Determination of capacity building by life stage for the farmers in Bangladesh

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Abstract: Several researchers have identified capacity building is essential for sustainable development of the farming community in developing countries. It is assumed that improvement of the capacity depends on physical, technical and managerial skills of the farmers at different stages of their life, which has not yet studied for developing countries. The study found that children of the marginal and small farmers engage earlier in assisting physical activities in farming than medium farmers in Bangladesh because they have less opportunity to educate their children. Majority of the marginal and small farmers are well ahead in improving physical and technical skill at a high level than the medium farmers and therefore, they enter into the Gehilfen stage of capacity building. Moreover, they have started to build these skills independently at the early age of their farming. Medium farmers are, on the contrary, reluctant to engage independently in farming activities than the marginal and small farmers. None of the farmers enter into Meister stage of capacity building. The study also found that physical skill is the dominant factor followed by technical skill for increasing capacity of the farmers in Bangladesh. The marginal and small farmers could make agricultural productivity better than the medium farmers owe to skill development. [Nature and Science. 2008;6(4):8-15]. ISSN: 1545-0740.

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Introduction

Capacity is often defined in terms of ability and performance. For example, the United Nations Development Program (UNDP) defines capacity as `the ability to perform functions effectively, efficiently and sustainably` (UNDP 1997). This definition of capacity can also be used in agricultural production activity. Agricultural production activity comprises of physical involvement, application of technical knowledge, procurement efficiency of raw materials, efficient management of land and labor, short term and long term farm development plan, financial management using accounting knowledge, and efficient management of assets and property. Therefore, how efficiently a farmer can perform these activities determines his capacity to do the job. Capacity building is associated with increment in these activities or performance through transformation process of different activity.

In the present study capacity building is associated with efficient performance of different agricultural activities to increase agricultural production in a further extent. Efficient performance of a different agricultural activity is a dynamic process instead of static one. For example, younger farmers may concern about the technology of different crop production such as appropriate planting time, requirement of irrigation, usages of organic and inorganic matter, harvesting methods along with involvement of physical skill. Middle aged farmers may think about the marketing strategy, efficient management of financial resources along with receiving and payment of credit, development of short term and long term farm planning etc. Therefore farmers build their capacity in different stages of life. According to the German literature there are three stages of capacity building for the farming activity. The stages are Lehrling, Gehilfen and Meister. The farmers, who have high skill in the technical aspect along with efficient performance of physical activities, are in Lehrling stage. The farmers who have high capability of cash, capital and production management are in Gehilfen stage. The farmers are in Meister stage; they can analyze their farming activities well, can do long term financial management in efficient way, and have capacity to manage assets and property efficiently, and ability to prepare short and long term farm development plans. Some farmers achieve successfully high level of capacity building arriving at Meister stage and some farmers achieve low level with Lehrling stage. Different literatures published in German and Japanese language show that many farmers in developed country are in Meister stage. However, there are no literatures found for the farmers of developing countries regarding in which stage of capacity building they are. Therefore, present study is undertaken to determine capacity building by life stage for the farmers in Bangladesh as a representative of developing country.

In developed countries like Germany and Japan agriculture is mostly capital intensive because of using heavy machines like tractor, combined harvester or greenhouses. For using these machines or plants

farmers need huge capital and they have to borrow capital from different financial institutions like banks, agricultural cooperatives etc. For receiving and payment of huge amount of loan farmers need to have financial management skill. The economy of Bangladesh is still dominated by agriculture sector. Around 19.6% of gross domestic product comes from agriculture (BBS 2006) in which crop and horticulture contributed 11.5% (BBS 2006). Among total labor force 48.1% employed in agriculture sector (BBS 2006). Approximately 79.4% farmers are landless (≤0.20ha), marginal (0.20ha to ≤0.40ha) and small farmers (0.40ha to ≤1.00ha) along with a dependency ratio of 3.60 and family size 5.19 (BBS 2007). Of them 25.2% are landless, and 31.4% are marginal farmers. With this salient feature the present study will also identify the current situation of Bangladesh agriculture whether it is capital or labor intensive and at which stage of capacity building he/she is.

