand (Zaman, 2001). Proper cropping intensity and management with high yielding modern varieties (MV) of paddy production is the logical way to raise the total production using limited land resources (Islam, Sattar, & Rahman, 2002).

Degradation of soil fertility is a major problem in agricultural production and the soil fertility of cropland is increasingly degraded since the introduction of green revolution in Bangladesh. Soil fertility mainly changes simply due to improper and excessive land use for similar crop management and land management (Rahman & Ranamukhaarachchi, 2003; Ranamukhaarachchi, Rahman, & Begum, 2005). The introduction of MV of paddy has increased the cropping intensity about 180 per cent in Bangladesh (BBS, 2014). Intensive cropping intensities promote high levels of nutrient extraction from the soil without replacing the natural regenerating of nutrition in soils for crop production (Narang, Cheema, Grewal, Sharma, & Dev, 1990). Moreover, increase in cropping intensity that is mainly contributed by MV paddy requires a large amount of chemical fertilizers application that enhance to reduce progressive degradation of soil structure, soil texture and depletion of soil fertility due to nutrients and organic matter (OM) from soil (Masciandaro, Ceccanti, & Garcia, 1997; Saleque, Abedin, Bhuiyan, Zaman, & Panaullah, 2004). Crop rotation mainly legumes and jute based cropping systems and more application of manure in crop production has led to such a depletion of OM of some parts of the country (Karim & Iqbal, 1997). Normally, the farmers do not choose cropping systems to maintain soil fertility. The selection of crop production mainly depends on the market situation and price of agricultural products. This situation continues and eventually affects the sustainability in agricultural production in a given land.

Ali (2004) conducted a research of the impact of the cultivation of high yielding variety (HYV) rice using modern inputs such as power tillers, low-left irrigation pumps, chemical fertilizers and pesticides on soil qualities and land degradation during the period 1985–2000 in a village in south-western Bangladesh, and his research concluded that the modern inputs especially the chemical fertilizers and pesticides have negative impacts on soil quality and land degradation. Ali (2006)

also drew similar conclusions. Recently, there is an increasing trend of application of chemical fertilizers, mainly urea (N), triple super phosphate (TSP) and muriate of potash (MoP) and a decreasing trend in the application of organic manure, intensive cultivation. Moreover, increased tillage has been reduced OM contents of topsoil in MV paddy cultivation considerably in Bangladesh (Saleque et. al., 2004). Furthermore, intensive cultivation and increased tillage are considered for accelerating mineralisation of OM, loss of nutrients, soil erosion and the reduction of soil fauna and microbes (Akinci, Cakir, Topakci, Canakci, & Inan, 2004). Therefore, OM application is needed to improve soil quality (Madejon, Burgos, Lopez & Cabrera, 2003). Recently, farmers of some parts of Bangladesh are using vermicompost (considered as organic manure) in vegetables in comparatively high land and MV paddy in medium low land. However, the economic impacts of vermicompost on soil fertility as well as affecting factors for MV paddy production in Bangladesh have been paid less attention. Therefore, the present study evaluates the impacts of vermicompost on soil fertility and affecting factors for paddy production. Moreover, the present study estimates the household income of MV producers who used vermicompost and who did not use vermicompost in MV paddy cultivation in Bangladesh. The findings of the present study are expected to be helpful benchmark information for economists, researchers, as well as policymakers and will provide useful insights for the further development of MV paddy farming in Bangladesh.

Methodology of the Study

Sources of Data

To assess the impacts of vermicompost manure on MV boro paddy production, Manoharpur village of Monirampur Upazilla in Jessore District was selected. Manoharpur village was purposively selected because a large number of farmers in this village have already adopted the use of vermicompost manure. Initially, a detailed list of farmers who used and who did not use vermicompost in MV paddy production was collected from the *upazilla* agriculture office. Primary data were used in this study. The information on various inputs and outputs of MV paddy production under these two existing irrigation systems and the socio-economic information of farmers were collected through comprehensive questionnaire. A total of 200 farmers were randomly selected from this study village, of which 100 farmers used vermicompost and the remaining ones did not use vermicompost in their MV boro paddy cultivation. The information covers the crop calendar 2016.

Analytical Techniques

Profitability Analysis

The formula for estimation of profit of MV paddy cultivation under the vermicompost method and traditional method is as follows:

$$\pi = \sum P_1 \times Q_1 + \sum P_2 \times Q_2 - \sum P_{xi} \times X_i - \text{TFC}$$

where

π = Profit for the vermicompost/traditional method under study
P_1 = Per unit price of the crop (paddy) grown
Q_1 = Quantity of output (paddy) obtained
P_2 = Per unit price of by-product (straw)
Q_2 = Quantity of by-product obtained (straw)
Px_i = Per unit price of the *i*th (variable) input
X_i = Quantity of the *i*th input used for the crop
TFC = Total fixed cost

Estimation of Household Income

Household income is a measure of combined incomes of all people sharing a particular household or place of residence. It includes every form of income of household such as agriculture income from crop production, agricultural wages of family members, profit of livestock, and vegetables and off-farm income in the study area.

Estimation of Cobb–Douglas Production Function

To estimate the marginal value productivities of inputs and the production functions, similar to Cobb–Douglas production function of the following form was used:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} + u_i$$

where

Y = Output of MV boro paddy (taka)
X_1 = Farm size (hectare)
X_2 = Seed cost (taka)
X_3 = Land preparation cost (taka)
X_4 = Pesticide cost (taka)
X_5 = Irrigation cost (taka)
X_6 = Urea cost (taka)
X_7 = Other fertilizer cost (taka)
X_8 = Manure cost (taka)
X_9 = Vermicompost (taka)
X_{10} = Labour cost (taka)

β_0 is intercept, and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$ and β_{10} are the coefficients of the regression.

u_i is normally and independently distributed with zero mean and constant variance.

Resource Use Efficiency

Neoclassical theory states that the resources would be efficiently used in agricultural production farming where marginal value product (MVP) is equal to

their marginal factor cost (MFC) under perfectly competitive market. In general, the producers would choose the input levels that maximise the economic profit (TR – TC). The MVP of an input would be estimated, the coefficient of production elasticity is multiplied by the output–input ratio of the geometric mean (GM) level, which can be shown in the following formula:

$$\text{MVP} = \frac{\bar{Y}_i}{\bar{X}_i} \times \beta_i$$

where

β_i = Regression coefficient of input X_i

$\bar{X}_i$ = Mean value (GM) of X_i variable input

$\bar{Y}_i$ = Mean value (GM) of gross return of boro paddy

The MVPs of various capital inputs are compared with their respective prices. If MVP of an input is higher than the MFC (market price of that input) then increase in input in production system raise output that increases profit. If MVPs of inputs are negative, then there are possibilities of reduction of these inputs and so the production is carried out in the second stage of production function and the marginal productivities of these inputs become negative. On the other hand, positive MVPs represent the possibilities of further increase in inputs to raise output as well as profit.

If the input resources are efficiently used then the profit will be maximised in MV boro paddy where the ratio of MVP to MFC will tend to be 1 or in other words, MVP and MFC for each inputs will be equal.

In order to test the resource use efficiency in MV boro paddy production, the ratio of MVP to the MFC for each input is compared and tested for its equality to 1, that is, $\frac{\text{MVP}}{\text{MFC}} = 1$ (Gujarati, 1995).

Brief Profiles of the Study Villages/Areas

Monohorpur is an ideal village of Monirampur Upazila under Jessore District. The area of this village is 607 ha and its population is about 5,792 where male and female population is 2,982 and 2,810, respectively. Literacy rate of this village is about 63 per cent. The main occupation of the people of this village is agriculture and they are very much comfortable to adapt modern agricultural technologies. Communication facilities are satisfactory and the socio-economic conditions of this village are quite good compared to other villages. Maximum lands are suitable for the production of different agricultural crops and cropping intensity is about 260 per cent. From agricultural point of view, it is located in the agro-ecological zone (AEZ) 14. The soil texture of the crop fields is clay to loamy in nature and consists of high and medium high land.

Characteristics of Sampled Farmers

Application of vermicompost in MV paddy cultivation is a newly adopted technology in Bangladesh. This method is only applicable in MV paddy cultivation for farmers who plant seedling in line by line in paddy field. At the early stage, most of the farmers in the study village were not aware about this application method of vermicompost in MV paddy cultivation. As the farmers lacked the basic knowledge about this particular technique in MV paddy cultivation, they decided to go for the trial and error basis initially but they did the experiment only on a portion of their total cultivable land. However, the farmers were satisfied with the improvement in their yield.

MV Paddy Production Systems in Bangladesh

Currently, three different types of paddies are being produced in Bangladesh in three distinct seasons: *aus* (April to August), transplanting *aman* (T-aman) (August to December) and *boro* (January to April). Among them, aus and T-aman paddy are produced in rain-fed water and MV *boro* paddy is produced in irrigated water (ground water or water from rivers and canals). MV of paddy were introduced in Bangladesh for the boro and aus season in 1967 and aman season in 1970 (Hossain, Gascon, & Marciano, 2000). In 2011, only 45.78 per cent of the area was irrigated under MV paddy production in Bangladesh (BBS, 2011). Irrigation and chemical fertilizers are not used for local aus and T-aman paddy production because the paddy fields remain under water. Farmers transplant MV boro paddy from mid-January to mid-February and harvest them from mid-April to mid-May. Farmers usually use chemical fertilizers, pesticides and irrigation for boro paddy production. Along with paddy crops, farmers also cultivate oil seeds, potato and vegetables in a comparatively higher land during the winter season.

Concepts of Vermicompost Manure

Vermicomposting is a method of using worms to transform organic waste into a nutrient-rich fertilizer. It is a healthy and clean way to eliminate wastes going into our landfills, which improves the environment. Vermicomposting is inexpensive and only takes two to three months to produce results. Vermicomposting is the breaking down of organic material using worms, bacteria and fungi. In nature, OM is decomposed through these organisms. The end product of vermicomposting is a substance called vermicompost or worm castings. This is a nutrient-rich organic substance that can be added to soil to increase its OM content and available nutrients. Using earthworms to convert organic wastes is an ecologically safe method that leads to an environmentally safe product.

Results and Discussions

Inputs Used in MV Paddy Production

Seeds, irrigation, chemical fertilizer, pesticides, manure and land preparation equipment are the main inputs of MV paddy production since the introduction of the green revolution. As most of the agricultural cultivable land has already been used in crop cultivation, mainly in MV paddy production, the farmers are trying to reach the maximum level of output by using the trial and error method for the available scarce inputs and technologies that are already adopted in MV paddy cultivation in Bangladesh. Recently, the farmers are using vermicompost along with chemical fertilizers and manure for MV paddy production in some parts of Bangladesh. As the present study wants to estimate the impacts of vermicompost in MV boro paddy production, the comparison between main inputs used in MV boro paddy production under the two production practices that used vermicompost and traditional method (that do not use vermicompost) in Bangladesh are discussed in this section.

Chemical Fertilizer and Manure

Farmers use various types of chemical fertilizers and manure to enhance soil fertility that helps in producing maximum rice yield. The farmers' practice of inorganic fertilizer management varied widely across and within the villages, as did the cropping patterns and seasons, soil textures and geographical areas. Chemical fertilizers such as urea, TSP, MoP, gypsum and zinc sulphate are commonly used in MV paddy production in Bangladesh. The main inputs used in per hectare MV boro paddy production under two practices (used vermicompost and did not use vermicompost) are presented in Table 1.

Table 1. Inputs Used in Per Hectare MV Boro Paddy Production Under Two Practices

Particulars	Vermicompost	Non-vermicompost	Ratio
A. Inputs used in MV paddy production			
(i) Seed (kg)	36.6	36.7	1
Chemical fertilizer			
(ii) Urea (kg)	236.3	259	0.91
(iii) TSP (kg)	127.2	143.6	0.89
(iv) MoP (kg)	109.7	105.1	1.04
(v) Gypsum (kg)	102.8	123.7	0.83
(vi) Zinc (kg)	14.4	16	0.90
Organic fertilizer			
(vii) Manure (mound)	109.8	124.2	0.88

(Table 1 Continued)

(Table 1 Continued)

Particulars	Vermicompost	Non-vermicompost	Ratio
(viii) Vermicompost (kg)	351	—	
Hired labour			
(viii) Hired male labour (man-day)	133	142	0.94
(ix) Hired female labour (man-day)	20	19	1.05
Family supplied labour			
(xi) Family supplied male labour (man-day)	23	26	0.88
(xi) Family supplied female labour (man-day)	20	18	1.11
B. Boro paddy production (kg)	7,028.1	6,401	1.10

Source: Field Survey (2016).

Notes: (i) Average farm size was 0.51 ha and 0.37 ha for vermicompost and non-vermicompost users of MV paddy production.
(ii) US$1 = 80.60 Taka (May 2016).

Table 1 shows that on an average, the farmers used about 236.3 kg and 259 kg of urea in per hectare MV boro paddy cultivation who used vermicompost and who did not use vermicompost, respectively. In other words, the farmers used slightly less amount of urea in vermicompost used paddy farms compared to those who did not use vermicompost in per hectare MV boro paddy cultivation. The sampled farmers also used comparatively lower amount of TSP (127.2 kg/ha), MoP (109.7 kg/ha), gypsum (102.8 kg/ha) and zinc (14.4 kg/ha) per hectare MV boro paddy production under the farms that used vermicompost compared to those that did not use vermicompost (143.6 kg of TSP, 105.1 kg of MoP, 123.7 kg of gypsum and 16 kg of zinc). The amount of chemical fertilizers and manure used in paddy production per hectare also varied significantly within the same farming system.

Labour Input

The utilisation of labour in agricultural sectors depends on many factors, such as cropping patterns, cropping intensity, irrigation and other intensive agricultural activities (Suryawanshi & Kapase, 1985). The green revolution has changed the agricultural land and labour productivity, and it has considerable impact on labour demand and/or employment in developing countries. The adoption of new technology has substantially increased total agricultural employment and has significantly contributed to the household income by increasing labour demand in

developing countries (Estudillo & Otsuka, 1999). The diffusion of modern technology has increased the size of the labour market by increasing the demand for hired labour in Bangladesh (Hossain, Quasem, Akash, & Jabber, 1990). However, Alauddin and Tisdell (1995) argued that modern agricultural technology increased labour demand fourfold from the 1960s to the 1980s in the dry season but the labour demand was stagnant in the wet season. The employment-generating effects of modern agricultural technology have slowed down in recent years in Bangladesh. The green revolution has increased labour absorption at its early stage but the labour absorption decreased in most developing countries after the adoption of the new labour-saving chemical and mechanical innovations (Jayasuriya & Shand, 1986).

The temporarily hired and family supplied male and female labour used in MV boro paddy cultivation is also presented in Table 1. The table shows that the sampled farmers used temporarily hired and family supplied male and female labour (man-day) in almost similar proportions in both the farms that used vermicompost and did not use vermicompost in per hectare MV boro paddy cultivation in the study area.

Yield of MV Paddy Production

The yield produced per production of MV boro paddy is also shown in Table 1. It appears from the table that per hectare yield of both MV boro paddy production under farms that used vermicompost (about 7 ton/ha) was significantly higher than the farms that did not use vermicompost (about 6.4 ton/ha). It is interesting to note that yield production per hectare varied significantly between the two practicing methods in the study village.

Cost and Return of MV Boro Paddy Production

The cost of and returns from MV boro paddy production under the farms that used vermicompost and who did not use vermicompost are discussed in this section.

Per Hectare Cost of MV Boro Paddy

The cost of items associated with the MV paddy cultivation includes the cost of seed, irrigation, pesticides, land preparation (bullock and power tiller), hired labour, chemical fertilizers and manure. Gross return from MV paddy farming includes revenue from paddy and by-product straw. Total cost includes the variable costs and fixed costs. The opportunity costs of home supplied seeds, family supplied labours (both male and female) and self-owned land was calculated based on the current market price in the locality.

The per hectare costs, gross revenue and profit of MV boro paddy production are presented in Table 2. The table shows that per hectare production cost of MV boro paddy cultivation was almost same in both practices but the costs of irrigation, pesticides, urea, MoP, gypsum, hired male labour and opportunity cost of family labour were different. The main reason for this was that, normally, organic manures enhance the soil fertility and maintain the optimum soil moisture level for crop production. As a result, comparatively lower amounts of chemical fertilizers are required for per hectare MV boro paddy production.

Table 2. Costs and Returns of Per Hectare Boro Paddy Production Under Two Practices

Particulars	Vermicompost (Taka)	Non-vermicompost (Taka)	Ratio
A. Variable costs			
(i) Seedling cost	1,691.9	1,697.1	1
(ii) Irrigation cost	19,370.8	21,856.1	0.89
(iii) Pesticides cost	3,533.5	3,676.9	0.96
(iv) Land preparation cost	4,982.7	5,245	0.95
Chemical fertilizers			
(v) Urea	3,780.7	4,143.6	0.91
(vi) TSP	2,797.7	3,158.3	0.89
(vii) MoP	1,645.9	1,567.3	1.05
(viii) Gypsum	617.1	742.3	0.83
(ix) Zinc	2,155.6	2,402.6	0.90
Organic fertilizers			
(x) Manure	2,489.1	2,251.6	1.11
(xi) Vermicompost (kg)	5,859	0	
Labours			
(xii) Hired male labour	34,903.7	37,084.8	0.94
(xiii) Hired female labour	3,213.2	3,227.5	1
B. Opportunity cost/Fixed costs			
(i) Family supplied male labour	6,663	6,332.2	1.05
(ii) Family supplied female labour	3,211	2,808.3	1.14
(iii) Opportunity cost of land	26,000	26,000	1
C. Total costs (variable and fixed costs) (A + B)	**122,915**	**122,194**	**1.01**
Revenue from paddy production			
(i) Paddy	137,909.5	125,696.8	1.10
(ii) By-product of paddy	11,235.5	10,226	1.10

(Table 2 Continued)

(Table 2 Continued)

Particulars	Vermicompost (Taka)	Non-vermicompost (Taka)	Ratio
D. Total revenue (i) + (ii)	**149,145**	**135,923**	**1.10**
E. Net profit (D – C)	**26,230**	**13,729**	**1.91**
F. Benefit cost ratio (BCR)	**1.21**	**1.11**	**1.09**

Source: Field Survey (2016).

