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POLICY OPTIONS ON SUSTAINABLE RESOURCE UTILIZATION AND FOOD SECURITY IN HAOR AREAS OF BANGLADESH: A THEORETICAL APPROACH

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Abstract:

This study consists of two theoretical approaches on the policy options regarding the link between entrepreneurship, resource utilization and food security in the haor-basin areas. The first one deals with a Cobb-Douglas technology to investigate the relationship between entrepreneurship and food security. In particular, we suggest that, while more entrepreneurship could mean more productivity in the production sectors, productivity growth in turn could affect the individual arbitrage between different haor's occupations (including entrepreneurship) and expected payoffs. The second question is concerned with the types of haor resource management to which the individuals or local communities direct their talents. We distinguish between community management and government management on the efficient utilization of haor resources. The impact on household food security and resource utilization can be assessed in static and dynamic frameworks.

Key Words:

Policy Options, Sustainable Resource Utilization, Food Security, Haor Area, Bangladesh.

1. Introduction

Haor- Basin in Bangladesh is one of the world's most valuable ecosystems, located in the north-eastern region of Bangladesh encompassing an area of around 8,000 km², is home to about 19.37 million people. Haors are unique, performing a variety of important ecological functions with their rich ecosystems and bio-diversity. It is a wetland characterized by a large, bowl-shaped tectonic depression that becomes an expansive body of water in the monsoon season, receding in the dry season. They contribute directly to food security through the production of rice, fish and vegetables. The main harvest in these areas, in the early September to end of March is indeed a critical survival mechanism and serves as a source of food security for those local people. However, it is important to mention that the magnitude of food security provided by haors varies with areas and socio-economic status. The variations by socio-economic group are to do with differential access to haors and varying ownership of resources with which to use these areas. Haors also contribute indirectly to food security by providing products which people can collect and sell to avail themselves with cash for purchasing food. Some of the poorer people make a living from collecting craft materials, and fish which they either sell or themselves. Medicinal plants are also found in haors and these items contribute to the well-being of households through direct use or through sales.

The various ways in which haors contribute to food security and the potential for degradation which can occur as a result of increased usage these areas, suggest that a major initiative is needed to help ensure sustainable use of these areas. In addition, recognizing the role of haors in moderating stream flow, especially during rainy season, but also in maintaining the flow during the dry season, shows the clear need to consider the role and functioning of haors and 'beels' not just for immediate food security and livelihood benefits, but also for the wider community and bio-diversity. It is with these multiple goals in mind that the efficient use of haor resources and efficient management of haors need to be examined.

Haor is subject to very peculiar conditions and suffers from extensive annual flooding. This makes livelihoods extremely vulnerable and limits the potential for agriculture production and traditional enterprise growth. For 6 to 7 months of the year, the cultivable land remains completely inundated. Strong wave action adds to the vulnerability as it can potentially wash away the land and poses a major threat to many villages in the haor (Haor Master Plan- 2012). Despite the economic importance of the haors, people in the region are poorer than those in any other part of the country. More than 28% of the total population here lives below the Lower Poverty Line (LPL). Natural disasters are the main reason of poverty, which is

aggravated by lack of availability of basic infrastructure and social amenities, inequity in resources acquisition and poor access to natural resources. Development potentials are huge, but need an integrated approach for maximizing the utilization of resources (both human and natural resources). In this regard, the present study aims to investigate the food security and productivity impact of entrepreneurship and institutional interventions in haor-basins in more details.

Several haors are under increasing pressure and in the process of losing many of their important functions, with serious consequences in the form of changed water regimes, significant conflicts over resource use, and loss of livelihood opportunities. Many haor-basin areas experience a rapidly growing population with poor people moving into the areas in search of livelihood opportunities leading to a strong economic pressure for conversion of haor resources to other functions, and only limited considerations are given to the sustainability of the changes. Management of haor is still very sectoral and does not recognize the multiple functions of haors and existing experiences on sustainable haor management in Bangladesh are not generally available or used by key stakeholders. Planning for land and resource use in haors is limited and furthermore plans are seldom put into practice. Coordination of the activities taking place on the ground in the haors is exceedingly difficult and the skills for undertaking haor management are insufficient. The knowledge-base about haor resources, status and key management problems is limited and no proper policy guidance is in place. So this study is important to examine the policy options for an efficient utilization of scarce haor resources.