There are some researches available in which managerial ability is found an important factor for improving efficiency of farming. Johanson (2007) empirically estimated the impact of personal aspects and decision making characteristics on farm level efficiency, in a sample of Swedish dairy farms. Individual beliefs of a person which can influence his decision are taken as a personal aspect. Öhlmer (1998) and Öhlmer *et al.* (1997) found a connection between the ability of a farmer and his or her locus of control i.e. individual beliefs. Rougoor *et al.* (1998) considered managerial capacity as consisting of both personal aspects of the manager (in terms of drives and motivations, abilities and capabilities, and biography) which affect decision making and which in turn affects the performance of a farmer. Solano *et al.* (2006) studies the impact of a series of biographical variables and decision making profiles, as a representative of the managerial capacity of the farmers, on the management and performance of their farm. They found that managerial capacity positively influences the performance of the farm. Trip *et al.* (2002) measured managerial efficiency for the commercial greenhouse growers. They considered decision making process as reflected by producers` goal, planning, data recording and evaluation. Kularatne and Takeya (2005) examined the management factor in relation to perennial crops or measured the implementation process to evaluate the management. There are no analytical studies found so far which considered physical, technical and managerial skill as factors for estimating capacity building of the farmers in developing countries. Therefore, the present study is focused on two aspects. First, determination of capacity building by life stage for the farmers in Bangladesh and second, identifying some factors which affect capacity building of the same farmers. It is expected that the findings of the study have some potentials to add some important knowledge on existing literature of capacity building study.

Methodology

Sample selection and data collection

Comilla, Bogra and Jessore districts of Bangladesh are selected as study areas for the present research. From these three districts 46 marginal farmers, 36 small farmers and 18 medium farmers were chosen by random sampling as samples. The data were collected using a pretested interview schedule through face to face interview.

Regression analysis

A multiple linear regression analysis was used to identify factors affecting capacity building of vegetable farmers in Bangladesh. The regression model is as follows (Gujarati, 2001).

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 D_{1i} + \beta_5 D_{2i}}$$

Where, Y_i = Total return from vegetable production of i^{th} farm, X_{1i} = Physical skill score of i^{th} farm, X_{2i} = Technical skill score of i^{th} farm, X_{3i} = Managerial skill score of i^{th} farm, D_{1i} = Communication skill dummy for i^{th} farm (1 for mobile phone using, 0 for otherwise), D_{2i} = Communication skill dummy for i^{th} farm (1 for using broadcast media, 0 for otherwise). Interpersonal communication is taken as base for using dummy variables.

Definition and measurement of variables

Considering the German concept of capacity building farmers need to develop their physical, technical and managerial skill. In this study physical skill is comprised of physical involvement of labor doing several agricultural activities and knowledge on doing these activities. Physical involvement of labor is divided into three parts; (1) land preparation, (2) Intercultural operation and (3) harvest and post harvest activity. Land preparation includes: ploughing, seed bed preparation, sowing/transplanting. Intercultural operation includes: establishment of bamboo stack/plastic net, fertilizing, irrigating, hilling, weeding, spraying pesticides. Harvest and post harvest activity includes: harvesting, handling, and grading. Technical skill includes use of recommended dose of seed/plant following required spacing, different kinds of chemical fertilizer with organic matter, application of required irrigation water, use of integrated pest management and spraying of plant protection chemicals at tolerance level. Managerial skill comprises of marketing skill, short term farm planning, labor management and financial management.

Marketing skill includes selling of products at wholesale market with appropriate grading, collection

of spot price information using mobile phone. Marginal and small farmers usually make short term farm planning for one year only because they lease lands from medium and large farmers. Medium and large farmers are almost keeping them absent from farming and they do not make any farm plan for a long term. Labor management includes employment of family and hired labor in different activities, determination of wage rate. Farmers have no book keeping experience to prepare day book, balance sheet and profit & loss statement. Therefore, financial management includes rough estimation of income and expenditure from farming, receiving and payment of loan. Capacity building by life stage is determined differently in two stages; first, how and when family members of a farm assist the farmer in different farming activities and second, how and when a farmer operate different farming activities independently by his/herself.

The dependent variable of the multiple regression analysis is measured in monetary terms to avoid an aggregation problem. Some vegetables are sold in number of pieces and some of them are sold in weight basis. Therefore, total return is used in monetary terms instead of physical quantity as a dependent variable. The farmers consume a portion of their vegetable products by themselves, distribute some portions to the relatives and sell the balance to the markets. Therefore, total return is calculated by aggregating the market values of consumed, distributed, and sold quantities. There is a positive relationship between total return from vegetable cultivation and capacity building of a farmer (Kamruzzaman and Takeya 2007). Therefore, total return is used as a proxy of capacity building for estimating the multiple regression model.