Notes: (i) Average farm size was 0.51 ha and 0.37 ha for vermicompost and non-vermicompost users of MV paddy production.
(ii) US$1 = 80.60 Taka (May 2016).

The table shows that the cost of irrigation of per hectare MV boro paddy production was about 11 per cent lesser in the farms that used vermicompost than the farms that did not use vermicompost. It is assumed that application of vermicompost manure in paddy field enhances the soil quality as well as increases retention of moisture that helps to reduce the application of irrigation in MV boro paddy production. As a result, comparatively lower amount of chemical fertilizers and pesticides are required in per hectare MV boro paddy cultivation for those who used vermicompost than those who did not use vermicompost. Table 2 shows that the costs of pesticides, urea, TSP, gypsum and zinc were about 4 per cent, 9 per cent, 11 per cent, 17 per cent and 10 per cent lower, respectively, in per hectare MV boro cultivation under the farms that used vermicompost than those who did not use vermicompost in the study village. The sampled farmers who did not use vermicompost hired slightly higher number of temporary labours than the farmers who used vermicompost in per hectare MV boro paddy production. On the other hand, the sampled farmers who used vermicompost utilised comparatively more family supplied male and female labours in per hectare MV boro paddy cultivation than the farmers who did not use vermicompost.

Per Hectare Return of MV Boro Paddy

Gross revenue is calculated by multiplying the total volume of production of enterprises with the farm-gate price. Net profit is calculated by subtracting total production cost (fixed and variable costs) from gross revenue. As mentioned earlier, on an average, per hectare production (yield) of MV boro paddy was higher in the farms that used vermicompost than the farms that did not use it. As a result, the revenue was also higher in the farms that used vermicompost than the farms that did not use vermicompost (Table 2). As average total cost of per hectare boro paddy production was same for the two adopted practices, net profit of per hectare MV boro paddy was also higher (1.91 times) in the farms that used vermicompost than the farms that did not use it. As a result, benefit cost ratio (BCR = total revenue/total cost) of per hectare MV boro paddy production was about 1.09 times higher in the farms that used vermicompost than the farms that did not use it. Therefore, it may be concluded that MV boro paddy cultivation is more profitable under the farms that used vermicompost than the farms that did not use it in the study village.

Table 3. Costs and Returns of Per Farm Boro Paddy Production Under Two Practices

Particulars	Vermicompost (Taka)	Non-vermicompost (Taka)
A. Variable costs		
(i) Seedling cost	850.24	631.31
(ii) Irrigation cost	9,882.09	8,074.69
(iii) Pesticides cost	1,830.88	1,365.35
(iv) Land preparation	2,556.64	1,952.58
Chemical fertilizers		
(v) Urea	1,922.26	1,537.45
(vi) TSP	1,451.10	1,169.95
(vii) MoP	846.44	584.15
(viii) Gypsum	308.56	278.92
(ix) Zinc	1,095.30	873.41
(x) Manure	1,260.79	824.64
(xi) Vermicompost	3,025.01	0
Labours		
(xii) Hired male labour	17,671.70	13,669.80
(xiii) Hired female labour	1,563.93	1,203.11
B. Opportunity cost		
(i) Family supplied male labour	3,382.87	2,328.87
(ii) Family supplied female labour	1,604.35	1,024.57
(iii) Opportunity cost of land	13,360.45	9,692.88
C. Total costs (Variable + Fixed)	**62,613**	**45,212**
D. Revenue from paddy production		
(i) Paddy	70,517.95	46,515.22
(ii) By-product of paddy	7,567.70	5,865.80
E. Total revenue (i) + (ii)	**78,086**	**52,381**
F. Net profit (E – C)	**15,473**	**7,169**

Source: Field Survey (2016).

Notes: (i) US$1 = 80.60 Taka (May 2016).
(ii) Average farm size was 0.51 ha and 0.37 ha for vermicompost and non-vermicompost users of MV paddy production.
(iii) Sample size was 100.

Estimation of Household Income

Household Income of MV Paddy Farmers Under Two Different Practices

Cost, return, profit and agricultural income as well as household income of the farmers of MV paddy cultivation are discussed in this section. The cost of items

in MV paddy farming include the costs of seed/seedling, land preparation (bullock), irrigation, pesticides, chemical fertilizers, manure and labour. The gross return includes revenue from paddy grain and by-product straw. The calculation procedure of variable cost, fixed cost, labour cost, gross revenue and net profit are presented in Tables 3 and 4.

It can be seen from Table 3 that on an average, the total cost, total revenue and net profit of MV boro cultivation under the farmers who used vermicompost were taka 62,613, taka 78,086 and taka 15,473, respectively, than that of the farmers who did not use vermicompost were taka 45,212, taka 52,381 and taka 7,169, respectively. The net profit of MV boro paddy cultivation under the farmers who used vermicompost was significantly higher than the farmers who did not use vermicompost and the net profit significantly varied among the farmers in both the method in the study area.

On the other hand, on an average, the total cost, total revenue and net profit of MV aman paddy cultivation using the two practices are shown in Table 4. The table shows that the total production cost, total revenue and net profit were taka 48,777, taka 57,686 and taka 8,909, respectively in the farms that used vermicompost, and taka 34,084, taka 39,115 and taka 5,030, respectively, in the farms that did not use vermicompost. The figure also shows that the net profit of MV aman paddy under the farms that used vermicompost was also significantly higher than the farms that did not use vermicompost and varied significantly among the farms in both the methods. The net profit from both the MV boro and aman paddy cultivation was very small. This scenario is found everywhere in Bangladesh for MV paddy production simply due to higher input costs such as higher cost of labour and chemical fertilizers and lower output price.

Table 4. Costs and Returns of Per Farm Aman Paddy Production Under Two Practices

Particulars	Vermicompost (Taka)	Non-vermicompost (Taka)
A. Variable costs		
(i) Seedling cost	736.70	567.96
(ii) Irrigation cost	879.75	779.98
(iii) Pesticides cost	819	510.28
(iv) Land preparation	1,680	1,363
Chemical fertilizers		
(v) Urea	739.20	550.91
(vi) TSP	1,174.80	740.11
(vii) MoP	390.15	214.82
(viii) Gypsum	166.20	95.51
Labours		
(ix) Hired male labour	20,233	13,441.11
(x) Hired female labour	3,255	2,006.99

(Table 4 Continued)

(Table 4 Continued)

Particulars	Vermicompost (Taka)	Non-vermicompost (Taka)
B. Opportunity cost		
(i) Family supplied male labour	8,577	4,908.58
(ii) Family supplied female labour	1,320	1,981.64
(iii) Opportunity cost of land	9,543.18	6,923.49
C. Total costs (Variable + Fixed)	**48,777**	**34,084**
D. Revenue from paddy production		
(i) Paddy	50,923	34,569.85
(ii) By-product of paddy	6,763	4,545
E. Total revenue (i) + (ii)	**57,686**	**39,115**
F. Net profit (C – B)	**8,909**	**5,030**

Source: Field Survey (2016).

Notes: (i) US$1 = 80.60 Taka (May 2016).
(ii) Average farm size was 0.51 ha and 0.37 ha for vermicompost and non-vermicompost users of MV paddy production.
(iii) Sample size was 100.

Agricultural and Household Income of the Farmers Using Two Different Methods

Rural households in developing countries derive income from various sources. Basically, the agricultural households in developing countries earn income from three sources—profit from agricultural production, agricultural labour income and non-agricultural activities. The agricultural profit is the sum of crop income, and income from livestock and poultry production. Likewise, agricultural labour income includes both family labour used on farm and labour sold to other farms, and non-agricultural income can be decomposed into earnings from self-employment, wage received in rural non-farm labour markets and remittances from household members working in urban areas.

Components and the ratios of household income of the farmers who used vermicompost and did not use vermicompost in MV paddy cultivation are presented in Table 5. The table shows that agricultural income remains the minor source of income for the sampled households in the study villages who used vermicompost and did not use vermicompost. Farm income of farmers who used vermicompost was significantly (statistically significant at 1% level) higher than that of farmers who did not use vermicompost in the both MV boro and aman paddy cultivation. The farmers earned more agricultural income from MV boro paddy cultivation than MV aman paddy cultivation under the farms that used vermicompost and that did not use vermicompost.

Table 5. Household Income (Taka) of MV Paddy Farmers

Sources of Income	Vermicompost (Taka)	Non-vermicompost (Taka)	Ratio	T-ratio
(i) Profit/agricultural income (Boro paddy)	15,473.07	7,169.35	2.16	3.45***
(ii) Profit/agricultural income (aman paddy)	8,908.72	5,030.48	1.77	3.12***
(iii) Opportunity cost of land				
(a) Boro paddy production	13,360.45	9,692.88	1.38	2.34***
(b) Aman paddy production	9,543.18	6,923.49	1.38	2.54***
(iv) Opportunity cost of family labours				
(a) Male (boro paddy)	3,382.87	2,328.87	1.45	2.98***
(b) Female (boro paddy)	1,604.35	1,024.57	1.57	3.06***
(c) Male (aman paddy)	8,577	4,908.58	1.75	2.86***
(d) Female (aman paddy)	1,320	1,981.64	0.67	–2.16***
(v) Agricultural wage	31,560.56	37,650.64	0.84	–2.78***
(vi) Livestock	45,650.45	40,450.67	1.13	1.98**
(vii) Off-farm income	26,450	22,345.50	1.18	1.96**
(viii) Homestead gardening	5,345.54	4,345.45	1.23	2.13***
Total household income	**171,176**	**143,852**	1.19	2.23***

Source: Field Survey (2016).

Note: *** and ** indicate statistically significant at 1% and 5% level, respectively.

The income from livestock, off-farm and homestead gardening were significantly higher for the farmers who used vermicompost than the farmers who did not use vermicompost. It significantly varied among the farmers in both the methods. The main reason was that the farmers who used vermicompost in MV paddy cultivation were engaged in various types of off-farm activities, rear more livestock and poultry compared to the farmers who did not use vermicompost. However, the income from agricultural wage (income) was significantly higher for the farmers who did not use vermicompost in MV paddy production. Most probably, the farmers who did not use vermicompost were relatively poor and sold their labours in other crop producing farms in the study area. Therefore, it can be concluded from the table that the farmers who used vermicompost have gained more agricultural income and household income compared to the farmers who did

not use vermicompost in MV paddy farming in the study area. Barmon and Tarafder (2014) made similar conclusion about household income of MV paddy producers in Jessore District.

Efficiency Measure and Resource Use Efficiency

The estimation of the efficiency measures and resource use efficiency of MV boro paddy production under the farmers who used vermicompost manure and who did not use vermicompost in the Cobb–Douglas production function, MVP and MFC are briefly discussed in this section.

Summary Statistics of Inputs and Output of Cobb–Douglas Model

The descriptive statistics of the key variables in the Cobb–Douglas production function are presented in Table 6. The inputs and outputs of MV boro paddy production under the farmers who used vermicompost and did not use vermicompost calculated in terms of monetary unit instead of quantitative units mainly because the present study estimates the resource use efficiency based on the coefficients of Cobb–Douglas production function. The table reveals that considerable variation exists among the farmers in terms of production practices. The input and output data were obtained on per farm basis in the farm survey. The average revenue (Y) from the sale of MV boro paddy under the farmers who used vermicompost and who did not use vermicompost was taka 70,517.95 and taka 46,515.13, respectively, and it significantly varied among the farms.

The mean farm size (X_1) of the farm that used vermicompost and did not use vermicompost was 0.51 ha and 0.37 ha, respectively, and it significantly varied among the farms. The mean seed cost (X_2) per farm for MV boro paddy cultivation was significantly higher for the farms that used vermicompost compared to those that did not use vermicompost, mainly for farm size that widely varied among the farms. Similarly, the mean of the other inputs those were used in MV boro paddy cultivation such as land preparation cost (X_3), pesticides cost (X_4), irrigation cost (X_5), urea cost (X_6), other fertilizers cost (X_7), manure cost (X_9) and labour cost (X_{10}) were significantly higher in the farms that used vermicompost than the farms that did not use vermicompost and a wide variation exists among the farms. The main reason was that the farm size was comparatively larger in the farms that used vermicompost than those that did not use vermicompost in MV boro paddy cultivation. The mean cost of vermicompost was about taka 3,025 in the farms that used vermicompost with a range of taka 2,121 and 13,500 and significantly varied among the sampled farms. However, the mean of almost all inputs used in per hectare MV boro paddy cultivation were significantly lower in the farms that used vermicompost than those that did not use it in the study area.

Table 6. Summary Statistics of the Sampled Variables in MV Boro Paddy Production in Jessore District

	Used Vermicompost				Non-vermicompost			
Name of Variables	**Mean**	***SD***	**Min**	**Max**	**Mean**	***SD***	**Min**	**Max**
Paddy grain (taka) (Y)	70,517.95***	45,478.32	16,940	192,660	46,515.22***	18,017.13	15,600	111,150
Area (hectare) (X_1)	0.51***	0.33	0.134	1.336	0.37***	0.14	0.13	0.94
Seed (taka) (X_2)	850.24***	552.28	180	2,700	631.31***	246.02	180	1,680
Land preparation (taka) (X_3)	2,556.64***	1,664.24	550	7,100	1,952.58***	729.47	700	4,550
Pesticide cost (taka) (X_4)	1,830.88***	1,270.26	430	6,500	1,365.35***	519.12	450	3,465
Irrigation cost (taka) (X_5)	9,882.09***	6,436.89	2,250	29,300	8,074.69***	3,002.30	3,000	18,585
Urea (taka) (X_6)	1,922.26***	1,258.82	480	5,760	1,537.45***	596.61	576	3,920
Other fertilizers (taka) (X_7)	3,701.39***	2,467.69	837	11,620	2,906.42***	1,115.36	905	7,102.2
Manure (taka) (X_8)	1,260.79***	815.32	286	3,900	824.64***	371.51	264	1,771.2
Vermicompost (taka) (X_9)	3,025.01***	2,121.07	375	13,500	—	—	—	—
Labour (taka)) (X_{10})	24,222.83***	14,956.66	5,525	69,400	18,226.36***	6,612.73	6,200	47,985

Source: Field Survey (2016).

Notes: (i) *** indicates statistically significant at 1% level.
(ii) Sample size of MV boro paddy production was 100.

Affecting Factors in Cobb–Douglas Production Function for MV Paddy Production

The model parameters in the Cobb–Douglas production function allowed us to compare empirically the impact of input variables on output. Cobb–Douglas production function has been fitted to work out the elasticity values of production of inputs, which in turn have been used to calculate their (inputs) MVP (at their GMs) for the average farms. The single equation Cobb–Douglas production has been estimated by the ordinary least square (OLS) method. The empirical results of the Cobb–Douglas production of MV boro paddy cultivation under the farms that used vermicompost and that did not use are presented in Table 7.

The regression coefficients of Cobb–Douglas production function indicated the elasticity values of an input production and the sum of these elasticity values indicates the nature of returns to scale. The returns to scale are decreasing, constant and increasing as the sum of regression coefficients is less than, equal to or greater than unity. It can be observed from the table that the sum of the elasticity values of MV boro paddy production was 1.057 and 1.09 which were close to unity indicating that both the farmers who used or did not use vermicompost had experienced constant return to scale in MV boro paddy production in the study area. The values of R^2 for MV boro paddy cultivation were quite high. These indicate that the variables appearing in the Cobb–Douglas production equation explained quite a high proportion of variations in MV boro paddy production under the farms that used (0.96) and did not use vermicompost (0.94) in the production process, respectively, and they were statistically significant at 1 per cent level.

The coefficients of farm area (1.065), pesticides cost (0.0451), irrigation cost (0.055) and vermicompost cost (0.036) were positive and they were statistically significant, whereas the coefficient of other fertilizers cost (0.075) and manure cost (0.0149) were also positive but were not statistically significant for MV boro paddy production under the farms that used vermicompost. This indicates that farm area, pesticides cost, irrigation cost, vermicompost, other fertilizers cost and manure cost were the main factors that significantly affected the MV boro paddy production under the farms that used vermicompost. However, the coefficient of seed cost (–0.055) and urea cost (–0.049) were negative and both were statistically significant at 5 per cent level, which indicates that the seed cost and urea cost had significant impact on MV boro paddy cultivation under the farms that used vermicompost. In other words, the farmers were able to produce same level of paddy grain output with the application of lower amounts of seed and urea in MV boro paddy cultivation. The coefficient of the cost of vermicompost was 0.036 and it was statistically significant at 10 per cent level indicating that the vermicompost had significant impact on MV boro paddy production.

On the other hand, the coefficients of farm size (1.125) and manure (0.055) were positive and statistically significant at 1 per cent level and the cost of urea (0.072) and other chemical fertilizers (0.109) was also positive but statistically significant at 10 per cent level under the farms that did not use vermicompost in MV boro paddy cultivation. This implies that the farm size, cost of urea, other chemical fertilizers and manure had significant positive impact on MV boro

Table 7. Estimated Value of Co-efficient and Related Statistics of Cobb–Douglas Production Model for Vermicompost and Non-vermicompost Usage of Boro Paddy Production in Jessore District

	Vermicompost			Non-vermicompost		
Name of Variables	**Coefficients**	**Standard Error**	***T*-ratio**	**Coefficients**	**Standard Error**	***T*-ratio**
Constant	13.34***	1.161	8.255	11.123***	1.651	6.74
Area (ha) (X_1)	1.065***	0.124	8.589	1.125***	0.163	6.90
Seed cost (X_2)	–0.055**	0.027	–2.037	–0.0345	0.055	–0.63
Land preparation cost (X_3)	–0.073	0.064	–1.141	–0.139	0.098	–1.52
Pesticide cost (X_4)	0.0451**	0.022	2.05	0.035	0.057	0.61
Irrigation cost (X_5)	0.055**	0.029	1.90	–0.049	0.053	–0.92
Urea cost (X_6)	–0.049**	0.023	–2.13	0.072*	0.043	1.67
Other fertilizer cost (X_7)	0.075	0.085	0.88	0.109*	0.065	1.68
Manure (X_8)	0.0149	0.027	0.92	0.055***	0.026	2.12
Vermicompost (X_9)	0.036*	0.0195	1.80	—	—	
Labour cost (X_{10})	–0.057	0.041	–1.39	–0.068*	0.039	–1.64
Sum of elasticities β_i	1.057			1.09		
R^2	0.96***			0.94***		

Source: The authors.