The main contribution of this study is threefold. First, we propose and develop two quantitative models to examine efficient methods of haor resource utilization covering general household's problem as well as specific resource utilization issues and pro-poor haor development policy. We believe that rather than examining solely the socio economic concern in general, adding information about some specific issues and attitude measures also in the present study would certainly help us learn more about a haor-basin people's true preference towards their food security and resource utilization. Second, we have reviewed the haor master plan and identified some policy gaps towards food security and haor development. Finally, there has been no literature published to date that has examined haor-basin food security issue on the basis of entrepreneurial activities and comparative resource management policy. This blank space must be filled. In addition, we believe that our theoretical contribution based on haor-basin resource utilization policy options would make national

comparison between haor-basins and other areas possible, which as a result enhances the future research opportunities in this field.

2. Objectives and Outcomes

The study and its theoretical approach will build on the presumption of the collection and availability of data and more innovative elements of the institutional financed project which are operating in the haor-basin districts and have very positive results on different indices. The first objective of the study is to examine the haor master plan and the existing haor-basin resource utilization process, its management system and how the management and utilization process are contributing to the households food security in the haor basin areas. The second purpose of this study is to propose a theoretical model of entrepreneurship and innovation in the haor areas with the aim of improving food security and efficient resource utilization. Finally they study will compare the haor management options between government and community management systems on the basis of a theoretical model. In general, the study will deal with the topics outlined below:

- To evaluate the haor master plan and its policy gaps to ensure efficient and sustainable resource utilization and household's food security.
- The role of innovation and entrepreneurship in the economy of haor, including its growth and productivity impacts, its linkages to other sectors and position in national production chains, and its impact on poverty and health.
- To compare the Community Based Haor Resource Management (CBRM) and indigenous development initiatives in haor areas and the role of knowledge of local population in sustainable livelihoods, reduction of household vulnerability and in facilitating haor-urban resource mobilizations.
- Technological innovation – opportunities or threats for haor development? What skills are needed for haor resource utilization and how can it be developed and explore the policy gap, if any?

3. The Main Outcomes Expected from The Study Include

Policy targets of haor-basin development and policy gaps in the proposed haor master plan-2011, an entrepreneurship model to enhance productivity in the agriculture, access to markets, livelihood opportunities, diversification and marketing of crop and livestock production , a comparison between institutional and Community Based Haor Resource Management (CBRM),

way to improve living standards and reduce vulnerability of the poor, process to enhance village mobility, reduction in production losses and protection against extreme weather events , innovation to enhance access to fishery resources and conservation of biodiversity and methods of efficient, cost effective and equitable use of haor resources.

4. Methodology

The study is a theoretical and conceptual one whose basic foundation comes from various secondary sources. The linkage of entrepreneurship for haor people's food security is the new idea originated from the Cobb-Douglas function. To remain with the focus of the paper, the study will follow the Cobb-Douglas production technology to develop an entrepreneurship model. Following classical linear regression model we also develop an econometric approach to compare the government and community management system in haor areas. For theoretical motivation the study mainly reviews haor master plan-2011 and other previous research work. The next section presents a review of haor master plan and its policy gap relevant for efficient resource utilization and food security issues along a description on haor areas of Bangladesh. Section five deals with a literature review on the previous research work. After that, section six presents the theoretical model on entrepreneurship and haor development and section seven presents an econometric model to examine the different institutional arrangements of haor resource extraction for haor people livelihoods and sustainable haor resource utilization and finally section eight concludes the study with some policy recommendations.