Physical skill score = Capability of physical involvement in j^{th} activity + technical knowledge on j^{th} activity. Thirteen agricultural activities are considered in this study where physical involvement is necessary along with technical knowledge. At first how many hours of physical involvement required for each activity are calculated and then average hours needed for each activity along with standard deviation are calculated for the samples of the study. High physical involvement is determined as; less than (average – 1/2 of standard deviation), medium as; within (average ± 1/2 standard deviation) and low as; greater than (average + 1/2 standard deviation). High, medium and low involved scored as 3, 2 and 1 respectively for each activity. Technical knowledge for each activity divided into two categories; low and high. If the farmer has adequate technical knowledge then a score of 2 is given and if inadequate then 1 is given. Therefore, a maximum of 65 and a minimum of 26 score can be obtained from 13 activities by each farmer for evaluating his physical skill.

Technical skill is calculated as; if a farmer follow recommended practice for transplanting, fertilizer application, irrigation water applied, integrated pest management, weeding and spraying of plant protection chemicals then a score of 2 is given for his high technical skill and if a farmer does not follow recommended practice for these activities then a score of 1 is given for his low technical skill. With this idea a farmer can obtain a maximum score of 12 and a minimum of 6.

Managerial score calculated as; if a farmer makes short term farm planning, grades their product according to size and shape, distributes labor according to their skill, receives loan, pays the loan in due time, maintains income and expenditure statement then a score of 2 is given, if they do not do it then a score of 1 is given. In addition, a score of 3, 2, and 1 is given if a farmer sells his product to the wholesale market, intermediary and local market respectively. Therefore, a farmer can obtain a maximum score of 15 and a minimum of 7. Communication skill is separated from managerial skill, because it is assumed that communication skill has a vital role in earning total return from farming. Therefore, high communication skill is treated for a farmer if he uses mobile phone for buying raw materials and selling his products, and obtains a score of 3 for his high communication skill, if a farmer uses broadcast media and interpersonal communication for this purpose then he obtains a score of 2 and 1 respectively.

Categorization of level of skill

Technical and managerial skills as well as the physical skill are categorized into three groups according to their scores obtained. Those whose score is ≥0.5 standard deviation below the mean score are categorized as “low” in each skill. Farmers whose score is ≤0.5 standard deviation on either side of the mean are categorized as “medium” in each skill and farmers with ≥0.5 standard deviation above the mean are categorized as “high” in each skill.

Results and discussion

Intensity of farming

Majority of rice farmers used human labor for conducting several agricultural activities for rice production. Of the farmers, marginal and small farmers used more than 50% of their total cost of rice production for human labor (Table 1). Among these farmers, around 40% of total cost was covered by the family members of marginal and small farmers whereas only 14% was shouldered by family labor for medium farmers. Power tillers are used for ploughing of land by the medium farmers and a small portion of marginal and small farmers used a power tiller hiring from other farmers for ploughing of their land. Therefore, most of the agricultural activities are still depended on human labor which indicates labor intensive farming is still dominated in Bangladesh. However, in Japan, only 36.4% of total cost of rice production is covered by labor

cost (MAFF 2005) and in Germany only 10% of total cost of agricultural production is covered by labor cost (FMFACP, 2006).

Table 1. Cost of rice production (per hectare) across different category of farmers.

Unit: Taka

Input use	Marginal		Small		Medium	
	Cost	%	Cost	%	Cost	%
Family labor (A)	10780	40.4	11550	40.2	4950	14.0
Hired labor (B)	3190	11.9	3630	12.6	6980	27.4
Human labor (A+B)	13790	52.3	15180	52.8	14630	41.5
Animal/Mechanical power	3750	14.0	3920	13.6	7450	21.1
Seed	1470	5.5	1520	5.3	1745	4.9
Fertilizer	4850	18.2	5050	17.6	6370	18.1
Irrigation	2210	8.3	2450	8.5	4250	12.0
Plant protection	450	1.7	625	2.2	840	2.4
Total cost	26700	100.0	28745	100.0	35285	100.0
Total return	44658		47521		58750	
BCR	1.67		1.65		1.66	

Source: Collected data by authors from interviews. Data in all tables and figures are the same as Table 1.