Notes: (i) ***, ** and * indicate statistically significant at 1%, 5% and 10%, respectively.
(ii) Sample size was 100.

Table 8. Resource Use Efficiency in Cobb–Douglas Production Function for Both Vermicompost and Non-vermicompost Usage in MV Boro Paddy Cultivation

	Vermicompost			Non-vermicompost		
Name of Variables	**Coefficients**	**MVP**	**MVP/MFC**	**Coefficients**	**MVP**	**MVP/MFC**
Seed cost (X_2)	–0.055**	–4.562	–4.562	–0.0345	–2.541	–2.541
Land preparation cost (X_3)	–0.073	–2.014	–2.014	–0.139	–3.311	–3.311
Pesticide cost (X_4)	0.0451**	2.084	2.084	0.035	1.192	1.192
Irrigation cost (X_5)	0.055**	0.392	0.392	–0.049	–0.282	–0.282
Urea cost (X_6)	–0.049**	–1.798	–1.798	0.072*	2.178	2.178
Other fertilizer cost (X_7)	0.075	1.429	1.429	0.109*	1.744	1.744
Manure (X_8)	0.0149	0.083	0.083	0.055***	3.102	3.102
Vermicompost (X_9)	0.036*	0.839	0.839	—	—	—
Labour cost (X_{10})	–0.057	–0.166	–0.166	–0.068*	–0.174	–0.174

Source: The authors.

Notes: (i) MVP = Marginal Value Product; MFC = Marginal Factor Cost, MFC = 1 for each input.
(ii) ***, ** and * indicate statistically significant at 1%, 5% and 10%, respectively.

paddy under the farms that did not use vermicompost in MV boro paddy cultivation. The coefficient of the cost of pesticides (0.035) was positive and it was statistically insignificant. On the other hands, the cost of labour (–0.068) were negative and they were statistically significant at 10 per cent, and the coefficient of cost of seed (–0.0345), land preparation (–0.139) and irrigation cost (–0.049) were negative and they were statistically insignificant in the farms that did no use vermicompost in MV boro paddy cultivation. This indicates that labour cost, seed cost, land preparation cost and irrigation cost had negative impact on MV boro paddy cultivation in the study area.

Resource Use Efficiency of MV Paddy Production

The MVPs of various capital inputs were worked out at the GM levels for the farmers who used vermicompost and who did not use vermicompost in MV boro paddy cultivation, and were compared with their respective prices.

MFC of all inputs is expressed in terms of an additional taka spent for providing individual inputs in Cobb–Douglas production. Therefore, to calculate the ratio of MVP to MFC, the denominator would be one and consequently the ratio would be equal to the MVP of an input in the production process. The MVP and the ratio of MVP to MFC of MV boro paddy cultivation under the farms that used vermicompost and that did not use vermicompost are presented in Table 8. The figures in Table 8 show that none of the MVPs of inputs was equal to one indicating that the sampled farmers in the study area failed to show their efficiency in using the resources in both the farms that used and did not use vermicompost for MV boro paddy cultivation.

The MVP and MFC ratio of seed costs of MV boro paddy production were –4.562 and –2.541 in the farms that used vermicompost and that did not use vermicompost, respectively, which was negative and greater than unity and it were statistically significant at 1 per cent level for the farms that used vermicompost and statistically insignificant for the farms that did not use vermicompost, indicating that the farmers used excessive seeds to produce MV boro paddy cultivation in both the farms in the study village. Therefore, there was an opportunity for the farmers to maintain the same level of production by using seed input. Similarly, the MVP to MFC ratios for land preparation cost were negative for both the farms but they were statistically insignificant and greater than unity which indicates that the farmers spent significantly excessive money for land preparation for MV boro paddy cultivation in the short run keeping the use of other resources at a constant level.

On the other hand, the ratio cost of urea (–1.798) were negative for the farms that used vermicompost (statistically significant at 5% level) but positive (2.178) for the farms that did not use vermicompost (statistically significant at 10% level) and greater than unity which indicates that the farmers who used vermicompost used excessive urea for MV boro paddy cultivation. However, farmers who did not use vermicompost had no opportunity to reduce urea to maintain the same level of MV boro paddy production in the study area.

The MVP to MFC ratio for pesticide cost (2.084) for farms using vermicompost was statistically significant at 5 per cent level and that of farms not using it was 1.192, which was statistically insignificant. The MVP to MFC ratio for other fertilizers cost for the farms using vermicompost was 1.429 which was statistically insignificant and for the farms not using it was 1.744 which was statistically significant at 10 per cent level. These ratios were all positive, were greater than unity, which indicates that the farmers did not utilise the opportunity of fully using the pesticides and other chemical fertilizers in MV boro paddy cultivation. Therefore, there was a little opportunity for the farmers to increase production by using pesticides and other chemical fertilizer inputs. The MVP to MFC ratio for the cost of irrigation for the farms using vermicompost was 0.392 and was positive and statistically significant at 5 per cent level. For the farms that did not use vermicompost, this ratio was –0.282, which was negative and statistically insignificant. For both the farms, this ratio was less than unity indicating that the farmers who did not use vermicompost used excess irrigation and the farmers who used vermicompost had little opportunity to increase production for MV boro paddy production.

The ratio of MVP to MFC for labour were –0.166 (statistically insignificant) and –0.174 (statistically significant at 10% level), respectively, for farms that used vermicompost and that did not use vermicompost and both ratios were negative and less than one indicating that the farmers in both farms used little bit excessive labours for MV boro paddy cultivation.

The ratio of MVP to MFC for manure were 0.083 (statistically insignificant) and 3.102 (statistically significant at 1% level) for those who used vermicompost and did not use vermicompost, respectively, and both ratios were positive which indicates that the farmers under both farms had opportunity to increase MV boro paddy production using more manure in the short run. The ratio of MVP to MFC for vermicompost was 0.839, which was positive and statistically significant at 10 per cent level but less than one which implies that the farmers had small opportunity to increase MV boro paddy production. Therefore, it may be concluded that the farmers did not efficiently and optimally use the input resources in both the farms that used and did not use vermicompost in MV boro paddy cultivation and this hindered the generation of maximum level of output of paddy grain in the study area.

Conclusions and Policy Options

Rice is the main staple food for the people in Bangladesh. The government of Bangladesh has been trying to achieve food self-sufficiency using the scarce input resources efficiently and optimally in production processes using our limited land resources to meet the continuous increasing demand to increasing rapid population growth. In this regard, the farmers are always trying to use trial and error technique to use the inputs efficiently as well as to maintain soil fertility and OM in the topsoil in paddy cultivation. Vermicompost is one such trial and error technique of

modified manure processing that is being used recently in MV paddy cultivation in Bangladesh. The present study attempts to estimate the economic impact of vermicompost on MV paddy cultivation. The findings of the study indicated that the average cost of per hectare MV boro paddy production was comparatively smaller in the farms that used vermicompost compared to those farms that did not use vermicompost. The sampled farmers used comparatively less proportion of chemical fertilizers such as urea, TSP, zypsum, zinc and manure except MoP in per hectare of MV boro paddy cultivation. On an average, the yield as well as revenue of MV boro paddy was significantly higher in the farms where the farmers used vermicompost than the farms where vermicompost was not used. As a result, the net profit of per hectare MV boro paddy cultivation was significantly higher in the farms that used vermicompost than the farms that did not use vermicompost. Moreover, the household income of the farmers who used vermicompost was significantly higher than the farmers who did not use vermicompost in MV boro and aman paddy cultivation in the study area.

The result also indicated that the farmers could produce same level of output (paddy grain) from MV boro paddy cultivation using vermicompost along with chemical fertilizers that was not possible for those who used only chemical fertilizers and manures. The farm area, seed cost, pesticides cost, irrigation cost, urea cost and vermicompost were the main factors that affected the MV boro paddy production significantly under the farms that used vermicompost whereas, the farm size, urea, other chemical fertilizers, manure and labour had significant impacts on MV boro paddy under the farms that did not use vermicompost. The results of the ratios of MVP to MFC showed that none of the MVPs of inputs was equal to one, indicating that the farmers did not optimally use the input resources in both the farms in MV boro paddy cultivation and this hindered the generation of maximum level of output of paddy grain in the study area. Therefore, it may be concluded that the vermicompost has significant impact on MV paddy production as well as on the household income of the farmers in the study area. If government takes the initiatives to boost up the availability of vermicompost in every farm and ensures efficient extension services in every village, this will lead to an increased paddy production which will contribute to greater food self-sufficiency in Bangladesh.

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Article

Women and Water Management: A Policy Assessment—A Case Study in An Giang Province, Mekong Delta, Vietnam

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Abstract

Women in developing countries are domestic water managers and therefore can be regarded as the primary beneficiaries of water supply project, particularly domestic water supply services (DWSSs). Globally, women are active in water supply policymaking, planning and implementation. However, women are often excluded from water management activities; this can result in the failure of water projects. Research to date shows that women's exclusion from water management processes stems from top-down approaches and traditional norms and gender differences. The work described in this research involved an examination of the effectiveness of DWSS policies implemented in rural Vietnamese communities, and was designed to produce an understanding of women's roles and responsibilities in water management, specifically within the Vinh Phuoc community of the Mekong Delta of Vietnam. The research found that women participation in Vinh Phuoc was greatly restricted in the water management and in the public sphere in general. Also, it sought to reveal whether women are involved in water management activities and the roles they play in achieving final outcomes.

Keywords

Women's participation, Mekong Delta, Vietnam, water management, domestic water supply services, policy assessment

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Introduction

Over recent decades, the link between gender and water resources management has become an issue of growing concern. Considerable efforts have been made to identify the role of gender in the field, as well as to empower women and their voices in the arena of water management policies. In developing countries, women are the main users of water—for cooking, washing, sanitation and family hygiene (Aureli & Brelet, 2004). Women could play a key role in water management as major stakeholders in the process of policymaking, planning and implementation, but are often excluded and regarded as merely the recipients (Singh, 2004). Women are domestic water managers at the household and community levels and hence women have the potential to become active stakeholders in processes of management and decision-making within the water sector.

It is important to note that the global policy concepts relating to rural water supply and sanitation (RWSS) have influenced the water policies of most developing countries including Vietnam (Reis, 2012). The Vietnamese National Rural Clean Water Supply and Sanitation Strategy addresses gender issues, particularly noting that women need to be included in water-related activities because they play a major role in the collection and usage of domestic water for maintaining the hygiene and health of a family (MARD & MOC, 2000). However, significant questions have been raised about how national commitments to ensuring gender equity in water-related activities influence policy implementation at local levels. For this reason, this research aimed to determine the nature and the effectiveness of the policies in terms of their impacts on Vietnamese women. A clear understanding of the policy framework is essential to determine how national policies regarding the water services sector are being implemented by the local governments, and ultimately how these policies affect women's participation in water management.

Existing studies have shown that social and cultural factors, including gender inequalities and lack of decision-making power, inhibit the participation of women in water resources management (Ademun, 2009; Svahn, 2011). Several researchers have examined key factors that act as barriers to women's participation within the water sector; however, previous researchers have not addressed the significant role played by cultural beliefs, and social structures and practices of local communities in the policy, which in turn influences both the process and the outcomes.

To fill this gap in the literature, the research was designed to assess the effectiveness of the existing policies regarding women and water in Vietnam drawing on the case of women's participation in the implementation of domestic water supply programmes in the Vinh Phuoc community of An Giang province of the Mekong Delta. Furthermore, the research examined the influence of socio-cultural factors related to gender equality on women's involvement in water management and the effectiveness of policies on female participation in DWSS issues.

Research Aims and Objectives

The main aim of the study was to determine the effectiveness of policies related to women and water in addressing the needs, interests and potentials of women in DWSSs in Vietnam. A secondary aim was to examine the role of social and cultural factors in creating and addressing the challenges of women's involvement in domestic water management. The research pursued the following specific objectives to support the primary aim:

- To identify the current Vietnamese DWSS policies and their nature by ways of questioning whether women have a role to play in the process of decision-making within the water sector,
- To understand how the concept of participation is being practised in Vietnamese domestic water supply policy from a gender perspective and in the complex socio-cultural matrix of the local communities,
- To assess the effectiveness of the current policies in relation to women and water.

Research Questions

The specific questions that the research sought to answer in order to achieve the objectives listed above were as follows:

1. What are the overall aims of current Vietnamese policies on DWSSs?
2. How do these DWSS policies enshrine the specific gender needs of women?
3. How the concept of women's participation is stipulated in these DWSS policies?
4. How does women's participation occur in Vietnamese rural communities and how do social and cultural factors influence it?
5. How effective have Vietnamese DWSS policies been in implementing women's participation in decision-making to address the specific gender needs of women in local communities?

Research Methods and Design

Study Area

The two villages in Vinh Phuoc commune were selected with the assistance of the local staff from People's Committee of Vinh Phuoc and the communal water and environment officials. The researcher also read through annual reports from the provincial and local water offices to obtain an overview of socio-economic development information of these communities. The following reasons were identified for the selection of the two villages, such as Vinh Thanh and Vinh Loi (Figure 1):

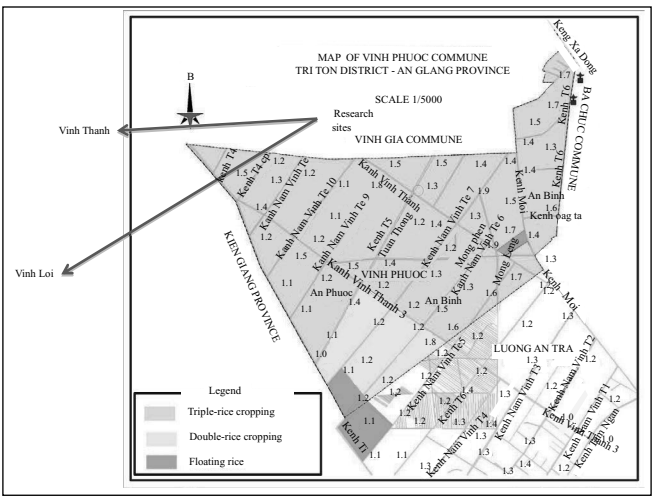

Figure 1. Location of Study Sites

Source: Pham Duy Tien (2016).

1. The Vinh Thanh village had a water supply station which is funded by the UNICEF,
2. The Vinh Loi village mainly depends on groundwater from the hand pumps for domestic use,
3. The private and communal initiative were identified in the construction and management of these water sources,
4. Women play a major role in water collection, use and management at household and community levels.

Data Collection Methods

Secondary Data

Secondary data is very important for understanding the background of research sites, DWSSs, socio-economic conditions as well as issues related to women and water. The secondary data used in this thesis was obtained from different sources: annual local government reports on socio-economic development, recorded information about the implementation of DWSS programmes and their impacts on water users and human health, and unpublished papers, and *International Journal of Water Resources Development* and *Journal of Gender & Development*. I visited provincial and local institutions to obtain the local government reports on the issues of gender and water supply programmes. I went through the abstract, methodology and finding of each paper to determine whether the article follows the aims, research questions as well as the relevant paradigms and research methods.

Collection of Empirical Material

In-depth Semi-structure Interviews

Semi-structure interviews were carried out with the participation of government officials, including Department of Natural Resources and Environment, Centre for RWSS and People's Committee of Vinh Phuoc Commune, regarding gender and the water services sector. The research used open-ended questions, which were designed for the participants as follows:

- The interaction between relevant stakeholders in the water supply services (How often and how they interact with the community and other stakeholders?)
- Who has the responsibility for delivering policies on the water services sector; and who reports and receives the feedback from results of water-related projects?
- How effective the implementation of DWSS policies have been achieved?
- Whether policies or guidelines with regard to gender and the water sector are at provincial and local levels?

Focus group discussions

Women in the two communities were selected to be involved in the focus group discussions (FGDs). The groups varied in size from 8–10 people. The two focus groups were carried out in the Vinh Phuoc commune with women—the water users and managers in the domestic water supply programmes. FGDs were set based on a list of designed open-ended questions. The participants were allowed to add topics for discussion if they wanted to. Participatory Rural Appraisal (PRA) techniques were used to allow women to share their knowledge and experience involved in the DWSSs. The four tools used were: timeline, seasonal calendar, Venn diagram and SWOT analysis. Such techniques give women the opportunities to express their voice about the actual implementation of DWSS programmes and challenges of women's participation in water management activities

Results and Discussions

Household Water Use and Water Collection

The Water Use in the Household

The FGDs showed that people in Vinh Loi preferred to collect water for cooking, washing and bathing from the hand pumps near their houses, while in Vinh Thanh, bathing and washing clothes are sometimes done in the canal. Generally speaking, the canal water remains the primary water source for people in both villages. Bottled water was identified as the main water source for drinking, while several households in the Vinh Thanh used piped water for cooking, washing and bathing. In the Vinh Loi, some better-off families can afford bottled water for drinking,

while many poor households drink rainwater, and some drink water from hand pumps (after filtering it for seven days).

Water quality can be improved by treatment; this helps to improve human health by avoiding water-borne diseases. However, the FGD findings show that not all households in the Vinh Phuoc community treat their water before use. The main reason is that the water treatment methods currently available in the community are limited and expensive. Rural households in both villages often boil the water for drinking (other than those with the access to hand pumps because they believe that this supplies clean water).