5. Haor, Haor Master Plan and Policy Gap

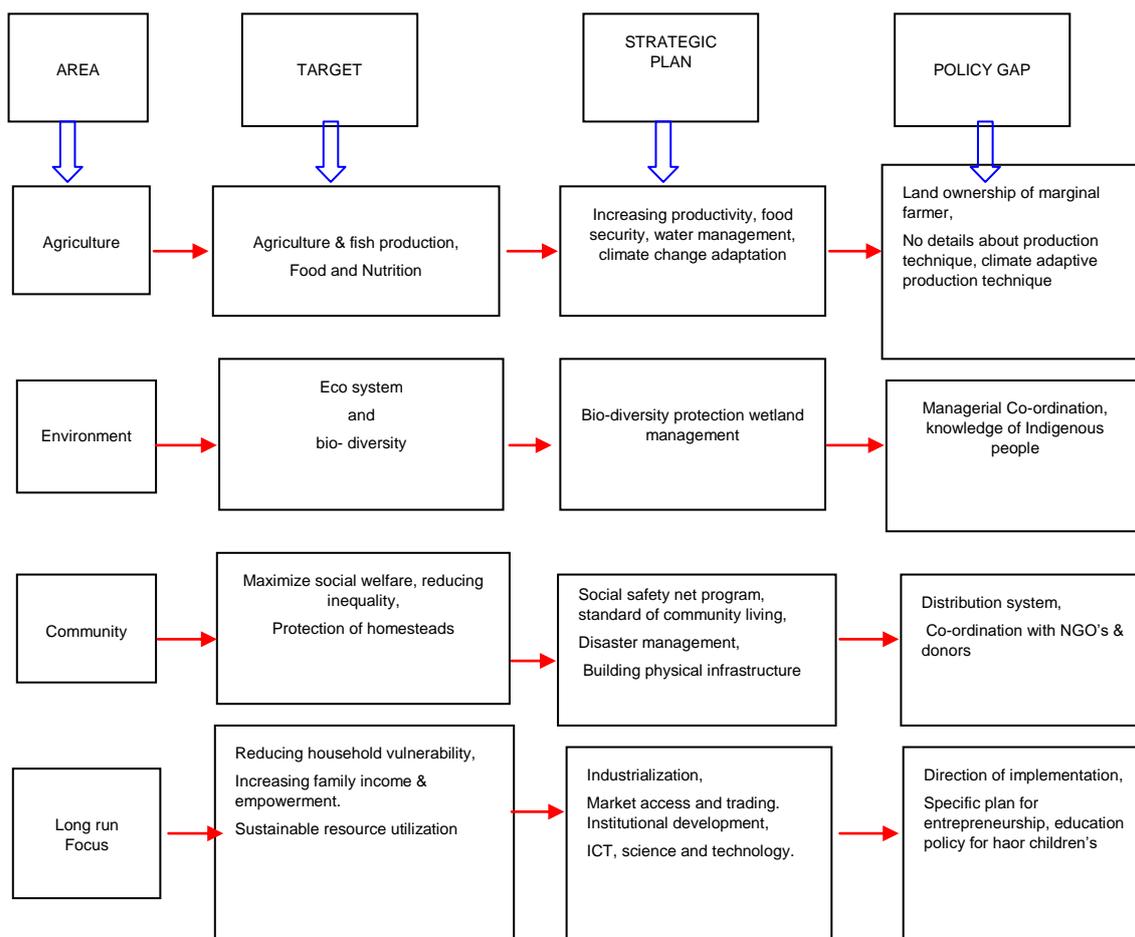
A haor is a wetland ecosystem in the north eastern part of Bangladesh which physically is a bowl or saucer shaped shallow depression, also known as a backswamp (Alam, 2004). Haor-basin area comprises two units, namely Haor and Beel. Haor is a large-scale lakes or hollows where flood- water depth is high, and beels are countless shallow lakes or ponds, surrounded by flooding fields. There are about 373 haors/wetlands located in the districts of Sunamgang, Habiganj, Netrakona, Kishoreganj, Sylhet, Maulvibazar and Brahmanbaria. There are 47 major Haor, and 6 of them are ranked as internationally important wetlands. There are 6300 Beel, and 3,500 of them are permanent and 2,800 of them are seasonal (Yoshitani et. al 2007). Population of the haor-basin area is tending to increase every year. Transport in this area is mainly by boats in both the rainy season and the dry season. Industries of the Haor area are mainly agriculture and fishing. Residents do agricultural work during the dry season that is

from the middle November to the end of April, and fish in September and December adapting to the life cycle of flooding inhabitant fish sorts. However, during the rest of the flood period in Haor, approximately 40% of the population engages in fishing while the others work as migrant workers or are unemployed (Haor master plan-2012, CEGIS, Yoshitani et. al 2007).