Vegetable production in Bangladesh is more labor intensive than rice because around 68% of the total cost of vegetables was covered by human labor for the marginal and small categories of farmers (Table 2). Majority of labor comes from family source for them. Medium farmers also have to spend around 58% of total cost for human labor, but a significant portion of human labor is used on hired basis for vegetable production. Because, family members of medium sized farms engaged themselves in non-farm business and in service out of agriculture. Vegetable production is also highly labor intensive compared to developed countries like Japan where, 40.6% of total cost is covered by labor for upland vegetable production (MAFF 2005).

Table 2. Cost of vegetable production (per hectare) for different categories of farmer

Unit: Taka

Input use	Marginal		Small		Medium	
	Cost	%	Cost	%	Cost	%
Family labor (A)	27515	53.4	27726	52.7	7012	11.0
Hired labor (B)	7264	14.1	7738	14.7	29975	47.2
Human labor (A+B)	34779	67.5	35464	67.4	36986	58.2
Animal/Mechanical power	3197	6.2	3305	6.3	9832	15.5
Seed	955	1.9	946	1.7	1103	1.8
Fertilizer	8329	16.2	8448	16.0	9972	15.7
Irrigation	2357	4.6	2464	4.7	3242	5.1
Plant protection	1886	3.7	2006	3.8	2439	3.8
Total cost	51504	100.0	52632	100.0	63575	100.0
Total return	197934		178835		130927	
BCR	3.85		3.42		2.06	

Involvement of labor for vegetable cultivation

Vegetable production is labor intensive. It shows high profitability (Sahabuddin and Dorosh 2002) and high correlation with capacity building ability (Kamruzzaman and Takeya 2007). Therefore, vegetable farmers are considered for this study to determine their capacity building by life stage. The results show that 2650, 2702 and 2818 hours of labor are engaged in per hectare of vegetable production for marginal, small and medium farmers respectively (Table 3). There are thirteen farming activities identified which requires human labor to be employed for vegetable production. Among these activities weeding and harvesting are the most labor intensive job. Because farmers have to uproot each individual weed around the plants and harvesting is done periodically depending on the maturity stage and high price getting opportunity. Therefore farmers have to develop their physical skill to perform well in the thirteen farming activities. It is assumed that farmers can build their capacity if they develop their physical skill at an early stage.

Table 3. Labor involvement (hours/ha) in different farming activity across farm category

	Marginal	Small	Medium
Land preparation	66	69	75
Seed bed preparation	59	59	67
Sowing/transplanting	170	173	180
Bamboo stack/net	38	40	44
Irrigation	158	162	173
Fertilizer	66	69	75
Weeding	960	966	980
Spraying pesticides	43	46	51
Harvesting	706	715	729
Handling	122	127	141
Grading	124	132	144
Carrying	90	94	103
Total	2650	2702	2818

Capacity building by life stage

Family members of the marginal and small farmers begin to assist the farmer in different farming activity at the age of 12.0, whereas medium farmers begin at the age of 15.5 (Table 4). Marginal and small farmers face disadvantages in terms of their limited resource base and small scale operations for producing of diversified crops, therefore family members of these groups of farmers engaged earlier in different farming activities to build up their capacity to earn additional income. Whereas, family members of the medium farm category are less interested to do farming business and their tendency is to do non-farm business and engage in service sector for earning more income. They also treated farming activity as an activity for poor people and they tried to maintain their social status not by doing farming but doing some non-farm business. Another reason is that younger family members of the medium farmers are usually go to high school and they also tend to think that agricultural activities is for the poor people who are irrational and they should engage in agricultural activities for its better performance. The medium farmers mostly used hired labor and machines for their agricultural activities and therefore, some of their family members started to assist the farmer a little later than marginal and small farmers.