Chlorination was once widely used to treat water, especially by poor people, but this method is no longer used; most households now buy bottled water instead. No FGD participants reported using solar disinfection because they believe that it takes several hours for water to settle and become clean and safe for household consumption.

Responsibility for Collecting Water for Domestic Use

The FGDs showed that women in the Vinh Phuoc community have the primary responsibility for collecting water for household use. Most women in Vinh Thanh collect water from the water taps from piped water systems and store it in domestic water tanks for later use. The participants stated that it was an easy task for them to meet water demands in the household. Women in Vinh Loi collected water from hand pumps for cooking, washing and cleaning, also storing it in private water tanks. The participants stated that men took over water collection tasks when their wives were sick or absent from the house.

As women have the main responsibility of water collection, they are first to detect water-related problems, such as the water source declining in volume, reduced water quality due to pollution or water taps break down. Most women in Vinh Loi said that they identify problems with the hand pumps and then their husbands help to fix them.

Policy Effectiveness and Its Impacts on Women and Water

The main sources of water supply in the Vinh Phuoc commune are communal. According to local officials, the communal water supply station provides water to 442 households living in Vinh Thanh, Vinh Loi and Vinh Thuan villages in the Vinh Phuoc commune. An estimated 90 per cent of households in Vinh Thanh collect water from the communal water supply station while in the Vinh Loi, 70 per cent of the households depend on traditional water sources such as hand pumps and canals. Such water sources are located close to people's homes, but the water is sometimes of poor quality and possibly unsafe.

Vinh Thanh's water supply station was built in 2006 with funds from UNICEF. In Vinh Loi, some households have access to water from hand pumps under the support of the Research Centre for Rural Development (RCRD) in 2013 (results of the timeline—a PRA tool). Nonetheless, participants from both villages said

that they were unhappy with the quality of water from the water supply services. Some participants mentioned that there is a water testing team that is responsible for the evaluation of water quality annually, but local people had not heard from this team. Similarly, little or no assessment of the water quality from hand pumps occurs in Vinh Loi. Reliability of supply, cost of water, water accessibility, and quality and quantity are significant elements that help to determine how policy guidelines in relation to women and water under the National Target Programme (NTP) for RWSS at the national level are being practised at the local level, and how these policies have impacted the lives of people, especially women in the Vinh Phuoc community. These criteria are discussed in the following sections.

Seasonal Unreliability of Water Sources

The FGD findings show that domestic water supply in Vinh Phuoc commune is impacted by seasonal variations, particularly in the dry seasons. In Vinh Loi, from January to March, traditional water supply sources such as canals dry up, water tables fall, so hand pumps produce less and poorer-quality water and rainwater harvesting is not productive. In Vinh Thanh, where people depend mainly on the communal water supply station. FGD participants said that though water supply station can store plenty of water for the dry season, the quality of the water was poor. Seasonal calendar—a PRA tool—was used to collect the information on the reliability of water supply sources in the selected communities. Figure 2 identifies all water-related issues that households in both villages are facing over a 12-month period.

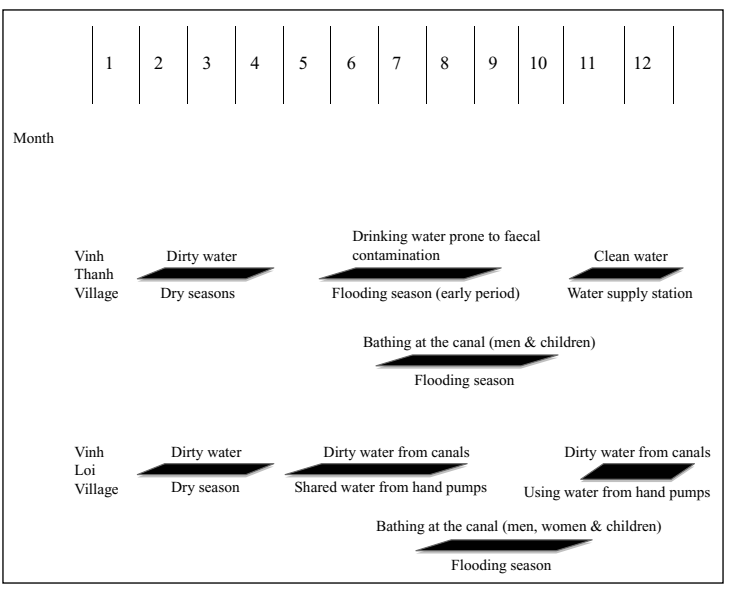

Figure 2. Seasonal Unreliability of the Water Sources in the Two Villages

Source: Own illustration based on focus group discussion, 2016.

As shown in Figure 2, seasonal unreliability powerfully affects the use of water in households. In particular, most households in both villages suffered from dirty water sources in the early flooding season. Women in Vinh Thanh stated that though they had access to a treated water supply from the water supply station, the water is not suitable for drinking. For instance, the participants said that they often get diarrhoea after drinking water from water supply stations, especially in the first two months of the flooding season, even when the water is boiled first. In Vinh Loi, the canal water is dirty in this season and this affects water from hand pumps used for domestic purposes. In this period, water sources from hand pumps are shared among many households and this also reflects the value of the communal water resources.

Women are generally identified as the group most affected by seasonal unreliability of water sources because they carry the main responsibility for water collection, use and management in the home. Therefore, seeking alternative ways to meet the water needs of households puts a heavy burden on women.

The Cost of Water

Charges for water differ in the two villages. In Vinh Thanh, every household is expected to contribute a monthly fee for water supply. However, as previously noted, many households in Vinh Loi use hand pumps so no monthly contributions are necessary. According to the local officials, rural households pay for water under the decision 23/2015/QD-UBND of the Provincial People's Committee. The first 10 m^3 of water is priced at 4.50 VND/m^3 this price applies for households in both urban and rural areas of An Giang province. The price rises to 11 VND/m^3 for the use of 10 m^3 of water or more. However, poor people pay only 3.60 VND/m^3 for the first 10 m^3, and 4.50 VND/m^3 for the use between 10 m^3 and 20 m^3. Although poor households pay less than rural households in general for water use, some of them cannot afford access to piped water.

The FGD findings show that women in Vinh Thanh experience great financial constraints for water use. This forces them to collect water from traditional water sources, such as canals. One woman in the Vinh Thanh's FGD said:

> Due to limited financial assets, households often use water from canals for bathing and washing while they use piped water for cooking and drinking.

Thus, DWSS programmes that provided piped water will be unsuccessful if women cannot afford the water use and return to their old sources (canals).

Water Accessibility

A SWOT analysis of water supply programmes was carried out in the two selected villages (see Box 1). The researcher found that some responses from the two FGDs were similar. In particular, participants identified similar strengths, opportunities and threats, whereas weaknesses varied with regard to the implementation of DWSS programmes. Hence, this information is presented in an integrated SWOT analysis.

Box 1. SWOT analysis of water supply programmes in Vinh Phuoc

Strengths (S)	**Weaknesses (W)**
• Easy access to water; reduced time and effort to collect water. • More time to engage in other productive activities. • Water from water supply station and hand pumps is better quality than water from canals.	• Water from the new water sources is sometimes turbid and smells bad. • Water-borne diseases occur when there is no water treatment. • The water supply mainly depends on the power station (Vinh Thanh). • Seeking alternative sources; for instance, canals to collect water in the dry season (Vinh Loi).
Opportunities (O)	**Threats (T)**
• Cooperation between the local authority and donors in community-based development projects, such as floating rice conservation and water-related projects will bring benefits to local people's lives.	• More droughts will result in the water scarcity. • Being scary, the flooding with very low levels in the future. • It is necessary to prepare the tanks to harvest rainwater in order to store and use in cases of severe droughts.

Source: Own illustration based on focus group discussion, 2016.

As shown in Box 1, the distance that must be travelled to collect water is no longer a problem for women in either village. Women have more time to participate in productive activities, such as rice seeding and transplanting, and small trade—activities that boost their family income. However, the water supply station represents a new source of instability in the water supply to households in Vinh Thanh. The main reason is that this water supply source is heavily reliant on the power supply station, thus when power outages occur, consumers cannot access water. One woman from Vinh Thanh said:

> The water supply is reliant on the operation of the power supply system, thus if power outages occur, especially on the weekend and in the dry season, this means households cannot have access to water sources.

As already noted, many people in Vinh Loi collect water from hand pumps, which are very close to their houses. However, during the dry season, the women in this village had to seek alternative water sources, mainly canals.

Women in the FGDs were concerned that future water scarcity would once again burden them with the responsibility to fetch water. One woman in Vinh Loi said:

> The weather today is hotter than in the past few years; people here have experienced prolonged hot days along with low level flooding and the decrease in rainfall has led to dry canals in the last year.

People in the Vinh Phuoc community are worried about climate-change-induced water shortages that will restrict both agricultural production and daily activities forcing them to use traditional sources, such as canals and rainwater, to meet their water needs.

The SWOT analysis indicates that women in the two selected villages experience challenges of water accessibility differently. In Vinh Thanh, the water supply station is unreliable because it depends on the power supply station; this compels women to fetch water from canals or collect rainwater for domestic use. In the Vinh Loi, women have to collect water from canals during the dry season as the water supply from hand pumps falls. Hence, DWSS programmes in these villages have failed to give women (water users) a stable access to water since these challenges force them to seek alternative water sources to meet their household water demands.

Water Quality

It is a common observation that due to different water supply services among the two research sites, women in the Vinh Phuoc have different ways to contribute to water management activities, such as recognising water quality and therefore making decision about how best to utilise it or identifying other ways to collect water. In the Vinh Thanh, the water is supplied by the communal water supply station and sometimes the construction itself failed to meet the desired qualities, which are culturally perceived by the local community. For instance, in the Vinh Thanh village, in the Tri Ton district in An Giang Province, the water supply station supplies water that is not regarded as 'good-quality' or 'safe and hygienic' water because it is coloured. One participant said:

> The water from the water supply station is sometimes turbid and even contains alum, and the water must be boiled for drinking purposes.

Such water is seen as unfit for drinking. Instead, the water from water supply stations is utilised for cooking, washing and bathing, while for drinking, women (except those from poor households) buy bottled water.

Similarly, the water supply from hand pumps is the main water source for households in Vinh Loi. However, such water also has limitations. Most participants agreed with this statement from a participant from Vinh Loi village:

> The taste of the water from the hand pumps is sweet which is very necessary for drinking water. However, women realise that the initial quality of the water is muddy, especially in the morning, thus they have to pump out the first 10–20 litres before collecting water.

Furthermore, women find it difficult that they will have to look for alternatives for their household water needs in the dry season when the water from hand pumps gets low and contains lots of alum. For this reason, rainwater harvesting is the main remedy for several households to meet the water demands; some can afford to buy bottled water in this instance. Therefore, this reflects that water supply from the hand pumps failed to obtain the goal of sustainability in the water

management programmes, specifically evidenced for the shortage of water in the scenario of climate variability.

The FGD findings show that women in both villages listed health problems associated with poor water quality in their villages, notably water-borne diseases such as dysentery and diarrhoea. These illnesses put a heavy burden on women, who are overwhelmingly the carers in their families. Poor water quality increases women's workloads because water needs to be boiled before drinking and this is especially hard for people who cannot afford bottled water. However, boiling has its own cost: It takes a lot of time and requires lot of firewood, which must also be collected. Thus, DWSS programmes have once again failed to achieve their basic goal of providing clean and safe water to households in the Vinh Phuoc commune. Poor water quality poses health risks and increases women's workloads due to the time spent on collecting water, firewood and water boiling.

Water Quantity

Households in both villages utilise water for drinking, cooking, bathing, washing clothes and other activities including watering plants and animals. The FGD data indicate that the water consumption of Vinh Loi households averages 100 litres/day, while the average water use per household in Vinh Thanh is estimated to be 80 litres/day. Water needs varied depending on household size and priorities. To explain: Differences in geography and water supply services drive differences in water usage among the villages. Some households in Vinh Thanh live along the canal, and sometimes their water supply source is water piped from it. Most of the participants in this area said that they had to pay for water from the communal water supply station. To save money, they use piped canal water for washing and personal hygiene. In Vinh Loi, most households rely on water from hand pumps and a smaller proportion uses water from the canal. Households relying on the hand pumps do not pay for the water use because they are exploiting a natural underground water resource. This explains the differences in the estimated average water use per household in the two villages.

The FGD findings indicate that women in both villages experience water shortages, especially in the dry season and in times when the water from water supply sources is dirty and unsafe (see Figure 2). To obtain sufficient water for domestic use, women often collect water from canals and harvest rainwater. However, such sources are unsafe; such as unhygienic post-harvest practices greatly affect the quality of rainwater (Wilbers, Sebesvari, Rechenburg, & Renaud, 2013). Thus, DWSS programmes have not achieved success on the criterion of water quantity; lack of water continues to burden women with the work of fetching water from alternative sources.

A Synthesis of DWSS Policy Practices and Its Effectiveness

A synthesis of DWSS policy practice and the related challenges women experience in participating in water management activities is provided basing on FGD findings. It reflects the state of implementation of DWSS policies with respect to women and water in the Vinh Phuoc community (Table 1).

Table 1. A Synthesis of DWSS Policy Practices and Challenges of Women's Participation in Water Management in Vinh Phuoc Commune

Criteria	DWSS Programme Implementation	Challenges of Women's Participation in Water Management Activities	Assessments of DWSS Programme Practices
Reliability	DWSS programmes have delivered water supply services funded by the UNICEF and RCRD: • Piped water supply in Vinh Thanh • Hand pumps in Vinh Loi	Women in both villages are facing seasonal unreliability of water supply sources: • In Vinh Thanh, the quality of water from the water supply station is poor for drinking. • In Vinh Loi, hand pumps produce less and poorer-quality water, especially in the dry seasons. • Households in both villages suffered from dirty water sources in the early flooding season. The findings show that women are highly affected by unreliable water sources because they are responsible for water collection, use and management in the home.	The criterion of reliability has not been achieved in practice.
Cost and affordability	The cost of water is applied under decision 23/2015/QD-UBND of the Provincial People's Committee.	Payment for water differs in the two villages: • In Vinh Thanh, women's ability to pay for piped water use is limited. Some households get water from canals for domestic use. • In Vinh Loi, no monthly contributions are necessary because women use the natural underground water from hand pumps (charges only need for hand pump construction). The findings indicate that due to the high cost of water usage, households in Vinh Phuoc cannot afford access to piped water and to build hand pumps. This forces women to return to use traditional water sources (canals and rainwater).	The cost and affordability have not been achieved in providing delivery services.
Accessibility	Households in the communities find it easy to get access to water sources, such as water taps installed in the home (Vinh Thanh) and hand pumps located near the house (Vinh Loi).	Women in both villages experience different challenges of access to water, such as: • In Vinh Thanh, the water supply station represents a source of instability in the water supply to households. • In Vinh Loi, women have to collect water from canals during the dry seasons as the water from hand pumps falls. The findings show that such challenges burden women with the responsibility to seek alternative sources (canals and rainwater) to meet their domestic water needs.	DWSS programmes have partly achieved to reach their basic goal of providing water accessibility to households in the Vinh Phuoc community.

(Table 1 Continued)

(Table 1 Continued)

Criteria	DWSS Programme Implementation	Challenges of Women's Participation in Water Management Activities	Assessments of DWSS Programme Practices
Quality	Water quality assessment processes differ in the two villages: • In Vinh Thanh, a team of water quality assessment established and water quality is annually monitored. • In Vinh Loi, RCRD only funded the construction of hand pumps for some households and no water quality assessments is made.	Women in the two selected villages listed health problems associated with poor water quality, considerably water-borne diseases such as dysentery and diarrhoea: • In Vinh Thanh, the water from the water supply station is sometimes turbid and even contains alum. The water must be boiled and households have to buy the bottled water for drinking (except from poor households). • In Vinh Loi, the water from hand pumps contains lots of alum, especially when it gets low. Also, the initial quality of the water is muddy, thus women have to pump out the first 10–20 litres before collecting water. The findings show that poor water quality increases women's workloads as the time spent on boiling water for drinking and the incidence of water-borne diseases as women carry the main responsibility of water collection and use in their families.	DWSS programmes have once again not been achieved in providing clean and safe water to households in the Vinh Phuoc community.
Quantity	The average water use per household in the two villages is different. Households in Vinh Thanh mainly use water from the water supply station, while in Vinh Loi households mainly depend on water from hand pumps.	The average water use per household differs in the two villages: • The average water use per household in Vinh Thanh is estimated 80 litres/day. • The water consumption of Vinh Loi's households averages 100 litres/day. However, women in both villages greatly experience lack of water, especially in the dry season and in times when the water from water supply sources is dirty and unfit for consumption. The FGD data indicates that water shortage, especially in the dry season, puts additional burden on women with responsibility to fetch water from alternative sources.	The criterion of water quantity in DWSS programmes has not been achieved in practice.

Source: The authors.

Generally, DWSS programmes in Vinh Phuoc commune have been unsuccessful. The findings indicate that the major criteria, including reliability, cost and affordability, accessibility, and water quality and quantity have not been achieved in the implementation of DWSS programmes in Vinh Phuoc commune. The water supply station and hand pumps represent new water supply sources, but the water needs of Vinh Phuoc households are not met due to the seasonal unreliability of these water sources, restricted financial capacity to access piped water, poor water quality and water shortage. Such challenges greatly influence women's lives and participation in water management activities, especially through incidence of water-borne diseases and increased water-related workloads.

Factors that Influence Women's Participation in Water Management

Traditional Norms and Practices

The results show that traditional norms and practice in the Vietnamese society and particularly in the Vinh Phuoc community constitute a major barrier for women to be involved in the public sphere and specifically in water management. In this respect, socially constructed roles and male-dominated society are identified as the major traditional norms and practices that impede women's opportunities to participate in the arena of water management.

