Role of lemon \((Citrus \text{ limon})\) production on livelihoods of rural people in Bangladesh

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The study was undertaken to determine the role of lemon production relevant to rural people enhancing livelihoods status which have a great contribution to overall livelihoods pattern in their family and community. It was conducted on January to March 2015. A sample size of 21 respondents was drawn by using an interview schedule from Kathalia village of Muktagachha Upazila under Mymensingh District of Bangladesh. It revealed that 52.38\% farmers were not educated but constituted economically active. It was found that the yearly income of the respondents were USD 610 to USD 730 from one acre lemon field. It was also found that women played a significant role in lemon production along with their male counterparts. We observed that a varied level of male-female joint involvement for growing lemon in the study area. The lemon production improved the livelihoods of the farmers in terms of access to land, well house, social networks, health, education, income, decision making ability and saving pattern. It suggests that government should take initiative to provide training the farmers on modern agricultural technology and to supply agricultural inputs in time to ensure increasing lemon production and sustainable livelihood.

**Key words:** Lemon production, livelihoods, rural people, Bangladesh.

**INTRODUCTION**

Bangladesh, People’s Republic of Bangladesh, is a country of southern Asia and the area of the country is 147,570 sq. km with a population of about 160 million (BBS, 2012). Bangladesh is predominantly an agricultural country. Agriculture plays a dominant role in its economy in terms of sustainable land management, food security, value addition, employments and export earnings (Hortex Foundation 2013). Agriculture is the single largest land resource exploring sector. In recent years, there is a substantial increase in citrus production in our country. Annual citrus production of the world (from 1992 to 2002) grew at a rate of 2.3\% and annual citrus production of all types is over 110 million tons covering an area of nearly 18.7 million acres among it around 13.7 million tons of lemon and limes (Yara, 2017).

Lemon, belonging to the family of \textit{Rutaceae}, is one of the most common citrus productions. Presumably it is native to Assam (a region in northeast India), northern Burma, and China. Lemon is very important in respect of its nutritional values especially in Vitamin C (Sfgate, 2017).

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In Bangladesh, mean intake of Vitamin C is far below from the recommended dietary allowance (Ahmed et al., 1998; Nielsen, 2000; Hels et al., 2003; Khan and Ahmed, 2005) and 93% people are suffering from deficiency of Vitamin C. Lemon can be eaten fresh, which can solve this Vitamin C deficiency partially. It also contains some organic compounds, which work against asthma, antidepressant, stress relief, aids digestion, colds, flu, fever, nosebleeds, mouth ulcers, throat infection and boils (Sfgate, 2017). Various kinds of food items like Jam, Jelly, pickle and salad can also be prepared from it.

In Kathalia, 47.71% people depend on agriculture, 22.76% on agricultural laborer, 2.82% on wage laborer, 8.3% on commerce or business, 3.59% on service and other 14.82%. The occupation of the household head is an important socio-economic indicator to measure the livelihood status (Sarker, 2016). Commercial cultivation as well as homestead cultivation of lemon can be a potential source of livelihood for rural poor people. Previous studies showed that small scale agriculture had a positive impact on rural livelihood. Kabir et al (2012) found a positive and significant relationship between small agriculture enterprises with improvement of livelihood. Sarker et al (2016) showed a significant increase of income, housing asset and other livelihood components due to adoption of modern agricultural technology in Bangladesh.

Specific objectives

The main objective of this research was to determine how lemon production improved the livelihood status of rural poor people in Bangladesh. The other objectives as follows

a) To find out the impacts of change in livelihood due to lemon production in the rural area.
b) To assess the potentials of lemon production in the rural area.
c) To find out the different problems and probable solutions in lemon production in the rural area.

MATERIALS AND METHODS

Both qualitative and quantitative methods were used to produce the report. The survey method was applied in the present study because it was thought to have some advantages over other methods. Survey can be done by using three main methods (Dillion and Hardaker 1993). These are: direct field observation, collecting recorded information (secondary sources) and interviewing respondents (FGD) by semi structure questionnaire.