Table 4. Physical involvement of vegetable farmers in different farming activity across farm category

Activity	Marginal		Small		Medium	
	Mean	Range	Mean	Range	Mean	Range
Land preparation	14.4	12.5-17.5	15.3	12.8-17.0	16.4	15.5-17.3
Intercultural operation	15.1	12.5-18.1	16.7	15.1-18.5	18.0	17.0-18.5
Harvest and post harvest	15.3	13.0-19.8	16.2	14.3-17.3	17.3	16.8-18.5
Marketing	15.7	12.0-18.0	18.1	13.5-20.0	18.8	17.0-21.0
Farm planning	18.5	16.0-21.3	19.9	17.0-21.7	21.5	20.3-22.7
Accounting	19.9	17.0-23.0	21.3	18.5-24.0	24.4	22.5-25.5

Similar trend is found for these groups of farmers when they started different farming activity independently (Figure 1). The result shows that majority of the marginal and small farmers are well ahead in Gehilfen[1] stage of capacity building than the medium category. Because, resource poor marginal and small farmers have to do their farming for meeting up their subsistence need and to improve their standard of living by increasing capacity of farm production.

The result also shows that farmers cannot enter into the Meister stage because marginal and small farmers cannot make long term farm development and financial management plan, maintenance of assets and properties etc. The marginal and small farmers have a small piece of owned land and they have to lease some lands from medium and large farmers. When they lease lands they cannot make a long term plan because land owners can take lands any time for their own purpose. Moreover, farm development plan requires specialized education in agriculture but the farmers in Bangladesh have no formal education at agricultural high school or college. The long term financial management plan also requires specialization in farm business management which is absent for the farmers in Bangladesh. Almost 80% of the farmers cannot use heavy machines like tractor, combined harvester, greenhouses because of their very limited resources. Therefore, farmers in Bangladesh can hardly enter into the Meister stage of capacity building.

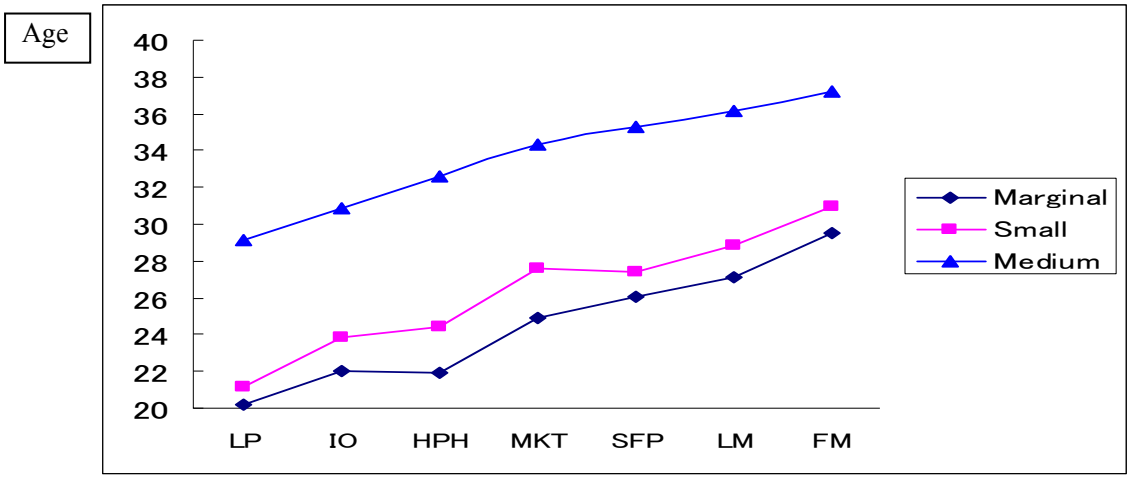

Figure 1. Similar trend is found for these groups of farmers when they started different farming activity independently.
Note: LP = Land preparation, IO = Intercultural operation, HPH = Harvest and post harvest activity, MKT = Marketing, SFP = Short term farm planning, LM = Labor management, FM = Financial management

Factors affecting capacity building

Physical and technical skill score is higher for marginal and small farmers than medium farmers (Table 5). Family members of the marginal and small farmers utilized their labor very efficiently because of their limited resource base. They participated in some training programs on how to produce vegetable in a scientific way, how to manage soil fertility, how to do integrated pest management etc given by department of agricultural extension or non-government organizations. Therefore, they have some technical knowledge on agricultural production which increases their technical knowledge base along with technical skill.

Table 5. Average score of physical and technical skills for the farmers across farm category.