Socially constructed roles are the major obstacle affecting women's involvement in water management in Vietnam. Traditional roles refer to how men, women and children traditionally divided the daily work of life (Svahn, 2011). Through many generations, these roles have become norms in Vietnamese society. Because traditional roles have been norms for women over centuries, and even women think that this is the way things should be organised. Most FGD participants agreed with the following statement by one woman:

> Labour division between women and men in the family is reasonable; for instance, men must go out to work, women have to fulfil household chores. Thus, water collection and allocation are women's tasks in the home, and it is fair and it is difficult to change this now.

It has been argued that traditionally constructed roles establish social behaviour within the culture of water management (Minoia, 2007) that influences its level of success. To illustrate this, practices among international institutions and donors sometimes disregard the traditional norms within a cultural context (Svahn, 2011). Therefore, complex cultural barriers are seen as the result of social behaviours and traditional roles that restrict women's involvement and these are often ignored when developing the practices of water management. From this perspective, traditional norms and practices may reinforce the complex gender roles that restrict women's participation in the community as well as improvements of their situation as a whole.

Another significant barrier influencing women's involvement in water management is the dominant position of men in Vietnamese society. FGD participants stated that women's exclusion from water management is commonly due to their husbands' lack of support for their wives' engagement in such activities. Specifically, some of the women in the FGDs agreed that:

> Men have the voice in the family, and they do not like women who often go out of the house and take part in social activities because that is not their role.

This indicates that women in these rural communities find it difficult to gain support from male family members. However, the FGD participants also stated that while women are often excluded from activities related to water management at the community level, they also restrict their own involvement; one said:

> It is not only men hindering women to involve in such activities and positions, women hinder themselves because they think that it is the role of men.

Women often experience limited and different opportunities and are excluded from decision-making processes, thus their viewpoints on various issues are different from men (Stamp, 1989). This can result in conflicts between men and women with regard to resource management and development processes. These conflicts may increase disparities between men and women and threaten the power balance in gender relations (Stamp, 1989). Women can even face domestic violence related to water consumption, as one participant implied:

> Women are often blamed and shouted at as their husbands find that there is not enough water for bathing when they get home after work.

Therefore, men in this case find that women have failed to fulfil their household tasks that at times may lead to conflicts in the family, and sometimes even violence. This indicates that women's exclusion from decision-making processes at both household and community levels are mainly rooted in social and cultural barriers, in which the gender roles have been conditioned over decades, and where the male is superior to the female. Power imbalances between men and women in the household and community participation activities, especially in water management, are clearly discussed in the next section.

Power Imbalances

It has been argued that once power imbalances in the household and the public spheres are altered, approaches designed to increase female participation will become more effective (Ivens, 2008). Power imbalances exist in terms of the ownership of assets and resources in families and communities. As already mentioned, male-dominated hierarchical structures remain common in Vietnamese society, rooted in traditional norms and practices. Due to the male-dominated nature of society, women in many parts of the country lack the power to make

decisions unless their husband or father gives the permission. As one FGD participant stated:

> Traditionally, the head of the house is the men, thus women must obtain the consent of men to make decisions about any activities, especially financial investment plans or business matters.

The FGD findings also show that lack of decision-making power prevents women from participating in water management. Although women are the main managers of water in the households, they are still afraid of speaking about water-related activities in the presence of men due to the restrictive culture. Participants expressed this in statements such as:

> When men have said something, women must be silent because they do not want to cause the conflicts in the family.

Men in these communities own all the resources because they are the decision-makers and the head of the family. Women are not expected to oppose or argue with men and are not allowed to speak in public due to the culture. Therefore, women find it difficult to adopt leadership roles and positions in the arena of water management at both household and community level.

Male dominance within Vietnamese society not only prevents women's involvement and empowerment in community activities, but has other pernicious effects. A case study in the Vinh Phuoc commune indicates that women's participation was greatly opposed since the men were reluctant to relinquish leadership positions, especially in the water-related project management committee. Men in Vinh Phuoc are involved in the processes of designing, planning and decision-making in water projects to a much greater extent than women. As one of the Vinh Thanh FGD participants stated:

> The water supply station was constructed with the involvement of the males in the community and male local officials. The importance of female participation in decision-making was disregarded and that raised some major concerns for the communities.

The male dominance within Vietnamese society strongly hinders women's engagement in the public sphere. Women will not have opportunities to participate in water management without the creation of an enabling environment.

Time Allocation

The FGD findings show that time allocation is also a key barrier to women's participation in water management in the Vinh Phuoc community. This finding corresponds with the literature, which notes that due to the double workload, such as household tasks and childcare, women are often restricted to take part in water management and water-related project activities (UN-Habitat, 2006, cited by Svahn, 2011). The UNDP (1995) estimated that women spent 9.7 hours and men 0.9 hours per day on fuel (mainly wood) and water collection. Girls devote more

than 7 times as many hours per day as adult males to such activities and 3.5 times as much as boys.

A case study in the Vinh Phuoc community found that women spent 8–10 hours per day on productive domestic activities, including water collection and family care tasks, while men spent much less time than women in these activities. As previously explained, this time has large opportunity costs. Women have little opportunity to engage in other productive activities, such as community development, education and income-generating activities that could improve their situation. Participants from both villages agreed with one woman's statement that:

> Women have to take on domestic tasks, including the care of the home, of children, of families; thus they do not have much time to be involved in other activities beyond their own households.

Due to their domestic workload, women are often unwilling to participate in water management activities. Nevertheless, the women involved in the FGDs were happy to attend the public meetings in general and meetings on water-related issues in particular. One said:

> When women are invited to take part in local meetings, we are ready to join in because we can sit together and share and learn from other women's experiences of daily living problems and gain new information.

However, when the discussion turned to women's participation in decision-making positions and water management teams, women in the two communities studied did not want to be part of it. The main reason is that women believe that undertaking community activities will add to their burden since their responsibilities for household tasks are not reduced. Ways must be found to increase women's free time and their ability to take part in water management meetings and activities at local levels.

A Synthesis of Women's Participation in the DWSSs

Neither of the villages studied maintain specific water committees nor water-user committees that have the potential to take responsibility for water supply planning, operation and maintenance. Generally, local government constructs, monitors and manages the performance and progress of water supply programmes. This contrasts with local officials' statements that selected local staff would be in charge of operating and maintaining the water supply system including monitoring, assessment and repair of water treatment facilities. Issues of women's empowerment may be discussed in the local meetings, but the principal actors intend to maintain the status quo. Hence, women are only seen as the beneficiaries and their views are not taken into account in the processes of operation and maintenance of the DWSSs in Vinh Phuoc.

Another factor determining women's lack of involvement in the operation and maintenance of the DWSSs is traditional norms. Vinh Thanh's women believe that the idea of them engaging in the operation and maintenance of water supply

station is unconventional, thus they find it hard to adopt. The main reasons they gave were, first, that men are considered to have primary responsibility for the maintenance of water sources and, second, women trying to participate in these matters are likely to face negative attitudes because they are not expected to work outside the domestic sphere. The FGD data shows that these women do not care about water supply activities as long as the water needs of their households are met. Hence, some women living in the Vinh Thanh had no role in the maintenance of the water supply station.

As previously noted, women in these communities had no opportunities to influence decisions concerning the construction of the water supply station. The main reason is that the local government holds the power to decide where water supply systems should be installed and who is selected for the management of this system.

Furthermore, women from these villages do not recognise the potential contribution they could make in leadership roles, partly due to cultural dimensions. As previously outlined, social norms strongly influence women's perspectives on such participation. One FGD participant in a statement supported by many others said:

> Management of domestic water supply is female's business, such as water distribution, water fetching and payment for water costs, but we do not think that we expect to be part of the water managing team at the local level because these activities and positions are proper for men rather than ours.

Previous authors have argued that women naturally want to engage in water management activities, but in the Vinh Phuoc's case study, cultural barriers prevent them from doing so.

Traditional norms and lack of confidence have been identified as the factors that prevent women's participation in water resources management in Vinh Phuoc. Women are not expected to participate in the management of programmes and are not encouraged to work outside of the home in such activities. The local government made no attempt to involve women in water management programmes. The corollary, and conclusion, is that efforts of policymakers to encourage women's participation in the DWSS programmes and policies have been ineffective.

Conclusion

Policies on domestic water supply in the Vinh Phuoc commune and in the An Giang province, in general, aim to provide water supply services, such as piped water systems and hand pumps, to rural households. However, the policies view women as mere 'passive recipients' of the output of these water-related programmes. Almost all women involved in the study are not encouraged to

engage in the process of planning, implementation, maintenance and decision-making within the water sector. Households and women were merely seen as the end beneficiaries of the DWSS programmes being implemented in the community.

NTP policy guidelines state that women are encouraged to participate in water management activities ensuring that their needs and interests are met at national and local levels. However, the research found that women's needs in the actual implementation of DWSS programmes, particularly in Vinh Phuoc, have been generally known. In fact, assessments of the water needs of local users are not included in the local government policy. Moreover, water needs were identified by the outsiders, which may differ from and be irrelevant to the actual needs of the local communities. For example, the quality of the drinking water has been universally identified as a crucial aim from the local government's perspectives. However, it tends to ignore the fact that other daily domestic water uses such as cooking and personal hygiene are also women's concerns. In addition, the water from water sources supply for households is perceived as the safe and hygienic drinking water under the policy framework, but this notion is divorced from the local belief about drinking water with good quality. In the case studies, women in both villages employed more than one water source, such as water from canals or rainwater, to ensure that their households' water needs were met rather than they only utilise a single source (the water supply station in Vinh Thanh and hand pumps in Vinh Loi). If the water supply station and hand pumps could fulfil the water needs of rural women in the communities, the work of women related to water fetching would be greatly reduced. Therefore, water needs and interests must be understood in relation to the social and cultural context of the community.

The participation of women in decision-making in the water service sector in particular and in community management mechanisms, in general, is supported by the agencies at the national and local levels. However, the results of the research show that there is no scope for consideration of the gender aspects in the water service sector at the local level. The FGD findings indicate that women in the communities were not given positions to participate in the activities of management, operation and maintenance, especially at the water supply station. Therefore, although women are globally recognised as the primary water managers in water-related activities, women's participation as well as their roles and responsibilities are still disregarded in the perspectives of policymakers and Vietnamese society as a whole.

In rural Vietnamese society, men are regarded to be able to fix technical water-related problems and women are socially and culturally regarded as the main collectors and managers of water in the households. Social principles do not allow women to assume responsibility for equipment maintenance in the water sector. The existing DWSS policy has failed in its intent to include women in this aspect of water management.

Women in the communities lack decision-making power in both the household and the public sphere, especially in activities of operation and maintenance of the Vinh Thanh's water supply station. The FGD data show that women are recognised

as the main managers of water at both household and community levels, whereas the site location and mode of operation of the water supply station was decided by the local government, which is male dominated. Setting up the water supply source, seen as a part of the planning, is a significant issue because it has to consider the factors that influence the process of achieving the final outcomes, especially the basic concern of making decisions on proper technology options. Thus, Vinh Phuoc's women hold little power over the process of planning, implementation, operation and maintenance of the water sources; this is due to the local governance structures where males dominate, but also factors including social and cultural barriers that prevent them from being involved in this arena. These factors adversely impact women's participation throughout the public sphere. It can be said that DWSS programmes, particularly in An Giang province, did not work because power imbalances and socio-cultural factors were not taken into account and addressed.

The modern water sources—the water supply station and hand pump—have failed to fully replace traditional sources such as rainwater harvesting and water from canals in the Vinh Phuoc community. Such sources provide water which may be used for the activities, such as cooking, washing and bathing, other than drinking. Hence, the DWSS programmes recently implemented in Vinh Phuoc have failed to reach their basic goal of providing safe and clean water for all domestic uses. This is particularly true based on the following criteria: reliability, cost of water, accessibility, water quality and quantity. In reality, the introduction of a 'modern' water source, namely hand pumps in Vinh Loi, still meant that women have to spend considerable time and energy fetching water from canals for household use. Similarly, the study indicated that the water supply station constructed in Vinh Thanh did not reduce the burden of local women because they continued to use alternative sources to meet water needs in times when the quality of piped water was not good and when the electricity supply failed. Therefore, Vietnamese DWSS policies or programmes have been ineffective in encouraging women's participation in decision-making because the specific needs of women are not addressed in local communities.

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Participatory Communication Approach for RD: Evidence from Two Grassroots CR Stations in Rural India

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Abstract

The traditional approach of communication for rural development (RD) was greatly influenced by the dominant paradigm of development. The retort against this paradigm gave birth to the participatory approach of communication wherein the common people in rural areas were considered as the 'subjects' of development in conjunction with their active involvement. It is the era when alternative communication medium like community radio (CR) was accepted as a tool of participatory RD in developing counters like India. Based on case studies of India's pioneer CRs (Sangam Radio and Radio Bundelkhand), using media ethnography tools, a qualitative enquiry was carried out to explore its role in the process of RD by inclusion of voices of rural subalterns in their own development.

Keywords

Participatory communication, community-radio, media ethnography, rural development, India

Introduction and Rationale

The discourse on rural development (RD) in fact reflects upon the international agenda for the development of developing nation's right from the 1950s when Community Development Programmes (CDP) were prescribed for and launched in many of these countries like India. The role of communication perspective had been perceived as one of the key elements of RD. RD with special reference to communication perspective is defined as the practice of methodically applying the processes, strategies and philosophy of communication to bring about affirmative change in rural society (Patil, 2010). The history of communication

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for development associated with the so-called 'dominant paradigm' evolved during the post-Second World War when new sovereign countries such as Asian, African and Latin American endeavoured to grow to be an advanced, self-sufficient and mechanised nations. Initially, the forefathers of communication (Daniel Lerner and Wilbur Schramm) connected the axiom 'development' primarily as a top-down approach linking with few emerging popular material aspects, for instance: modernisation, fiscal growth, technological dissemination furthering to federal planning and policymaking, extensive mechanisation, along with the amplification of fundamental public communication infrastructure. The very objective of mass communication channels was to encourage desired change in the mindsets, values and manners of masses.

The post-independent political era of Nehru and the Western dogma among the planners in India passionately applied this so-called approach of implementing communication media channels as means for advocacy and influence, targeted especially India's largest section of rural poor to transform their attitudes and bring out desired societal change. Communication strategies and campaigns focusing primarily on health communication (family planning) and agriculture communication (green revolution) were the pioneering efforts in India's development communication history. For instance: (a) UNESCO sponsored 'radio farm forums' implemented in the villages of Pune district of Maharashtra in the mid–1950's with an objective of inculcating advanced agricultural practices among the peasants, (b) the USA (NASA) supported gigantic communication project 'Satellite Instructional Television Experiment (SITE)' in the mid–1970s in six backward states. These two were truly noteworthy initiatives of this perspective. However, the post 1970s demonstrated disillusionment within the popular hypothesis of the classical dominant theory of development that relied heavily on modernisation and economic growth which did not correlate to the structural social realities and cultural ecology of the underdeveloped and developing countries including India. Appraisal reports of communication programmes designed to cater the needs of rural audience showed extremely scanty evidences of the effects of 'dominant' theory since the rural sociocultural fabric let down these efforts absolutely. The elitist Western centric planning bureaucracy and the historic sociocultural hurdles were two fundamental reasons that made the application of mass media for RD unproductive. In India, there were critical political crises like emergency that gave birth to various social movements during the same period. Since the 1980s, movements lead by NGO's and social activists around issues such as environment, gender equity and human rights of indigenous and peasants opened up severe critique on the dominant paradigm that eventually paved way for the emergence of participatory, the democratic and alternative communication approach of development. These new approaches emphasised the need to establish decentralised media systems with a more 'receiver centric' and participatory. Community-based independent media, such as community radio (CR), participatory video and popular theatre are currently professed by media activists and NGO's as a means of enabling rural people to manage their own development needs (see, Agarwal, 2006; Patil, 2015; Patil & Ambekar, 2006; Pavarala, 2016). The central focus of such participatory communication initiatives is to provide fundamental right to the voice of the marginalised communities like

rural subalterns who have excluded from the mainstream development discourse and development, so far. This process has further created voice poverty among the voiceless rural masses. Voice poverty has been considered as a serious human development concern in an agrarian country like India and a key hurdle in the process of sustainable RD. In this study, we are primarily concerned with the 'voice poverty'—the inability of citizens to influence the decisions that affect their lives and eventually right to development. 'Voice' can be defined in relation to development as inclusion and participation in social, political and economic processes. So defined, strategies to reduce voice poverty require a bottom-up communication approach which can give underserved communities an opportunity to influence their own social vectors using communication channels (Tacchi, Watkins, & Keerthirathne, 2009). In such a context, after a decade, long movement by media activists and NGO's in 2006, the Ministry of Information and Broadcasting (MIB) approved participatory CR policy in India. After its approval, as of now nearly 180 CRs have been functioning, of which about a third are serving in the rural backward regions of India. For this present study, the case studies of two pioneering CRs located in the most backward regions of rural India were purposively selected:

1. Deccan Development Society (henceforth DDS) run Sangam Radio (SR), a CR in Medak district of Andhra Pradesh and
2. Development Alternatives (henceforth DA) run Radio Bundelkhand (RB) in Orchha district of Madhya Pradesh, India.

Thus, against this backdrop, this article attempts to explore the following research questions:

1. Whether CR in India gives voice and space to the voiceless marginalised sections to participate in their own development affairs?
2. If yes, what sort of positive developmental changes emerged out of the actions of the voiceless marginalised sections in the rural setting?

Methodological Framework

Method

Researching on alternative media like CR is not merely a head count; it goes beyond and explores micro realities at the grass roots level (Kidd, 1999). Studies of alternative media tend to employ qualitative approaches. Therefore, for the present study, case study method was used.

Tools of Data Generation

The media ethnography tool is used which is more appropriate for this kind of study that mainly includes observation, in-depth interviews, background studies, focus group discussions (FGDs) and document analysis with an ethnographic fascination in the research context.

Data Collection

Considering the vitality of this study, 27 in-depth interviews were conducted at both SR and RB. These interviews were conducted taking into consideration the preferential categories of participants such as CR reporters and CR managers of both CRs. Likewise, five FGDs were also conducted including the listener's participants during April–May 2011 and November–December 2012.