Kathalia village situated in Daogaon union Parishad of Muktagacha Upazila under Mymensingh district of Bangladesh has been purposively selected by the researcher team. International Fertilizer Development Center (IFDC) project is being implemented in the village with the cooperation of department of agriculture extension (DAE). We consulted with the International Fertilizer Development Center (IFDC) project staff and finally selected the area. The selection of the study area was based on the following main consideration: the area is famous for lemon production, lemon producers living in clusters and almost no study was done on livelihood of lemon producers. The interview schedule was prepared carefully to record the required data of various aspects of the study. A semi-structured questionnaire was used to collect data from respondents. We randomly selected 21 respondents (10 males and 11 females) for two Focus Group Discussions (FGD) for this study. Qualitative information were primarily collected by the team through FGD, transact walk and field observation. However quantitative data were gathered from Upazila respective government department, different study report as a secondary data source.

Physical Profile of the Study Area

Kathalia village under Daogaon union is 27 kilometers far from Mymensingh district headquarters and 10 kilometers (km) from the Muktagacha upazila headquarters in Bangladesh. The access to district headquarters is via a metallic and katcha road. Transport facilities are available from village to Upazila and district head quarters.

Environmental factors of the study area

Soil

The total agricultural land of this village is 61 hectares (ha). Three textural classes of soils exist: Sandy loam, loam and silt loam. Soil pH condition (4.62) and average organic matter (OM) content (2.57%) was responsible for higher lemon production. The soils have a moderate to strong acidic reaction.

Topography

There are three types of land in this village. Most of the land is under the medium-high land category and covers about 75 percent of the total cultivable land. Other categories are high land and medium low land, which cover 14 percent and 11 percent, respectively.

Climate condition

Climatic condition is moderate, annual rainfall from 2030-2290 mm, annual temperature from 10-37°C, humidity between 60 and 86%, duration of sunshine from 5-9 hours. Temperature fluctuations are high across the year. Minimum temperature prevails in the month of January and is about 10.9 - 12.3°C. Maximum
Table 1. Physical Profile of Kathalia Village

<table>
<thead>
<tr>
<th>Item</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village boundary North</td>
<td>Forest land of Rosulpur and Paharpabajan</td>
</tr>
<tr>
<td>South</td>
<td>Kath bowla</td>
</tr>
<tr>
<td>East</td>
<td>Kashimpur</td>
</tr>
<tr>
<td>West</td>
<td>Modhupur, Tangail</td>
</tr>
<tr>
<td>Total households</td>
<td>337</td>
</tr>
<tr>
<td>Total population</td>
<td>1546</td>
</tr>
<tr>
<td>Total cultivable land</td>
<td>61 ha</td>
</tr>
<tr>
<td>Total lemon production (2010-11)</td>
<td>4113 Hectares</td>
</tr>
<tr>
<td>Average family size</td>
<td>4.58</td>
</tr>
<tr>
<td>Religion</td>
<td>98% Muslim</td>
</tr>
<tr>
<td>Adult literacy rate</td>
<td>21.6%</td>
</tr>
<tr>
<td>Mosque</td>
<td>01</td>
</tr>
<tr>
<td>Metallic road</td>
<td>About 03 kilometer</td>
</tr>
<tr>
<td>Katcha road</td>
<td>05 kilometer</td>
</tr>
<tr>
<td>Community clinic</td>
<td>No</td>
</tr>
</tbody>
</table>

Figure 1. Kathalia village (study area) indicated in the Muktagacha Upazila map of Bangladesh

The temperature rises up to 35.00°C in the month of May. Hot air blows over the village from Mid February to May. In that area the amount of Sulphur (S) and moisture content is (11.62%). (DAE, Muktagacha, 2015).

RESULT AND DISCUSSION

Socio-economic Characteristics of the Respondents

Based on the case study report, lemon cultivation significantly changes the socio-economic conditions of the peoples of Kathalia village. Socio-economic features of the respondents are the important aspect to be discussed.