District	Total Area (hectare)	Haor Area (hectare)	No. of Haor
Sunamganj	367,000	268,531	95
Sylhet	349,000	189,909	105
Habiganj	263,700	109,514	14
Maulvibazaar	279,900	47,602	3
Netrakona	274,400	79,345	52
Kishoreganj	273,100	133,943	97
Brahmanbaria	192,700	29,616	7
Total	1,999,800	858,660	373

Source: Haor Master Plan 2012

The government has approved a 20-year master plan for haor areas of the country aimed at development of resources of the haor regions for welfare of the inhabitants of the area, provide adequate living standard, social services and ensure equitable distribution of income and property. The master plan prepared by Ministry of Water Resources is an 'integrated development plan' to ensure optimum utilization of the available resources of haor areas for future development of potential by incorporating all relevant social and environmental considerations. Similarly, local or indigenous knowledge develops over time from a detailed understanding of local environmental conditions, and is modified in response to changing conditions. It is a resource that can help development processes become more sustainable. This has not always been recognized and respected by all haor related stakeholders. If these opportunities can be utilized, the development benefits in terms of greater food and nutritional security, a better diversified and less vulnerable haor economy, growing national revenues and ultimately more, better and sustainable employments for haor poor may be the result.



More than two thirds of local communities carried out their economic activity in the haor areas, including commercial fishing, trade in fuel wood, hunting and trapping waterfowl, the harvesting and sale of grasses and reeds, and farming. People have managed haors sustainably for generations. However, planners have often seen haors as wasted areas, which need to be made economically productive. New management approaches, as designed by government's master plan that depends heavily on technology, innovation, organizational efficiency together with environmental change, mean that many haors are now threatened. In many of the most pressing development challenges today, haor areas agriculture and food security is central. Food and water security, transforming scarce land to be more productive, environmental degradation and climate change, and the capacity of entrepreneurship and innovation in production systems, are but a number of key issues that are currently at the top of community and national agendas.

The development objective of the sustainable haors management component is sustainable haor management approaches implemented widely in the haor-basin areas and contributing to improvement of livelihoods. This is a long-term goal and 10-15 years of support is envisaged

to be needed to achieve this. Another important objective is wise use policy being applied in selected haors and integrated development framework and support functions for sustainable haor management operational. The first immediate objective reflects the existence of GO/NGO base institutional activities and the importance of progress on the haor livelihood with tangible examples of more sustainable management output. The second immediate objective stresses the need for ensuring that the institutional level provides better support to field level implementation. A number of haor-related programs, projects and activities are undertaken in haor-basin areas supported to a great extent by external donors. Many of these activities are comprehensive and achieving a number of important results. Their co-ordination can, however, be improved, as they work somewhat in isolation and their selection of field activities should be better linked to national priorities. The master plan must point out and design the avenues so that there will be a continued opportunity to enhance co-ordination via the work of GO/NGOs and the haor unit as well as through the framework of the haor master plan management strategy.

5.1 The Specific Objectives of the Haor Master Plan

- Integration of haor issues into planning processes and implementation in haor-basin regions in general and improvement of sustainable haor management
- Develop integrated programs to ensure efficient resource utilization prevent degradation of resources and ensure sustainable management.
- To establishment of haor inventory and monitoring activities as well as to strategic studies in support of policy development
- To increase agricultural production, protection of homesteads and infrastructures compatible with the ecosystem.
- Sustainable utilization of haor resources to the benefit of local people in a way compatible with the conservation of biodiversity
- Strong emphasis on the poverty alleviation, redesign the expansion of settlements and infrastructural development for wise management of wetlands.
- To increase awareness on the maintain aquatic environment, preserve natural water bodies such as haors and beels, and facilitate drainage among key target groups.
- To improve skills among key stakeholders to provide support to keep and maintain existing wetlands in and around natural canals for mitigation of flood risk and damage.