Results and Discussions

This section provides analysis based on the two critical research questions raised in the earlier section. The upcoming segment attempts to explore the answers of the first research question briefly, followed by the concluding question duly.

Inclusion of Local Voices

The representation of community in the CR (mainly reporters–managers) is one of the important indicators of the inclusion of the voiceless people. This implies providing representation to those groups (gender, ethnicity, age and minority religion) not usually represented in the mainstream media as well as providing the audience with access and an opportunity to voice their own wants and needs.

In this context, the Station Manager of RB Anuja Shukla explained the station's philosophy regarding the representativeness of local community:

> The station deems that the community radio must be staffed by the community. Natural talent, aptitude, mastery of local languages, knowledge of community and the willingness to work for its development are criteria for selecting volunteers and reporters. Radio Bundelkhand is aware of its community function as a CR. The stations programming aims at reflecting the interests, believes and traditions of its listeners. The station makes an effort to be representative of its community. RB staff covers a strong representativeness and voice of age as well as gender, religion, social groups and region origin.

Table 1. Inclusion of the Representatives of the Voiceless Rural Masses in the CRs

Sr. No.	Variables	Radio Sangam	Radio Bundelkhand
1	Age	Middle and senior age	Young, middle age
2	Gender	Female concentration	Both male and female
3	Religion/caste/class	Downtrodden backward caste (Dalit), Buddhist: lacks minority and tribal representation	Lower middle caste, Hindu: lacks minority and tribal representation
4	Class	Lower below poverty line (BPL)	Lower below poverty line (BPL)
5	Region/community	Same region, community	Same region, community

Source: Patil (2014, p. 10).

If we see the variables selected in Table 1, it clearly demonstrates how a grassroots alternative media provides equity and inclusiveness in representation of the subaltern groups who have historically been excluded from both media and other social institutions in Indian society. It is interesting to note that none of them have any kind of journalistic education or experience. This shows the strength of alternative journalism where 'ordinary people' can also participate in production and distribution process of media content. Voice is the ability of people to be heard and to influence decisions affecting them. It is not only the voice of the majority that needs to be heard but also the poor and the marginalised. The qualitative observations during the field work at both the CRs confirm that many of the CR listeners are women from the lower socio-economic status with erratic earnings or landless or seasonal labourers and people such as SC's/ST's and OBC's who have traditionally and historically excluded with diminutive voice in their communities. Plurality and diversity gives better power to democracy than law of the utmost amount. As Steve Buckley (2006, p. 18) says,

> The growth of community radio is a story of people and communities striving to speak out and to be heard. Community radio has provided a means of empowerment and of self-reliance. It has enabled people to engage in dialogue about their conditions and their livelihoods.… It is a story in which the pursuit of social and development goals has been deeply entwined with the struggle for human and political rights and particularly the right to freedom of expression.

The socio-economic characteristics of the listeners and the representation of local community members as radio staff and volunteers in both CRs confirm that community voices are well represented through the participation of community volunteers and reporters which is one of the prerequisites of participatory development communication.

Participatory Content Creation

Participatory content creation can be shown to provide a mechanism to express oneself and participate in social and public spheres. But real life is messy, and a one-size-fits-all approach is unlikely to succeed; context is all important. Especially in a country like India, where a range of factors—including gender, land ownership, religion and caste—significantly affect the rural subaltern voices for inclusion in the content creation. It is a kind of developmental process through which the voiceless people find socially acceptable space and access in the content-creation process for their personal development.

> Content created after extensive discussions, conversations and decision-making with the target community; and where community group members take on content creation responsibilities according to their capacities and interests. (Tacchi et al., 2009, p. 1)

During the fieldwork, participatory content-creation activities were monitored throughout in both CRs that allowed a range of people—including marginalised individuals and communities—to have a voice within local public spheres.

Furthermore, the field observations also indicates that in a patriarchal and traditionally caste-based dominant society, the participation of women is increasing; it is quite positive indication, however, the participation of other subaltern groups, that is, SC, ST and OBC's too is significantly improving in the content creation of various programmes of CRs. SR has discarded the traditional top-down development approach. Instead, the participatory approach has been adopted, where the community makes the decisions about what is important to their lives and accordingly they prepare and construct their programme content. At SR, the 16 *sangham* (association of rural folk) supervisors, 6 men and 10 women, are assigned the task of producing radio programmes of one hour each every month. SR is working keenly towards actualising that every woman in their village has a chance to participate in the radio programme at least once a year. On the other hand, regarding the initiatives for participatory content creation, RB has been working in the following way:

> Before the radio shows are scripted and recorded, the RB teams meet with a group of 30–50 men and women who attend a one-two day-long working session to suggest specific content and themes to be addressed, working from the RB's themes related to good governance, water, education, agriculture and so on. The presence of important community members at the initial stakeholders meeting ensures that the members of local society are apprised of the content of the radio programmes and have the opportunity to make suggestions. The stakeholders are the first set of voices to begin shaping the content for the radio programme and the act of seeking input at the earliest possible stage establishes the element of the programmes I identify as contributing most to their success—their porous and inclusive design. (Anuja Shukla, Station Manager, RB)

Likewise, explaining the importance of participatory content creation, Buddamma, a semi-literate agricultural woman, critically remarks the following facts:

> When we share our views with our people then only we know our local issues such as government subsidies for income generating programme and local livelihoods issues, for example goat raring or buffalo marketing. We will tell about where we bought the goats. How did we take care of them? What were our problems? How did we solve them? And how did we make profit out of it. The commercial media never participate with us and do not care for our voices. As we share these experiences, we also get suggestions from our community members. I am very happy that our radio can do this efficiently and provide equal freedom in our radio. (Says Buddamma, SR)

Thus, the above notions indicate that in the context of globalisation and revival of grassroots movements, conventional development strategies are giving way to more participatory and inclusive approaches that are recognising the involvement of those who have suffered systematic inequalities and deprivations as 'equal partners' in developmental process. This paradigmatic shift from dominant-hegemonic to alternative-proletariat counter approach offers prospects of giving everyone, who has a stake, a voice and a chance.

Alternative Actions for Rural Development: Evidences from SR–RB

Broadcast media can serve as an imperative agent of social development when sufficient consideration is paid to both message production and reception factors. Media programmes that are based on audience needs evaluation, participatory content creations are particularly likely to be successful. In this context, CR has been emerging as one of the 'most appealing tools' for participatory communication and development. Participatory communication (PC) approach to development involves a collective action of individuals who are closest to the social problems to develop solutions that address social issues (Patil, 2014). Before going to explore the tangible developmental actions by adopting PC approach by both the CRs at the village level, let us first have a synoptic outlook of how these two CRs operationalised the PC towards policy issues in RD and their mode of collective actions. The PC approach to RD at both the CRs has shown three-fold features: (a) effective mapping diffusion of local problems and issues (b) Monitoring and coordination with rural administrators towards local developmental goals (c) Identification of local developmental challenges and working on alternatives (see Table 2).

Table 2. CR: Policy Issues in Rural Development and Mode of Participatory Actions by SR–RB

Sr. No.	Policy Issues in Rural Development	Mode of Participatory Actions by SR and RB
1	Effective mapping—diffusion of local problems and issues	**SR** has strong SHG members and participatory methods for feedback. Highly dedicated cadre of volunteers to collect micro data and an ability to disseminate the same while maintaining local sociocultural features. **RB** uses narrowcasting method to collect and disseminate local needs/problems even in the remote villages, recordings of listener's feedback and comment box in every village through effective localised appropriate and truly participatory methods.
2	Monitoring and coordination with rural administrators towards local developmental goals	**SR** evolved a participatory monitoring and coordination mechanism through primary contacts and action groups that concurrently works with rural administrators through weakly meetings and invited talk show and discussion forums. **RB** synchronised feedback mechanism with government officials, follow-up news, involvement in programme production as guest editor and online interface programmes on selected issues.

(Table 2 Continued)

(Table 2 Continued)

Sr. No.	Policy Issues in Rural Development	Mode of Participatory Actions by SR and RB
3	Identification of local developmental challenges and working on alternatives	**SR** has a traditional concept of *sangham* group meetings through which they identify local development challenges and prepare a very clear plan for the proposed action at local level in a participatory way. Furthermore, SR also provides support and appropriate publicity as the action is being implemented like in the case of awareness about indigenous seeds of cotton and the ill effects of 'BT cotton'. **RB** has quite modernised and multipronged strategies such as organising special episodes on identification of local problems, use of mobile calling and SMS, and preparing case studies on special problems such as water scarcity, out migration and climate change. Likewise, RB also keeps their CR listeners informed about the actions on specific problems and its concurrent progress and also collects their reactions on specific problems and most importantly reporting the impact of the action on rural masses and the administrators.

Source: Patil (2015).

The taxonomy of PC approach narrated in Table 2 demonstrates the essence of CR even though in a relatively limited rural setting. Further section explores some of the concrete developmental evidences at grassroots level occurred in the jurisdictions of both the CRs.

Stories of Developmental Actions: Sangam Radio

Agricultural sustainability is an important feature of RD adopted by SR. For few years, farmers of this region were facing severe problem regarding the use of BT cottonseeds and genetically modified crop. To create awareness, reporters made extensive reporting and grass roots level research to record the dismal experiences and opinions of farmers and made an excellent programme, *Why are Warangal Farmers Angry with BT Cotton?* which has generated a favourable environment among the farmers to go with alternative measures such as organic seeds and practices that further create a sense of belongingness irrespective of CR listeners or non-listeners, or agriculturalist or non-agriculturalist. Since majority of the people are illiterate and poor, they are not able to learn these issues through written material, but the programmes made by SR in their own language with supporting local level evidences and experts creates mammoth impact.

An illiterate farmer says,

> We cannot follow written material, but we can listen to the programmes and learn more about things that affect our lives.

SR's efforts endurably help the poor people for making sustainable agriculture. A preliminary content analysis reveals that near about 99 per cent of the programmes have been made by local people on local concerns importantly in which more than 80 per cent of the participants are women and Dalits (in the traditional Indian caste system, a member of the lowest caste). Substantial contributions come from the elderly who are seen by the station as repositories of very valuable knowledge otherwise are exclusively treated as most uncreative and neglected by mainstream media.

Narsamma (Manager, SR) says, not without some pride:

> We have programmes on agriculture, gender, children not attending school, bonded labour, health, tips in cropping, weeding, organic manure and other subjects. We interview people with traditional knowledge and skills, record discussions on current issues and have over 300 hours of recordings.

For the first time, it seems that many of these community members feel an ownership of the radio and its content and also an understanding of the power of expression and access to the public sphere to create social change and action. SR has created various tangible changes among the rural communities, for example, it has provided right to voice to the common people through which they are now able to ask questions to even the public servants much more efficiently than the earlier.

> Now we discuss matters in our *sanghams*, make radio programmes and even talk to any superior public official, including the *patwari* [village accountant] to whom earlier we even can't speak. (Member, *sangham*)
>
> When we go to conduct interviews with government officials, because they see recorders in our hands, they take us a bit seriously. You can see that they have 'prepared' themselves for this interaction as they have all their relevant documents and files in place to show you. That is the first step towards transparency and accountability for us. (General Manager, SR)

Furthermore, it has the potential to be extremely powerful—symbolically and in everyday practice. It allows for everyday issues of ordinary people to be voiced in ways that is extraordinary in the opportunity it provides.

General Narsima, who was one of the pioneers of SR since 1997, says,

> After working in this field for more than 10 years, I've really come to appreciate a kind of magic ability to empower and mobilise that comes from sharing the ability to have your voice heard in the media with communities that for too long might have been excluded from decision-making in their societies. It seems so simple, but I've seen over and over again, in so many contexts, that this is the key to positive social change in many rural communities.

SR's Initiatives on Climate Change

P. V. Satheesh, Director, DDS, Hyderabad, says,

> In order to create a Community Charter on Climate Crisis, SR was used for a series of participatory exercises to consult local communities. The consultation revealed living and dynamic capacities of the local communities to combat the climate crisis through their traditional farming, fishing, pastoral and other such life affirming practices and their resounding confidence in their ability to find solutions to the climate crisis. If this awareness does not follow this route and depends upon those very scientists and scientific institutions which through their agricultural and energy policies brought about the climate crisis in the first place, it would be a travesty of justice and an incompetent use of the media.

Rural Women: Inclusion of Most Excluded Voices

One of the most excluded groups in rural communication structure is women. However, it has been observed that through the various initiatives of both the CRs, the traditional power structure of information is liberating and the marginalised sections mainly rural women are getting a new space. SR is the only CR in India owned, run and managed completely by women and Dalits.

So far although the above cases are merely an indicative but offers absolutely tangible message to the development community towards the essence of PC approach. The impending section will also focus on the stories of participatory developmental actions taken up at RB with quite different contexts and alternatives.

Stories of Developmental Actions: Radio Bundelkhand

At the very first instance during the FGD at RB, we have received encouraging feedbacks from the direct listeners. Some of which are mentioned as follows:

> We expect CR should be different than the AIR (All India Radio) or private FM radio channels, because they never come to us and ask about our needs and problems. It is the RB where we have hopes and really observed that it reflects our day-to-day common needs and problems. It is only possible with frequent community interaction and involvement. (Puspesh, a college student, RB)

> When we hear on the radio that the problems of neighbouring villages have been solved, we will also put together an effort to take actions to do something about our own situation. (Keshv Panth, RB)

> [Radio Bundelkhand] is a medium to express and make known my concerns and views … freely; there is also a feedback (phone-in programme, drop-box in villages and letters) that opens a space people who had not have the chance to be participants in this medium. (Local tourist guide, RB)

The real strength of RB is their truly participatory way of programme production and selection based on participatory content-creation process. The channel's popular chunk *Apne Aas-paas* (our surrounding) is an open forum programme. In

this programme, many of local problems highlighted and some of those have been solved. The participatory communication initiatives of RB resulted in the following outcomes:

1. Sitapur village (8 km away from RB station) had piling waste near school premises inviting many diseases on the health of students. Due to collaborative efforts of reporter and village youth, public attention to get rid of this danger was drawn.
2. Community members raised issues of Pratappura water hoarding problem, Jijora village water scarcity problem and Ajadpura's unavailability of wheel in well. This resulted in action by authorities. In fact, National Rural Employment Guarantee Scheme (NREGS) is a big success story of impact of radio in the area; some listeners also purchased radio to get aware of the information. In Maharajpura, workers got back their job cards after learning about (NREGS) through radio programmes.
3. *Khet khalihan* (Farming threshing) is another successful programme. The channel has collected a number of case studies and success stories where the community applied suggestions and solutions, broadcast from radio. Letters of impact of its programmes and folk songs were sent in by listeners, where issue-based folk songs and programmes were composed, inspiring and motivating the community to take action.
4. At the time of village level election campaign of '*Hamara sarpanch kaisa ho*' (How should be our village chief), channel received remarkable reaction from listeners that include not only youth who just turn 18 years old but women in veil were also willing to share their opinion on the ideal face of *Sarpanch* (village chief) via phone calls. To engage women and identify the issues of women in the area, radio started a biography based programmes *stri ... ek kahani meri bhi* (Women: A story of self).
5. Spreading awareness on climate change as part of the *Shubh Kal* (Tomorrow Morning) radio campaign in Bundelkhand is also encouraging which works on the principle that the local and global effects of climate change can, in some measures, be dealt with in rural communities by adopting the means to derive enhanced economic benefits with lower carbon emissions and work to regenerate the environment.

Bundeli Idol: A Way Towards Sustaining Local Culture

The oral traditions are very strong in this region. RB, one of the early CR stations in India, started live musical programme which is meant for preserving the local music and promoting local talent through the participation of local, amateur artists in a show called *Bundeli Idol*, a version of the popular reality television show American/Indian Idol.

Prakash Narayan, one of the community reporters of RB, says it is our natural responsibility to give a voice to the marginalised. The programme (*Bundeli Idol*), he adds, is also aimed at giving opportunities for oppressed/suppressed artistic talent (*Kuchle/dabe hue kalakar*) in the villages.

Kamalnath, a local artisan and upcoming singer from village Orchha, says,

> The programme Bundeli idol gave us tremendous confidence and encouragement to express our unexplored talent, the most important factor is it has given us a different identity as a singer among the community members.

Till date, RB has collected 1,025 songs and around 400 artists from the communities who have performed for the radio and won the prestigious Commonwealth Educational Media Centre Asia Award in 2011. It has enabled the people to broadcast in their own *Bundeli* (a local dialect of Hindi) language, tell their own story and sing their own songs.

Conclusion

This study concludes that there is a paradigm shift in the earlier dominant approach of communication. It has moved from merely using media to inform and aware rural masses to engaging the beneficiaries in the communication process not as receiver but producer of the content itself. A participatory paradigm has been instrumented in successfully reaching out to the marginalised communities and assisting in their development at the village level. The participatory bottom-up approach of community media has proved significant marks, as corroborated by the evidences aforementioned. The PC approach has also justified that there is a need to change the development process upside down. The study also necessitate that an interactive, participatory tool like CR to engage the rural masses which encourages them to participate in their own socio-economic developmental subjects more conveniently where the government system has to function as a facilitators. However, it is finally suggested that while interplaying with state, funding agencies and NGOs, the core values of CRs should not be negotiated.