Age structure of the respondents

The age structure of the rural people in the study area was found to vary from 22 to 65 years with an average of 42.48. On the basis of the scores obtained, the rural people were classified into three categories, for example less than or equal to 30, 31-45, more than 45. The distribution of the rural people according to their age group...
Table 2. Age structure of the respondents

<table>
<thead>
<tr>
<th>Age group (Year)</th>
<th>No.</th>
<th>Percentage</th>
<th>Average age</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than or equal to 30 years</td>
<td>4</td>
<td>19.04</td>
<td>25.75</td>
</tr>
<tr>
<td>Age 31-45 years</td>
<td>9</td>
<td>42.85</td>
<td>39.56</td>
</tr>
<tr>
<td>More than 45 years</td>
<td>8</td>
<td>38.09</td>
<td>54.13</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>100</td>
<td>42.48</td>
</tr>
</tbody>
</table>

Table 3. Level of education of the respondents

<table>
<thead>
<tr>
<th>Level</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>5</td>
<td>23.81</td>
</tr>
<tr>
<td>Don’t complete primary education</td>
<td>6</td>
<td>28.57</td>
</tr>
<tr>
<td>Completed primary education</td>
<td>4</td>
<td>19.05</td>
</tr>
<tr>
<td>Primary level to SSC</td>
<td>5</td>
<td>23.81</td>
</tr>
<tr>
<td>More than SSC</td>
<td>1</td>
<td>4.76</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>100</td>
</tr>
</tbody>
</table>

is shown in Table 2.

Level of education of the respondent

Improving rural people’s education is probably the most important instrument to empowerment. Education is also critical for rural people in the fields of agriculture and non-agricultural employment, health, nutrition, children’s education and family planning. In Kathalia, rural people are now more conscious about their education. There are private sector Boys and Girls High school, and a government Primary school. Most of the children read in Rasulpur High School which is 1.5 km from the village. But sometimes, girls do not want to go to school, they like to read in madrasa (Islamic school). For College level education the villagers mainly depend to send their children to the upazila headquarter. The level of education of the respondents of the present study was assessed on the basis of classification of ‘cannot read and write’, ‘don’t complete primary education’, ‘completed primary education’, up to Secondary School Certificate (SSC)’ and ‘more than SSC’ which is shown in Table 3.

Lemon Production of the study area

Citrus is very important in respect of its nutritional values especially being very rich in Vitamin C. In Kathalia, lemon cultivation has started for about eight to ten years ago. Rural farmers cultivated banana and pine-apple before lemon cultivation in Kathalia. But now, lemon production has increased in large volume and getting better market price. By this lemon cultivation, peoples of Kathalia village introduced different types of modern lemon varieties outside of their area. They collected high yielding lemon varieties from Sylhet, Tangail, Manikgonj. They collected cuttings of Elachi, Kagozi, Colombo lemon variety from the different locations of the Bangladesh. Kagozi lebu has produced for only once a year, in March- April, as increased more production in May-June. Elachi lebu and Colombo lebu has produced in all time. Colombo lebu has two kinds like Manikgong Colombo lebu and Mymensingh Colombo lebu. Manikgong Colombo lebu has better production than Mymensingh Colombo lebu. Colombo lebu can tolerate water logging for seven to eight days. The farmers prefer the grafting seedling for their lemon garden because within one year of transplanting it gives fruit. In that area, the farmers prefer nine feet distance between two plants. About 400-500 seedlings were transplanted per acre in that area. They use fertilizers and organic matter in their lemon garden. Cost of gardening is almost about 5000 taka per acre. They use urea, triple superphosphate (TSP), muriate of potash (MOP) as fertilizer, and cow dung as organic matter. Crop diversification occurs in the Kathalia village due to starting of lemon production. Before lemon cultivation two or three crops produce there. After lemon cultivation, five or more inter crops (sathi foshol) like Papaya, Zinger, Termaric, Onion, Garlic, Kolocasia, etc. different types of vegetables crops produce in the lemon field as an intercrop, which increase the cropping intensity of that locality as well as increase the income from different crops, ultimately improve the economic status of the community. Besides the lemon cultivation,
Box 1. Descriptions of the Varieties