□ Research and recommend integrated approach oriented interventions and future action programs based on proper survey, investigation as well as department/agency-wise action plans.

□ Strategic information and analysis available to guide policies, frame projects in line with local demands and implementation of wetland management projects through local government institutions or any other appropriate organizations.

A long term development strategy behind the master plan approach is that haors management will need to develop new and innovative approaches towards integration of land-use planning, production techniques and adaptations, water resource management and natural resource management and that this integration and innovation needs to include not only the haor communities themselves but the capacities for implementation of plans. Economic theory suggests that entrepreneurial planning processes will be supported. Development and implementation of such integrated management approaches takes considerable time and will probably require external support for a considerable period. But the role of entrepreneurship is not adequately mentioned in the haor master plan.

5.2 Entrepreneurship and Food Security

Should haor people start firms or an organization to produce market related goods and services? And if they do, what impact will such entrepreneurship have on their employment, household income, productivity and food security? These questions are at the heart of haor research, not just important in economics but for government and other development organizations. Relationship between entrepreneurship and productivity improvement and economic development is a result of the tangible expression of entrepreneurship's skills, and more precisely, their propensity to innovate. The carrying out of new productions through the innovative activity can be described by distinguishing five cases (Schumpeter 1911): (1) The introduction of a new product – that is one with which haor peoples are not yet familiar – or of a new quality of a agricultural product. (2) The introduction of a new method of production, that is one not yet tested by experience in the area of haor agriculture or fishery, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially. (3) The opening of a new market, that is a market into which the particular branch of production of the haor in question has not previously entered, whether or not this market has existed before. (4) The conquest of a new

source of supply of raw materials (5) The carrying out of the new organization (govt. of NGOs) of any industry.

Table: Types of Entrepreneurships Relevant in Haor Areas

	Self employed	Employee
Entrepreneurial	Schumpeterian Entrepreneurs	Intrapreneurs
Managerial	Managerial Business owners	Executives Managers

Source: Wennekers et Thurik (1999, p.47)

Among the possible classes of entrepreneurship, we will emphasize on Schumpeterian entrepreneurs to build our theoretical model. The model has received a special treatment in the economic literature because it has link with the technological change and innovation. Through the innovative activity, the Schumpeterian entrepreneur seeks to create new profit opportunities that can result from productivity increases.

The starting point is to distinguish a necessity of entrepreneurship,” which has to become an entrepreneur because we have no better option, from an opportunity of entrepreneurship,” which is an active choice to start a new enterprise based on the perception that an unexploited or underexploited resource utilization opportunity exists in the haor-basin areas. The Global Entrepreneurship Monitor (GEM) 2010 Global Report states that: “Most policymakers and academics agree that entrepreneurship is critical to the development and well-being of society. Entrepreneurs create jobs. They drive and shape innovation, speeding up structural changes in the economy. They contribute indirectly to productivity by introducing new competition. Entrepreneurship is thus a catalyst of economic growth and national competitiveness,” (Kelley, Bosma, and Amorós, 2010, p.12).

As such, an enterprise creates the opportunity for extending up of some key economic components of the previous institutional investment such as organizing the labor contracting group for construction of village roads, using block building technology for submersible roads construction which is more durable and cost-effective. In addition, entrepreneurship will strengthen and expand the community management of water bodies that have found to have a significant impact on fish production and increase in incomes of poor fishing households. Building rural markets which have proved very successful as part of the market infrastructure development can increase local people’s income directly and it has backward production linkages.