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An Analysis of Water Policies and Strategies of Bangladesh in the Context of Climate Change

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Abstract

Water sector is crucial to sustainable development. It sustains the natural resources, livelihood of the people and facilitates to operate economic activities of the country. Currently, the water sector of Bangladesh is under severe threats particularly due to impacts of climate change. The Fourth Assessment Report of International Panel on climate change confirms that the water sector will be one of the most vulnerable sectors to climate change. Climate change impacts are being manifested in the form of extreme climatic events and sea-level rise followed by salinity intrusion into the groundwater and rivers. The Government of Bangladesh has formulated policies to address the climate-induced water vulnerabilities. However, the existing policies are heavily leaned towards strategising adaptation options to address short-run climate-induced water vulnerabilities. Implementation of long-term approaches to combating climate change require laying groundwork which include extensive research on determining the future impacts of climate change on water resources. The article aims to assess some of the major policies, including National Water Policy, Bangladesh Climate Change Strategy and Action Plan, National Strategy for Water Sanitation and Hygiene, The National Sustainable Development Strategy, National Adaptation Programme of Action and Bangladesh Delta Plan 2100, through the lens of climate change to determine that up to what extent these policies have addressed the climate-induced water vulnerabilities. The article has recommended to emphasise on conducting a comprehensive research with proper institutional setup on the long-run impacts of climate change on water resources and undertake subsequent water adaptation strategies to address the water-related problems.

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Introduction

Across the world, the crisis of freshwater supply is persistently rising with the increasing population (Dolatyar & Gray, 2000, pp. 60–84). Globally, two-thirds of the population lives under the condition of severe crisis of safe drinking water for at least one month in a year. Bangladesh, with a population of 167.4 million, has made a commendable progress towards providing access to water supply and sanitation in the past two decades. The WHO/UNICEF Joint Monitoring Programme (henceforth JMP) for Water Supply and Sanitation (2014) report confirms that around 85 per cent and 57 per cent of the people have access to safe drinking water and sanitation facilities, respectively. However, ensuring nationwide access to safe, sustainable and affordable water supply, there still remains a significant challenge for the country. Sustainable and clean water supply is crucial for the ecosystem, human and economic developments.

Bangladesh, being highly dependent on groundwater for water supply, will experience multi-facet challenges in proving universal access to safe water supply. Rapid urbanisation, increasing population and unsustainable practice of the usage of water have been attributed to shortages of clean water supply. These challenges are further being compounded owing to pre-existing arsenic contaminants and salinity intrusion, as a result of sea-level rise, in the groundwater. In some local areas, dissolved iron has been detected in the groundwater, however arsenic contamination appeared to be one of the major impediments to ensuring safe drinking water. About 20 million people are currently being exposed to water contaminated with arsenic (JMP, 2014).

Climate change will alter the hydrological cycle hence will disrupt the recharge rate of surface and groundwater aggravating the existing quality and quantity of safe water supply. The impacts of climate change manifested in the form of sea-level rise and extreme climatic events contributed to intrusion of salt water into the groundwater and has posed adverse impacts on the quality and quantity of the supply of freshwater. For example, in 2009, cyclone Aila inundated many sources of drinking water due to storm surge in the south-west part of the country (FAO 2009; Mallick, Rahman, & Vogt, 2011) The Intergovernmental Panel on Climate Change (IPCC) projected that the global warming will contribute to a sea-level rise of between 0.18 and 0.79 m which could intensify coastal flooding and salinity intrusion into aquifers and rivers across the southern part of the country, irrespective of land enclosed and protected by polders. The pattern of rainfall has been projected to be higher and erratic, and the intensity and frequency of drought are predicted to intensify in the northern and western of the country. Floods, tropical cyclones and storm surges are projected to intensify in the coming decades (Solomon et al., 2007). Climate change induced water vulnerabilities will pose threat to humankind and attaining sustainable development goals.

The article aims to assess some of the major national policy documents on water resource management to examine and identify the prescribed strategies and policy approaches which perceive the problems through the lens of climate change. The government of Bangladesh has undertaken several national policies to manage and regulate water-related challenges arising from the impacts of climate change. The article identified five major national policies including National Water Policy, Bangladesh Climate Change Strategy and Action Plan, National Strategy for water Sanitation and Hygiene, The National Sustainable Development Strategy (NSDS) and Bangladesh Delta Plan (BDP) 2100 to assess through the lens of climate change. The article has also attempted to propose a new policy approach to address the climate change-induced water vulnerabilities effectively.

Methodology

Major policy documents on water resource management and development have been reviewed to determine that up to what extent the climate change issues have been integrated and reflected into the policy framework. The article is primarily based on secondary data. Information obtained from documents available and accessible on electronic database and websites of government agencies using few terminologies: 'water policy documents in Bangladesh' and 'climate change and water policy'. About six national water-related policies and several relevant journal articles, both national and international, were downloaded from the electronic database and websites. The article endeavoured to contribute to the existing knowledge through analysing the policies, strategies and action plans through the lens of climate-sensitive water resource management. The policies which have provided strategic directions managing water resources, considering the impacts of climate change, have been considered as a climate-sensitive water-related policies. It is important to mention that water resources has mostly been considered as a cross-cutting issues since it sustains and maintains economic, social and environment sectors. Therefore, policies comprising strategic directions/approaches to safeguarding water supply, particularly for the direct usage including rehabilitation of water structures and providing access to safe drinking water, from extreme climatic anomalies have been highlighted.

Impacts of Climate Change on Water Resources and Associated Challenges

Groundwater is one of the major sources of drinking water since the surface water is already polluted primarily due to anthropogenic waste. The coastal region comprises 19 districts inhabited by above 35 million population, constituting one fifth of the total population. The coastline is about 710 km, which is between 30 km to 195 km away from the shore, and the exposed coast is between 37 km to 57 km. A total of 62 per cent and 86 per cent of the coastal area is 3 m and 5 m above

sea level, respectively, rendering the country susceptible to sea level rise (SLR; Mohal, Khan, & Rahman, 2006).

Combination of natural and anthropogenic hazards, including land erosion, arsenic contaminated aquifers, water pollution and climate change, have posed negative impacts on the livelihood of the coastal population. In the coming years, frequency of floods, cyclones storms and drought are most likely to be severe. During monsoon period, higher rainfall has been projected in the Ganges basin which would contribute to increased frequency and severity of floods stemming from the swollen rivers, and less rainfall during winter which would lead to less water during dry season in rivers, thereby posing negative impacts on industry, fisheries and salinity in the coastal rivers. It has been projected that the water sector will be one of the vulnerable sectors rendering livelihood of the poor people at stake (Hossain, Dearing, Rahman, & Salehin, 2016). Currently, the climate change induced salinity intrusion into groundwater aquifers and surface water is being considered as an existential crisis in the coastal region (Talukder, Rutherford, & Chu, 2015). According to World Bank (2000) projections, the climate change will pose widespread inundation in the low-lying areas contributing to increasing rate of salinity intrusion.

Recent studies suggest an increase in sea level will be inevitable by the end of this century. The Bangladesh National Adaptation Programme of Action (NAPA) projected the mean sea level to rise to 14 cm, 32 cm and 88 cm in the year 2030, 2050 and 2100, respectively (Ahmed, 2006). Nishat and Mukherjee (2013) reported that the rise of sea level could increase to around 50 cm taking into consideration the past and the current trends, and the assumption of the trends for next 100 years by the end of the century. World Bank (Talukder et al., 2015) reported the sea level is projected to rise above 1 meter near Dhaka, Bangladesh, which is around 200 km away from the coast, by the year 2080–2100. However, the projections of the seal level rise ranges from 30 cm to 50 cm for the year 2050 and 105 cm for the year 2100 indicating a potential adverse impact on the social and economic disruptions for the coastal population (Mohal et al., 2006). Institute of Water Modelling (IWM) and Center for Environmental and Geographic Information Services (CEGIS) conducted modelling of SLR which depicted that rise of sea level by 27 cm and 62 cm would trigger an inland salinity intrusion by 10 km or 20 km, respectively. It has further showed that a 62 cm rise in sea level by the year 2080 would increase the areas with brackish water during the dry season by 9 per cent and 6 per cent during monsoon season (Nishat & Mukherjee, 2013). An assessment to determine the salt content in the soils in the coastal region revealed that the areas affected by salinity intrusion had been increased by almost 27 per cent (i.e., from 833000.45 ha to 1056000.26 ha) from the year 1973 to 2009 (SRDI, 2012). Globally, thermal expansion of seawater due to rise of temperature of ocean and melting of ice sheets contributes to SLR. It has been observed that between 2003 and 2009, the melting of ice sheets, caps and glaciers led to 80 per cent increase of the total SLR contributing to more than 1 cm of the global level (UCS, 2013).

Sarwar (2013) conducted a study to determine a spatial variability of sea level through collecting tidal data from 13 stations along the coasts including Rayenda,

Amtali, Hiron Point, Tajumuddin, Char Changa, Companiganj, Outfall Karnafully (Chittagong), Lemsikhali, Saflapur, Khepupara, Sadarghat (Chittagong), Cox's Bazar and Teknaf. The study revealed that mean SLR at Hiron Point was 3.38 mm/year. Although the distance between Khepupara and Amtali SLR is only 17.5 km, the SLR was 14.84 mm/year and 3.16 mm/year, respectively. At Rayenda and Khepupara station, which is only 53 km away from the two stations, the SLR rate was 3.64 mm/year. The central part of the coast exhibits an extreme increasing trend of SLR. At the Char Changa station, SLR was 5.73 mm/year but at Hatiya Island and Tajumuddin stations, it was 19.81 mm/year and 38.82 mm/year, respectively. Companiganj station exhibits SLR at the rate of 2.5 mm/year. At Karnafulli station of the Chittagong coastal zone, the SLR was 6.1 mm/year, whereas the Sadarghat station showed SLR of 11.75 mm/year. The Cox's Bazar coastal zone exhibits a rise of 1.36 mm/year. However, a decrease in the sea level has been observed at the rate of 0.08 mm/year, −5.59 mm/year and −8.33 mm/year at the Lemsikhali station, Saflapur station and Teknaf station, respectively.

There are various factors contributing to increase in the salinity intrusion, particularly in the coastal region of Bangladesh, which includes geographical settings, excessive sedimentation due to river morphology, climate-induced SLR, etc. Climate change has accelerated the process of salinisation. In the south-western coastal district of Bangladesh, around 70 per cent reduction in the production of rice had been recorded between 1985 and 2003. Also, the crop production has been projected to decline following a SLR to 14,000 and 252,000 for the year 2030 and 2075, respectively (Khan et al., 2011). Khan et al. 2011 conducted a study to determine the daily sodium consumption in their dietary intake in Dacope sub-district of Bangladesh. The findings suggested that the consumption of daily sodium in the dry season was 16 g, whereas the recommended daily dietary intake of sodium is 2 g. In the dry season, the average daily consumption of sodium from drinking water ranged from 5.2 g to 16.4 g and 0.6 g to 1.2 g in the wet season. The incidence of hypertension, particularly in pregnant women, has become prevalent in the dry season compared to wet season. During the dry season, the number of cases related to hypertension was 70 of 576 pregnancies, whereas 20 of 393 pregnancies in the wet season. Hypertension during pregnancy pose negative impacts on maternal health which includes intrauterine growth retardation, premature birth and impairs liver function.

Importance of Integrating Climate Change into Water-related Policies/Climate Change and Water Development

Integrating climate change into the policies would facilitate to ensure climate-sensitive water management strategies to minimise any crisis generating from the impending impacts of climate change on water resources. Water resource sector is a very complex and intricately linked with other sectors. Major sectors, including agricultural, industrial and ecosystem will be under severe crisis provided adequate approaches to addressing climate-related water vulnerabilities are not being addressed. Ensuring strategies to address climate-related water vulnerabilities

would help to attain the overall development. It is important to mention that the current water resource management policies have not been adequately addressed the possible challenges arising from the impacts of climate change. The IPCC Technical Paper on Climate Change and Water states that 'water resource issues have not been adequately addressed in climate change analysis and climate policy formulations. Likewise, in most cases, climate change problems have not been dealt with in water resource analysis, management and policy formulation' (Bates, Kundzewicz, Wu, & Palutikof, 2008). This would create difficulty in ensuring effective climate-compatible water development strategies, rendering the livelihood of the people at stake. The article attempted to shed some light in ensuring sustainable water resource management in the wake of changing climatic pattern.

National Policies to Ensuring Water Resource Management Through the Lens of Climate Change

Over the years, the Government of Bangladesh has undertaken several water-related policies to address water-related challenges. This section comprises of the analyses of some of the major policies through the lens of climate change to have an understanding of the extent of which climate change issues have been integrated and highlight the existing gaps of the policies.

National Water Policy

In 1992, National Water Policy has been formulated with the aim of guiding public and private actions to ensure optimal management and development of water resources which would benefit individuals and society as a whole. The policy laid down six broad objectives to ensure sustainable water management and have recognised that the present water crisis is being generated from weak institutional management, regulatory tools and unsustainable practices. Climate change had not been considered as an inhibiting factor to water resource development. It has dedicated several sections to address the environmental vulnerabilities in the water sector which includes 'water and agriculture', 'water for the environment', and 'water and fisheries wildlife'. The impacts of climate change will trigger extreme climatic events, spatial and temporal variation in the temperature and rainfall pattern. These changes will pose negative impacts on natural resources including agricultural, fisheries and the environment as a whole. It is important to mention that the said document has some policies which may support climate actions however, the suggested policies require to address the incremental challenges posed by climatic anomalies through adopting climate compatible strategies. For example, under the section 'planning and management of water resources', responsibilities to manage the water resources had been discharged to several relevant government agencies to materialise some of the policies which have some commonality in approaches to combating climate

change includes development of early warning and flood-proofing system to minimise the impacts of natural disasters and undertaking appropriate measures in the designated flood risk zone such as raising platforms for homesteads, market place and educational institutions had been proposed (MoWR, 1999). It is worth noting that there is a difference between natural disasters and climate-induced disasters. Climate-induced disasters incur adverse incremental changes in the climatic pattern which is being manifested in the form of extreme climatic events hence which require climate compatible strategies to be integrated into the policy framework.

Under the 'water and agriculture' section, the policy had been heavily leaned towards ensuring efficiency in the usage of water, particularly for the irrigation purpose, including drainage-water recycling, rotational irrigation, adoption of water conserving crop technology, judicious usage of groundwater and surface water. However, it is not clear how the agricultural sector would cope in the wake of some adverse climatic anomalies. Under the 'water supply and sanitation' section, lack of available drinking water had been recognised and had proposed policies such as rainwater harvesting and conservation. The section 'water for the environment' stipulated policies for the restoration, conservation, protection, preservation of water resources through regulatory, planning and management approach (MoWR, 1999). Climate change had not been integrated into any of these broad themes.

There has not been any section mentioning about the significance of incorporating the emerging and future challenges to effectively realise water resource development. It is important to mention that the National Water Policy has not been updated since 1992. There are numerous emerging challenges such as climate change, rapid urbanisation, increasing population, industrialisation and economic development which require to be integrated into the national policy for better water resource management. The Government of India has updated their National Water Policy three times integrating emerging challenges into the policy framework. The first National Water Policy of India had been initially formulated in 1987. The document was reviewed and updated in 2002, and now the new policy version had been issued in 2012. The new policy version formulated in 2012 encompasses issues relating to enhancing usage of water, conservation of water bodies, flood and drought management, etc. A section has been dedicated to adaptation of climate change in the context of water resource development.

The National Adaptation Programme of Action (2005)

In response to the decision undertaken in the Seventh Session of the Conference of Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC), NAPA had been prepared by the Ministry of Environment and Forest (MOEF) and Government of the People's Republic of Bangladesh. The NAPAs was prepared to identify the key adaptation measures to respond to immediate and impending climatic anomalies. The NAPA was first prepared in 2015. Initially, fifteen adaptation measures had been suggested to address climate

change-related issues including climate variability and extreme events. In 2009, the NAPA has been revised elaborating present policy, planning, institutions and governance regime to manage environmental and climate change related issues. It has highlighted key climate change induced developmental concerns through analysing the adverse impacts of climate variability, extreme events and other aspects of climate change on the social, economic and biophysical sectors of the country. About 38 adaptation measures had been identified which was further categorised into eight thematic areas including: (a) research and knowledge management (b) agriculture fisheries and livestock (c) health (d) building climate resilient infrastructure (e) disaster management (f) livelihood (g) biodiversity and (h) policy and institutional capacity building. NAPA (MoEF, 2005, 2009) has recognised the impacts of climate change on water resources and proposed to get access to safe water supply in climate sensitive areas particularly threatened by salinity intrusion as a result of sea-level rise from changing climatic anomalies (MoEF, 2005, 2009).

Bangladesh Climate Change Strategy and Action Plan (BCCSAP)

Bangladesh is one of the first least developed countries to formulate a long-term climate change strategy, a total timeframe of 10 years (2009–2018), which provided strategic directions towards eradicating poverty and attaining economic and social welfare through implementing 'pro-poor climate change management strategy' and prioritising in addressing adaptation, disaster risk reduction, low carbon development, mitigation and deployment of international fund to finance the action plan. The first strategic plan was formulated in 2008 and later revised in 2009. The process of revising the latter version entailed consultations of various stakeholders including civil society organisations and the public. The said action plan had been built on six thematic pillars including food security, social protection and health, comprehensive disaster management, infrastructure, research and knowledge management, mitigation and low carbon development, and capacity building and institutional strengthening. About 44 programs had been identified, under the 6 pillars, which will be implemented by institutions including government, academic, research organisations and NGOs (MoEF, 2008).

The poor and vulnerable sections of the community or society will be adversely affected from the impacts of climate change owing to their entrenched vulnerabilities including social, economic and political issues. Under the pillar 'food security, social protection and health', adequate adaptation efforts have been proposed to be undertaken to ensure food security, safe housing, employment and access to basic services to protect them from climate change. Several elements have been stipulated under the stated thematic pillars. Ensuring to water resource development have been recognised as one of the elements in attaining 'food security, social protection and health' and 'infrastructure'. Under the pillar 'food security, social protection and health', implementation of drinking and sanitation programme have been proposed in the climate risk areas. Under the pillar 'infrastructure', repairing and rehabilitating the water resource structures

including coastal embankments, river embankment and drainage systems have been proposed. The document recognised several environmental, social and economic vulnerabilities in the context of climate change in an integrated and comprehensive manner. Although the resilience of vulnerable groups, including women, had been proposed to be enhanced through community-adaptive developments and livelihood, the importance of the participation of women in managing the water resources and possible strategies to overcome from challenges generated from climate change have not been given due consideration. It is important to note that the impacts of climate change will be disproportionately distributed, particularly to rural women, owing to their cultural, social and entrenched gender inequalities. Women's participation in managing and protecting the natural resources is imperative since they play a pivotal role in managing the households and providing day-to-day sustenance of the family.