<table>
<thead>
<tr>
<th>Local name</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elachi lebu</td>
<td>Lemon</td>
<td>Citrus limon</td>
<td>BARI lebu-1, 2, 3 BAU lebu-2, BAU lebu-3</td>
</tr>
<tr>
<td>Colombo lebu</td>
<td>Colombo Lemon</td>
<td>Citrus spp</td>
<td>Colombo-Manikong, Colombo-Mymensingh</td>
</tr>
<tr>
<td>Kagozi lebu</td>
<td>Lime</td>
<td>C. aurantifolia</td>
<td>BAU kagozi lebu-1</td>
</tr>
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Box 2. Activity calendar in lemon production

<table>
<thead>
<tr>
<th>Activity/month</th>
<th>January</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<td>Land Preparation</td>
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<td>Pit Preparation</td>
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<td>Cutting Preparation</td>
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<td>Transplanting Cutting</td>
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<td>Pruning</td>
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<td>Fertilizers application</td>
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<tr>
<td>Plant/fruit protection</td>
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<td>Irrigation</td>
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<td>Harvesting of fruit</td>
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they produce rice, winter season high value vegetables like cabbage, cauliflower, tomato etc. they are raising livestock and poultry in their homestead area, which help them as additional income for their family needs.

Why respondents are more interested for more lemon production?

Farmers of the study area are more interested to cultivate lemon due to maximum and quick return. The market demand is higher than other citrus fruit. They can supply it all over the country. Lemon grower can utilize their land properly with low investment for cultivation of lemon. The entire family member can engage their effort for lemon cultivation. The demand of lemon in the market is always exist like essential vegetables.

TREND OF LEMON PRODUCTION IN BANGLADESH

The following graphs show the increase of lemon production in both area coverage as well as production. The production and area coverage gradually increase from 2002 to 2013 but sometimes fluctuated. The change of lemon production in year 2003 was 8.56 % higher than base year 2002 and growth of production is positive except the years 2007 and 2013. Production of lemon was 125.1 % higher than the previous year.

Net profit of lemon production compared to other crops

The lemon produced in the lands possess the soil is more suitable for any horticultural crop rather than rice production. Among the horticultural crops like pineapple, banana, mango and other fruits, lemon required less cultural practices and hence reduced labors. So, lemon production is more profitable than other horticultural crops as mentioned and obviously from rice. Actually the area now under the lemon production was remaining fallow earlier of lemon cultivation. This cultivable land though is very enough to cultivate cereal crops it is very suitable for horticultural crops like lemon and other fruits. The reason behind the fallow condition may be due to the belongingness of land, it is government Khas property and hence it was difficult for anyone to cultivate. At the same time the people are engaged in lemon production, were landless, day labor and unemployed. Now the land has owned by these people in the name of enemy property and got for 99 years as lease.
Role of lemon (Citrus limon) production on livelihoods of rural people in Bangladesh

Figure 1. Trend of lemon production (Metric ton and area (Ha))
Source: Graph produced from the data available at: http://www.factfish.com/statisticcountry/bangladesh/citrus+fruits,+total,+production+quantity

Figure 2. Net profit of lemon production compared to other crops and rice.

PROBLEMS AND POSSIBLE SOLUTIONS IN PROMOTING LEMON PRODUCTION

Pest and diseases in Lemon
There is acute infestation of some pests and diseases in lemon cultivation. Lemon butterfly (Papilio demoleus L), green caterpillar, leaf miner (Phylloncistis citrella St), die back (Colletotrichum gloeosporioides), leaf scald, canker (Xanthomonas axonopodis), greening (Candidatus liberibacter asiaticus) these are create a high production loss of the lemon farmers. For controlling these, farmers use different types of pesticides and insecticides for reducing their yield loss.