We use a Cobb-Douglas function to model the relationship between input factors, entrepreneurship innovation and the level of production. Cobb–Douglas production function of the general form:

$$Y = A^0 K^\alpha L^\delta$$

where Y= output, A^0 = disembodied factor productivity, K= Stock of physical capital; L= Labor employed. Dividing both side by L:

$$Y/L = A^0 (K/L)^\alpha L^{\alpha+\delta-1}$$

f we allow constant returns to scale, $\alpha + \delta = 1$

Therefore, $Y/L = A^0 (K/L)^\alpha \dots\dots\dots(i)$

Taking natural logs on both sides,

$$\ln(Y/L) = \ln A^0 + \alpha \ln(K/L) \dots\dots\dots(ii)$$

Now we can take first differences in order to obtain growth in Y/L as the dependent variable.

For small percentage changes,

$$\Delta \ln(Y/L) = \% \text{ change in } (Y/L)$$

$$\Delta \ln(Y/L) = \Delta \ln A^0 + \alpha [\Delta \ln(K/L)] \dots\dots\dots(iii)$$

We assume the growth in disembodied factor productivity, A^0 , to be explained by stock of knowledge capital (technological innovation or any other innovative activities of GO or NGO related projects) and entrepreneurs (total entrepreneurial activity rate). Therefore we can write the following equation:

$$\Delta \ln A^0 = B^0 + \eta Pjt + \phi TEA \dots\dots\dots(iv)$$

where B^0 = constant ; Pjt= intensity of project related activities measuring Technological Innovation Intensity; TEA= Total Entrepreneurial activity measuring either entrepreneurship rate or GO/NGO project base activities in a sector, e.g. fishery or poultry and any other agricultural product. Substituting (iv) into (iii):

$$\Delta \ln(Y/L) = B^0 + \eta Pjt + \phi TEA + \alpha [\Delta \ln(K/L)] \dots\dots\dots(v) \text{ For cross-region context,}$$

we can include base year value of (Y/L) to control the convergence effect. Therefore,

$$\Delta \ln(Y/L) = B^0 + \lambda \ln(Y/L)_{t-1} + \alpha [\Delta \ln(K/L)] + \eta Pjt + \phi TEA \dots\dots\dots(vi) \text{ Now we can operationalize}$$

the model (v) and (vi) to examine the impact of entrepreneurship on household food security through the increased productivity.

Proposition one: Productivity growth by entrepreneurship will be greater in haors with NGO's activities than non-entrepreneurial activities.

Proposition two: Productivity growth by entrepreneurship will be lower if any institutional barriers to entrepreneurship

6. Resource Utilization: Community versus Government

This section is aiming to find out the effects of different institutional arrangements of haor resource extraction on haor people livelihoods and haor development. Different haor-basin areas with different arrangements (i.e. institutions either government or formed by the international organizations practicing some rules for the extraction of haor resources) will be selected for this comparison. There are different degrees of dependency among the households based on resource extraction for their livelihoods. However, different types of institutional arrangements which are governed by different set of rules are being practiced by the haor people to extract these resources in the face of tremendous pressure on haor areas imposed by emerging population and acute poverty. These may be the set of resource utilization rules adhered to the individuals or groups engaged in the haor uses (Table 1). Nevertheless, the absence of structured and efficient institutional arrangements, haor resources is being collected in unsustainable ways which lead to the destruction and depletion of resources. Therefore, this section is seeking to solve this haor management issue by examining the role of different institutional arrangements of resource collection on poverty reduction, haor biodiversity conservation and haor development.

Table 1: Institutional Arrangements of Resource Extraction in Haors

Institutions (Arrangements)	Type	How do they function
Co-management	Formal	A group of haor dependent rural people have been undertaken into co-management regime through providing alternative income generating (AIG) support to reduce their dependency on haor-basins. However, those people still may have some degree of dependency on haors specially for seasonal fishing which is informal
Regular access	Informal	Practice by the group of extreme poor people mostly women (80%) for collecting food items which is the only mean for their daily livelihood
Conditional access	Formal but implemented informally	Practice by the group of poor people who have been registered as day labor for haor resource management works, on return, they collect their necessary items informally; or other than that some of the people