Skills	Marginal	Small	Medium
Physical	56.5 (12.6)	52.0 (13.6)	33.9 (7.6)
Technical	10.5 (2.2)	9.5 (2.1)	6.8 (1.0)
Managerial score	13.4 (2.5)	12.1 (2.8)	9.0 (2.0)

Note: Maximum value for physical, technical and managerial score is 65, 12, and 15 respectively. Figures in the parentheses indicate respective standard deviation.

Regarding physical skill 67.4% of marginal and 58.3% of small farmers have high skill, whereas there are no medium farmers who have high skill (Table 6). Technical skill level was also high for marginal farmers (67.4%) followed by small farmers (44.4%). The tendency is also similar for managerial skill. The marginal and small farmers devoted themselves in farming activities to sustain their life using very limited resources. They have utilizes their family members owe to skill development to have high physical and technical skill of farming activities. Though physical and technical skill score is higher for marginal farmers than small and medium farmers but there is an increasing tendency of having high skill for small farmers also.

The result of multiple regression analysis shows that if physical score increase by 1 point then total return from vegetable production increases by Tk. 1762 (USD 25). The result also shows that mobile phone users for buying raw materials and selling products have a possibility of earning Tk. 18082 (USD 262) than the farmers who use interpersonal communication for this purpose (Table 7). The result also shows that physical skill is the most important factor with a standardized value of 0.58 for increasing total return than technical skill (0.21) and high communication skill dummy (0.20). The managerial skill factor does not show any significant factor for increasing total return. In earlier discussion we saw that vegetable production is highly labor intensive and it needs physical involvement of labor with some technical knowledge. The farmers also need to have some ideas on recommended practice of some agricultural activities which is defined as technical score also vital for increasing vegetable production. Communication skill also shows a significant role in increasing total return because farmers can sell their product at a high price prevailing in the market through mobile phone and broadcast media. Managerial skill in the study area can not play an important role because farmers do not use machines, greenhouses for vegetable production. Moreover, they cannot make any long term farm

development plan because of lease lands from the large and medium farmers, and medium farmers are almost out of farming business, engaging in non-farm business. Therefore, it can be concluded that physical skill is the dominant factor for increasing capacity building of the farmers in terms of earning total return.

Table 6. Distribution of different categories of farmers by physical, technical and managerial skill level.

Skill level	Marginal		Small		Medium	
	Count	%	Count	%	Count	%
Physical skill						
Low	12	26.1	11	30.6	15	83.3
Medium	3	6.5	4	11.1	3	16.7
High	31	67.4	21	58.3	0	0
Technical skill						
Low	12	26.1	12	33.3	17	94.4
Medium	3	6.5	8	22.2	1	5.6
High	31	67.4	16	44.4	0	0
Managerial skill						
Low	10	21.7	11	30.6	14	77.8
Medium	5	10.9	11	30.6	4	22.2
High	31	67.4	14	38.9	0	0

Table 7. Factors affecting capacity building of the farmers in the study area

Variable	Coefficient	Standard value	Sig. level
Constant	38042.4		
Physical skill	1762.3	0.58	8.16
Technical skill	3808.8	0.21	2.48
Managerial score	552.5	0.04	0.74
High communication skill dummy	18082.0	0.20	4.54
Medium communication skill dummy	5595.5	0.05	2.22

R^2 is 0.98 and F-value is 1734 with 5 and 94 degrees of freedom.

Conclusion

The findings of the present study revealed that some of the farmers in Bangladesh are in the second stage (Gehilfen) of capacity building and there is a minimum possibility to enter into final stage (Meister) of capacity building. Majority of Marginal and small farmers are well ahead in entering into the second stage of capacity building than the medium farmers. The study also identified that physical skill is the dominant factor for increasing capacity in vegetable production for the farmers. Therefore, marginal and small farmers could make agricultural productivity better than the medium farmers owe to skill development. This sort of studies has not yet done by any researchers for the developing countries. Moreover, the findings of the present study is based on the characteristics of Bangladeshi farmers, therefore, there is a possibility of including more developing countries to verify the present findings.

Note:

Lehrling, Gehilfen and Meister are the established stages of capacity building in developed countries like Germany and Japan. Farmers of those countries have to pass an examination with some designated experience to enter into next stage from the previous one. In Bangladesh, there are no formal licensing systems of capacity building by life stage like Germany and Japan. Therefore, it is hypothesized that the farmers who have high physical and technical skills are entering into the Gehilfen stage of capacity building from Lehrling stage.

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