The National Sustainable Development Strategy

The NSDS (2010–2021) is based on the long-term vision of the government—Sixth Five Year Plan FY2011–FY2015, the Perspective Plan of Bangladesh 2010–2021, and other government sectoral policies, existing plans and strategies. The objective is to propose strategies which would facilitate to attain sustainable development by 2021. The vision of the NSDS states 'Achieving a happy, prosperous and enlightened Bangladesh which is free from hunger, poverty, inequality, illiteracy, and corruption and belongs completely to its citizens and maintains a healthy environment'. The vision has been developed in consultation with various stakeholders.

The NSDS identified five strategic priority areas including: (a) sustained economic growth (b) development of priority sectors (c) social security and protection and (d) environment, natural resource and disaster management, and other cross-cutting issues which would facilitate to achieve the vision of NSDS and address sustainability of critical areas. The three cross-cutting areas including: (a) good governance (b) gender and (c) disaster risk reduction and climate change. Environment, natural resource and disaster management encompasses issues pertaining to environmental protection of humans, ecosystem and resources through emphasising on conservation and utilisation of natural resources. It covers water resources, forestry and bio-diversity, land and soil, coastal and marine resources, natural disasters and climate change (MoWR, 2013). Integrating of climate compatible development strategy into disaster management system has not been emphasised in the document.

A separate section titled 'water resources' has been dedicated to address water resource management. The strategies proposed under the section includes restoring the surface water system and groundwater, enhancing sustainable practices and managing river system and pollution. However, climate-sensitive water resource management strategies have not been integrated. Integrating climate change into the water resource management framework is imperative for sustainable supply water supply. Climate change alters the hydrological cycle and

disrupts the discharge of surface water and hence affects the groundwater-surface water interactions. A recent study conducted by World Bank (Yu, 2010) suggested that the groundwater in the coastal areas are susceptible to vertical infiltration of saltwater owing to seasonal flooding. Also, impacts on the surface water, particularly due to variability in rainfall pattern, affects the recharge rate in the humid areas.

National Strategy for Water Supply and Sanitation 2014

In 2014, the National Strategy for Water Supply and Sanitation has been formulated with the aim of ensuring universal access to sustainable and safe water supply, sanitation and hygiene services through providing a uniform strategic guideline to the sector stakeholders including government institutions, private sector and NGOs to achieve the goal. The timeframe of the document is five years starting from 2014. To achieve the goal a set of 17 strategies, in accordance with the 13 guiding principle encompassing safe, sustainable, transparent, equitable and innovative access to water supply and sanitation services, have been formulated. The strategies have been categorised into three broad themes including: water, sanitation and hygiene (WASH) interventions, emerging challenges and sector governance. The strategies proposed to be undertaken under the theme titled 'emerging challenges' would facilitate to counter the challenges being generated from emerging issues. Climate change has been identified as one of the emerging challenges. The strategic directions provided in the document to safeguard water supply and hygiene services from the impacts of climate change primarily encompass strengthening existing institutions, including WASA, DPHE, Local Government Engineering Department (LGED) and NGOs, making efforts to mobilise climate change fund to prepare projects relating to climate change and introducing regular monitoring system to keep track of rainfall pattern to undertake appropriate measures and salinity intrusion and depletion of groundwater (MLGRDC, 2014).

The document also emphasised on conducting research on pressing issues and emerging challenges, however, in reality there has not been much research, both in developing and developed countries, undertaken to understand the replenishment rate, levels and the possible impacts of climate change on groundwater and groundwater-surface water interactions.

Bangladesh Delta Plan 2100

BDP 2100 is a long-term strategic plan for land and water resources management plan for the next several decades. The delta plan vision states 'Ensure long-term water and food security, economic growth and environmental sustainability while effectively coping with natural disasters, climate change and other delta issues through robust, adaptive and integrated and equitable water governance'. This vision would need to be translated into specific goals for materialising the stated

vision. The BDP 2100 proposes 3 national level policy set by national plans and 6 Delta-specific goals which would contribute to these goals. The 3 national level policy goals comprises of eliminating extreme poverty by 2030 achieving upper middle income country status by 2030 and being a prosperous country beyond 2041. Among the six delta specific goals, which mostly entails water and land resource management, ensuring safety from floods and climate-induced disaster has been considered as one of the goals.

The plan has identified six hotspots, areas with existing water-related challenges, in order to facilitate the formulation of strategies and address them at the national level. These six hotspots areas include coastal zone, Barind drought prone areas, river systems and estuaries, hoar and flash areas, urban areas and Chittagong Hill Tracts. River flooding has been identified as one of the common challenges in the all the selected regions. The possible measures recommended to address the problems include: (a) flood risk management (b) dry season water availability and irrigation management (c) river management (d) coastal zone protection and management (e) fresh water supply and (f) wetland protection (GED, 2017).

Improved climate adaptive measures, including technical and non-technical actions, have been prioritised to be implemented in some of the key climate-sensitive areas. One of the priority sectors is water resources. Some of the proposed actions for water resource management include scaling up of the existing good practices of water conservation and management, and application of widely integrated water management, including flood control and prevention schemes, flood early warning systems, improved irrigation system, and demand-side management have been prioritised.

Concluding Remarks

The policies reviewed comprise strategies to address the current and short-term climate-induced water vulnerabilities. For example, majority of the policies reviewed have emphasised on providing access to safe drinking water supply or construction of water structures to arrest salinity intrusion into groundwater and aquifers. Policies to manage and regulate water management are not sufficient to deal with climate-induced water vulnerabilities or impacts. The impacts of climate change are more complex. There is still some uncertainty involved on the impacts of climate change on the hydrological cycle. It is difficult to determine how much run off will be generated or how the entire hydrological cycle will be disrupted and affect the humankind, economy and entire ecosystem.

Adequate research to determine the future climate-induced impacts on the water resources and subsequent implementation of adaptation strategies to minimise any future water-related calamities is yet to be materialised. Although, some of the major policies have suggested to conduct research, in reality there has been very little research in this matter. For example, very little research has been conducted to determine the possible impacts of climate change on the groundwater or groundwater-surface water interactions. Adequate efforts are required to be

undertaken to conduct comprehensive climate modelling to determine the future impacts on the water resources. Inadequate information will make the policymakers to undertake maladaptive actions.

Furthermore, it is vital to revise the National Water Policy of Bangladesh (1999) through integrating adaptation strategies to address climate-induced water vulnerabilities and other emerging challenges into the document. The document is the guiding framework for the country hence strategies formulated following the framework would not contribute an effective impact. The policies reviewed have not recognised or emphasised the importance of comprehensive local-specific vulnerabilities assessment prior to implementing the prescribed climate-sensitive water management strategies. Effective adaptation policies would require conducting a research on local-specific socio-economic analysis, climatic and water vulnerabilities prior to implementing them. The impacts of climate change will trigger long- and short-term effects on multiple sectors including social, environment and economy. Therefore, it is imperative to effectively integrate the multidimensional impacts of changing climate into the policy framework.

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Book Review

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Ralph D. Christy, Joselito C. Bernardo, Aimée Hampel-Milagrosa and Lin Fu, *Asian Agribusiness Management: Case Studies in Growth, Marketing, and Upgrading Strategies*. Singapore: World Scientific Publishing Co. Pte Ltd, 2019, USD 56, 242 pp., ISBN: 9789813233133.

Agribusiness has a tremendous scope to ensure inclusivity since this business venture pursues a positive human development impact as well as it is commercially viable and environmentally sustainable. Inclusivity fortifies participation at every level which leads to poverty reduction and women's economic participation. On the other hand, the benefit of the business secures high profitability and larger market share as well as creates a base for larger consumer base and low operation cost.

The modalities of agribusiness is quite divergent, such as management contract, contract framing, joint ventures, farmers' own business, or upstream and downstream business and also there is a gigantic opportunity of backward and forward linkage in this sector.

According to Pragnell and Berendes (2008) in global industry, agribusiness has grown up to 49 billion USD and consistently broadened to ensure the full potentiality of enhancing yield, preserving biodiversity and protecting economically viable farming.

World Bank, in 2011, reported that in South Asia alone, agro business accounts for almost one third of its GDP and also this agro business has the potential to turn itself almost double by 2030. The demand for agro-food products and services is expected to be $1.5 trillion by 2030.

Against this backdrop, a book on Asian Agribusiness Management Case studies in Growth Marketing and Upgrading Strategies was published by World Scientific Publishing Co. Pte Ltd in 2019. This book includes 13 case studies carried out by different groups of renounced scientists on the initiative of Asian Productivity Organisation (APO) and Cornell International Institute for Food, Agriculture and Development (CIIFAD) after a series of workshops conducted in Bangkok, Thailand, Bali, Indonesia and Manila, Philippines. These case studies were conducted to serve as a vehicle to continue important discussions on Agribusiness for students, managers and public policymakers globally.

The book contains 13 case studies of different countries by different eminent scholars subjected to covering different aspects of agribusiness. These case studies include: Key Trends and Drivers in Asian Agribusiness; Soyuz Foods International:

Small Fruit, Big Dreams; CEO Agrifood Limited: Growing through Value-addition; Maharashtra Hybrid Seeds Company: Evolution of an Agribusiness Success Story; Metro Kang Jian: Marketing Strategies in a Competitive Health Supplement Industry; Krirom Food Production: Cambodia's Flagship Dried Fruit Company; CDIP: Introducing Crocodile Oil to ASEAN+3; River PRO's Environmentally-friendly Paper: Growing Through Sustainability; Zenxin: Organic Produce Trailblazer in Malaysia; A Primer on Enterprise Upgrading; Malagos Farmhouse Cheese: Crafting Cheese at 380°C, Lingzhi Mushroom Company: Not Your Typical Mushroom Management and Mathesis Food Products Company: Bringing Back the Millet.

In the first chapter, the authors discussed the current situation in the region especially about the rising income and increasing populations and their relations to agribusiness in Asia. The authors detailed about why agriculture remains a vital sector in all types of economies. The major categories of agricultural policies and their impacts are discussed. The book discussed the evolution of supermarket in Asian countries and their impact on production, supply chain and logistics technology. Even inflow of capital in the market, development of supermarkets and improved infrastructure facilities to cater the requirements of supermarkets are also scrutinised by her in the book. They proposed that with the rising income and increasing population in the region, agribusiness would be stronger. They also expect that supermarkets will play a major role in food retailing. Continued urbanisation will lead to increased interregional food trade. On the other hand, they discussed the impact of climate change on successful food supply and suggested that greater technological innovations are required to combat the challenges. They concluded the chapter by stating that 'challenges and opportunities alike lie ahead for the regions agribusiness'.

Chapter 2 on Soyuz Foods International: Small Fruit, Big Dream is a case study of a company which had its own initiative to promote an underutilised fruit, Calamansi, in local and international markets. This chapter described the economy of the Philippines, business environment and status of agriculture sector. Helen, a women entrepreneur in Philippines, took bold initiative to forge with farmers to improve their living conditions through introducing the Calamansi fruit to the world. They have struggled through finding funding for expansion of their production plants and market development. This chapter further described the product development, marketing strategy of their product, etc. The challenges faced by Soyuz also thoroughly discussed and explained about how these challenges are overcome.

Chapter 3 dealt with Agrifood Company in Thailand that produced and marketed rice bran oil successfully. Thailand, a country having conducive environment for business, Agrifood changed their business strategy to suit emerging situation in the country. They have successfully identified the product demand locally and internationally, and accordingly they have started to supply their product. This kind of approach turned them as a successful agribusiness company and even they have diversified their products such as health conscious snacks and supplements using high quality rice bran and cosmetics from rice bran oil. The success story of this producer cum marketer is very well discussed in this chapter.

The fourth chapter on Maharashtra Hybrid Seed Company, Evolution of an Agribusiness Success Story talked about an ordinary man who initially started to sell seed for his neighbouring farmers as a mean of survival. Today, his seed business has grown as Mahyco operating nationally and internationally acquiring complementary business in Africa and Southeast Asia. This chapter also dealt with economic growth of India, a brief note on Indian agriculture past and future and its contribution to Indian economy. Then the author moved on to discuss the seed industry and its organisational structure in India and how it is transformed to the current form. The background of Dr Badrinarayam Barwale, the founder chairman of Mahyco seeds, and the troubles he underwent to bring the company to present status are also described. Those who read this chapter should be able to understand clearly the transformation of seed industry and their survival through all the challenges. Finally, the future challenges for the company and the strategies to be adopted were also analysed.

The fifth chapter about Metro Kang Jian dealt with the marketing strategies that were adopted in a competitive health supplement industry in Taiwan. This chapter analysed the process of successfully identifying a new product, launching that product in the market and penetrating the market by competing with ready established leading multinationals.

The author went on to explain the nature of Taiwanese Health Supplement market and regulatory measures that should be adopted to introduce a new health products. He also analysed the medicinal value of the Lingzhi mushroom (Ganoderma lucidium) and niuzhangzhi (Antrodia cinnamomea). Both of them were chosen by the company for marketing. He emphasised the importance of branding, sale and promotional channels, along with exploring the new markets and also emphasised on the successful marketing strategies for their new products in the United States, China and Japan.

The sixth chapter is also about a success story of a woman entrepreneur from Cambodia who took up the challenge of entering into dry fruit production, marketing and exporting. The idea was floated to absorb the oversupply of fruits and to make them available during the off-season. This factory has become the Cambodia's first dry fruit factory. This chapter also gave an outlook on Cambodia's agriculture with special emphasis on fruit production and analysed the problems in fruit marketing. The authors, while praising the courage of the entrepreneur, detailed the challenges faced by the company in developing the product as well as diversifying their product range.

Chapter 7 is about successful introduction of 'crocodile oil' to ASEAN+3 as a skincare product in Thailand. The idea came as a disposal mechanism of large quantities of crocodile fat, a by-product of a crocodile farm. Conceptual Development Intellectual Property (CDIP) is a firm that creates unique products for its clients. In this chapter, the authors, showed how successfully CDIP developed a unique product using a strange waste from a crocodile farm. The authors developed confidence on readers that any novel product with strange ingredients can be successfully produced and marketed if a right approach is employed. A brief account of skincare products available in ASEAN+3 markets

including China is also mentioned. Finally, this chapter explained the future steps of CDIP to continue to be a successful business.

The eighth chapter on River PRO's environmental friendly paper talked about an introduction of unbleached, recycled tissue paper in the market of Thailand. This chapter described the scope of a new product in the market and also the competition it is going to face with other giant and small tissue paper manufacturers. It gave a detailed account on the growing market for tissue paper and the prospective growth for this industry considering environment issues. Further, it described the history of the company River PRO and its growth in terms of production, branding, marketing and distribution which include capturing of first-mover advantage. But a consumer survey on the preference to recycled tissue indicated the negative perception of consumers. Therefore, the clear indication here is that River PRO has to do hard work regarding recycled tissues to sustain the market.

The ninth chapter on Zenxin: Organic Produce Trailblazer in Malaysia is a pioneer for organic agricultural products. The authors of this chapter described how the managing director of this company embarked on producing and selling organic products in local and international markets. This chapter gave a brief account on Malaysian economy and a detailed description of Malaysia's organic food industry and organic certification. The chapter also discussed the lapses in the organic agriculture in the country like lack of organic agricultural extension support and also discussed the organic retail and nascent domestic organic demand. Then the authors concentrated on the Zenxin Agri-Organic Food giving details of their vision and mission, current products and operations, the challenges, etc. The main challenges they faced are the shortfall of production and low public awareness. Finally, authors linked the success of Zenxin mainly with the value chain related to improving productivity, understanding the healthier living and lifestyles through organic food. The general perspective of the public towards organic food is also enlightened.

The tenth chapter on A Primer on Enterprise Upgrading discussed about the enterprise upgrading with a literature review in this regard. The authors defined what is enterprise upgrading and based on the definition, he discussed key requirements for the upgraders. Then came the detail of the innovation drivers in a firm and a discussion based on the determinants of micro, small and medium enterprise upgrading like the Onion model. This model was used to carry out the next three case studies.

Chapter 11, 'Malagos Farmhouse Cheese: Crafting Cheese at 38°C', is about a story of untiring women entrepreneur who underwent so many troubles and challenges to be successful in this endeavour. Cheese making at 38°C itself is highly challenging undertaking. But this woman with the support of her family members and friends became a highly successful innovative entrepreneur in the Philippines.

Chapter 12 depicted about a woman entrepreneur in Vietnam who struggled through various difficulties to become a successful anti-cancer mushroom producer. The authors of this chapter gave an overview of Vietnam and its agribusiness, the business environment, women participation in business, health

situation of Vietnamese and LMC's participation in the pharmaceutical sector, etc. Then the owner's version of origin of the firm and difficulties encountered by the company are also given in detail. This chapter also dealt with how this enterprise went through the upgrading process successfully.

The last chapter on Mathesis Food Products Company is reintroducing millet-based food products in India. This company is owned by a woman entrepreneur who wanted to manufacture and to market a range of cereal and millet-based snacks, breakfast foods and instant foods. This chapter gives an overview of the Indian economy, followed by a glimpse of the Indian agriculture sector and the success story of this young women entrepreneur. The authors found out three main constrains to the growth of this company which are lack of technology for millet processing, less awareness among public and gender based discrimination. The authors discussed in detail about how this woman overcame all these barriers through her untiring effort.

Throughout all the 13 chapters of this book, different authors emphasised on commitment, courage, innovation, understanding the market, motivation, risk-taking attitude and determination. They are some of the key factors leading to success in the agribusiness sector. Authors also gave different suggestions for policymakers to create a favourable environment especially for new entrepreneurs.

This is a highly motivating book for new entrepreneurs and for policymakers to go into details of suggested policy implications. This book could also be used by academia and researchers for developing models in respect of successful enterprises.

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