Institutions (Arrangements)	Type	How do they function
		pay toll to haor management department staff informally before entering into the haor areas to collect resources
Limited access	Informal	A group of people enter into haor areas at a frequency of three days per week to collect various resources
Seasonal access	Informal	This may practice by a group of local people where they collect resources seasonally as during the harvesting season of specific haor products.
No access/ban	Formal	No access or ban to any type of haor resources and need food substitution compensation policy

So, a research hypothesis would like to answer the question: “how and to what extent the socio-economic and haor development benefits differ with difference in institutional arrangements of haor resource management in the haor-basin areas?” There is a haor master plan and policy guidelines about haor resource extraction in the latest haor resource utilization policy of Bangladesh (Haor Master Plan-2012 vol-1, 2, 3). Moreover, there is a ban to some types of resource extraction in the different haor areas. While haor resource extractions are the major livelihood activities in the haor areas of the haor people of Bangladesh. So, there is a conflict between the haor dependent rural people and government policy on the same. Therefore, it is essential to formulate a comprehensive and well articulated ‘Haor policy for efficient resource utilization’ or to develop policy statement or policy guidelines which are vital for the better management of haor resources to get sustainable haor development and livelihood benefits.

Let consider the stakeholders from different villages surrounding the haor areas who have varied degree of dependency on these haor resources for their livelihoods. So, household level variables include information on production, income and consumption expenditure, dependency; where household income source will be grouped into different key sources, such as income from agriculture, livestock, off farm income and income from common property resources. Variables related with households socio-economic status like, education, age, household size, gender roles, land holding, land under irrigation and non-irrigation, land under private forest, livestock holding, relationship with political party when party is in power and distance from market and from nearby haor resource hub. To measure the gross income from the haor resources, the total quantity of resources collected for 12 months by their

respective prices will be estimated. All cash and labor costs, including cost of tools and equipment used in the collection of resources will be measured to calculate the net income from haor resources.

Next we need to estimate the economic dependence of haor populations. Household benefits of haor resources practicing different institutional arrangements can be assessed by valuing the resources collected and harvested from haors. The economic value of different resources will be estimated. Firstly, gross income of resources to household livelihood will be measured by the total amount of cash income (ignoring transportation cost as the location of market is nearby their collection place) generated by the selling of resources in the market. So, the gross income generated by selling resources is used to explain the market value of resource and the commercial collection of resources. Where the extraction is sustainable, the value of the haor products will be measured using the formula: $\sum Q_i(P_i - C_i)$, where Q_i =the quantity of good extracted, P_i = the price of the good (which may be equal its price under competitive market conditions with no externalities), C_i = cost of extraction and $i = (0-n)$ i.e. set of haor products. An attempt may be made to find out the resource extraction rent (market price minus the cost of producing and collection) using the monetary value of time spend for collection and processing of resources and legal and illegal token fee involving in the entry into the haor-basin areas. Different methods of resources valuation will be used for those are not traded in formal markets or bartered locally. Non market share of resources use for household consumption also to be assessed by using the same market price of sold item. Both the gross and net income (i.e. revenue minus cash and imputed costs of labor, costs of tools and equipments and their depreciation cost) of resources will be calculated following the different market valuation methods of non-market goods. Then the household dependency on haor resources will be measured by the proportion of resources income to the total income of the household.

On the basis of the above analysis, we can set two regression models to find out the significant factors related to resources income for different institutional arrangements. Another dependent variable is the ratio of haor resources income to non-haor resources income which will also be regressed using independent variables. Both regression models will be examined separately for different institutions to assess which arrangement have significant impacts on improving rural (households) livelihoods and haor development.

Econometric analysis will include the pattern of household's economic activities and distribution of various annual average incomes by economic activity of the sample households

in different institutional arrangements. In order to investigate the linkages between resources extraction, dependence and household's income in different institutional arrangements, two regression models have to set. Resources extraction model with two regressands and error specification is as follows

$$Y_i = f(X_i, \beta) + e_i \quad (1)$$

Where Y_i is a dependent variable, shows haor resources income in the first model and in the second model it shows the ratio of haor resources income to non- haor resources income in two different areas i , $i = 1, 2$.

$f(X_i, \beta)$ is the deterministic part of the model, X_i is a vector of two inputs of both household's total income and square of total income, β is a vector of unknown parameters to be estimated and e_i is a residual component. The regression results will lead us to draw an inference how haor resources extraction changes within a range of household income and the degree of resources dependence on two haors system.

Various socio-economic factors have significant influence on the haor resources dependency, the nature of resources extraction, effectiveness in utilization of community resources and haor management policy.

So, gross haor resources income can be modeled including all relevant socio-economic variables and three dummy variables.

$$Z_i = f(\aleph_i, \alpha_i, Di) + \eta_i \dots \dots \dots (2)$$

Where Z_i is a dependent variable of total gross resources income from haors and private lands,

$f(\aleph_i, \alpha_i, Di)$ is the deterministic part of the model, \aleph_i is a vector of following explanatory variables:

$\aleph_1 = hage$ = Age of household age in years

$\aleph_2 = edu$ = Average education of household (in no. of schooling years)

$\aleph_3 = pfland$ = Land under private cultivation (in decimal)

$\aleph_4 = livestock$ = Number of livestock owned by a household

$D_1 = gender$ = Gender of household head (1=if female and 0= otherwise)

$D_2 = polink$ = Holding political power as party is in power (1=if not link, 0=otherwise)

$D_3 = institutions$ = Institutional arrangements (1=if with formal arrangement, 0=otherwise)

$\aleph_5 = frmsize$ = Number of people in household

$d.frmsize$ = Number of people in household x dummy of haor type

$\aleph_6 = landt$ = Land area under household management excluding private cultivation (in decimal)

$d.landt$ = Land area under household management excluding private cultivation x dummy of haor type

$\aleph_7 = distance$ = Distance to haor from households (km.)

$d.distance$ = Distance to haor from household (km) x dummy of haor type

α_i is a coefficient of variables to be estimated and η_i is a residual component.

Therefore, analysis based on estimated regression results will provide us a list of variables that might have significant impact on total haor resources income. Along with socio-economic characteristics, regression result will also provide an indication whether rules and regulations have a significant impact on haor resources based livelihood or not.

Proposition: Formal institutional (government) arrangements of haor resource management have less significant impacts on efficient resource utilization, improving household's livelihoods and haor development than the community or indigenous management.

7. Conclusions

Haor has plentiful potentiality of agriculture production and abundance of fish. After that haors all over the Bangladesh are threatened in spite of various international agreements and national policies. Public good nature of haors(a lack of enforceable property rights) and policy intervention failures, particularly a lack of uniformity among policies in different areas such as, economic, agriculture, environment, nature protection, physical planning are the main reasons. Therefore, sustainable resource utilization and food security policies are heart of haor areas research. Integrated haor research program combining social and natural sciences can provide the way to solve the management problem and to get a grasp on the required consistency among various government policies. A theoretical framework is presented here that suggests that a combination of entrepreneurial innovations and economic valuation, systems modelling, stakeholder analysis, and management evaluation can provide complementary insights into sustainable and welfare-optimizing haor-basin management and

policy. A recent haor master plan underpins the importance of combining the various techniques to arrive at a comprehensive understanding of sustainable solutions to haor degradation and loss. The study made preferences to work with local communities than government management system and entrepreneurial access to the haor natural resources to ensure the sustainable resource utilization.

Haor management requires coordination amongst different users in order to obtain the best returns from these areas in a sustainable manner. Haors and beels are inter-linked systems and actions in one area can lead to changes elsewhere in the wetland which can impact upon other users. In order to make progress, further and intensified co-operation is needed between government initiatives, project taken by NGOs and other international agencies and local community knowledge. We develop a model that connect in a systematic and coherent way all necessary economic information's and two alternative haor management systems. Such an approach is theoretical and requires detailed information, description of ecological, natural and socio-economic data. Therefore we recommending complementary research program of haor master plan on haor economy focusing on agricultural land and product verities, water resources and fisheries, forestry, wetland, land distribution and co-management systems.

8. Notes & References

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