Irrigation problems
The total irrigated area of the village is 60 percent of cultivable land and the remaining 40 percent is rain fed. Irrigation problem in the dry season, it is the common
problem of the study area. Long time draught reduce the lemon production which impact on the cost of production of lemon. Yield loss reduces the profit margin of the lemon farmers. For reducing the yield loss, now they take some group initiatives, such as establish Deep Tube Well (DTW) and Shallow Tube Wells (STW) irrigation pump near their lemon garden. There are seven STWs and one DTW.

Lack storage facilities

There are no storage facility for lemon in the Kathalia village and even no processing plant. In the peak season while there is high production of lemon, the producers get low prices compared to the off-season and also the price consumers purchased.

Unavailability of technical supports

The lemon producers get minimum technical support from the pesticides dealers but lack of proper technical guidance and support from the DAE parts as well as other development partners in that area. Hence, the lemon cultivators suffering from low production instead of potential yield of lemon.

Monopoly marketing facility

Local middle men are now controlling the lemon business throughout the year and the producers are bound to sale their produces as per their set prices and the lemon cultivator cannot bargain for higher prices as there is no other market opportunity in the Kathalia village.

Lack of credit facility

They take micro credit from the different Micro-finance Institution MFI organizations, like Bangladesh Rural Advancement Committee (BRAC), Association for Social Advancement (ASA), BURU Bangladesh, Gameen Bank, ASPADA and local Rupali Samabai Samity for getting support for small business, others crop production, cow-goat-poultry rearing etc. Almost 80% villagers get loans from NGOs before starting the vegetable and crop production.

Lack of institution like cooperative among the lemon producers

Though lemon cultivation stated 10-12 years past but there is still no cooperative or institutional development in the area by the lemon growers. Even, the lemon producers did not able to form a common interest Group so that they will fight for their interest and promote to a financial institution development.

IMPACT OF LEMON PRODUCTION ON LIVELIHOODS OF THE COMMUNITY

Home status

Before lemon cultivation, people of Kathalia were suffered in many ways. They lived in a poor condition. But after lemon cultivation, they improve their home status. Many of the participants have Tin shed housing, some have half-building house and some have muddy walls. Most of the family has own tube-well. They drink water and cook from their tube-well but no gas for cooking. The villagers use leaves, wood, crop residues, jute stick and some farmers use cow dung as fuel for cooking. Every male and women has mobile telephone for contacting themselves. Besides lemon cultivation, they rear poultry, livestock and cultivate rice and various vegetables in their homestead garden. They use kerosene lamp due lack of solar system and current facilities. They charge their mobile battery in market.

Annual income

In the study area, some respondents (56%) have own cultivated land where they produce lemon and 44% farmers have no own land, who earn their livelihood by working for another’s land. Annual income of a respondent was determined on the basis of his total earnings from agriculture, service, business and other sources. They earn yearly USD610 to USD730 from one acre lemon field, deducting all types of production costs.

Sanitation facilities

The households in most cases use safer sources of water for drinking (tube well water 99.5%) as well as for other purposes. Majority (61.2%) of the household respondents using hygienic latrines while 39 % use unhygienic latrines (e.g. pit latrines without slabs, flush to unsafe hole or hanging latrine and no latrine/bush/open field). The proportion of open or hanging latrine is lower in the study area compared to national estimate. FGD and transect walk revealed that major portion of the villagers uses good ring-slab sanitation facilities.

Health facilities

The people of the Kathalia village especially the lemon growers were unable to avail health care services. In the livelihood pattern, among the basic needs food and shelter come first. Small and marginal people always compromise health facilities while they could not afford food and shelter. Lemon cultivation gradually increases family income of the growers. Now, the lemon producers are quite better in condition to have health facilities for
the family members. In the case of health facilities, villagers depend on the Upazila Public hospitals and get services from Upazila Public hospitals as well as Mymensingh Medical Collage hospital.

Infrastructural Development in the area

Lemon cultivation change the infrastructure situation of the Kathalia village, local government division constructed a road for creating linkages with the different growth center of that area like Rasulpur, Gabtoli, Madhupur and Muktagacha. People supply their product very easily to the different location of the country and they get fare price of their product.

SUSTAINABLE LIVELIHOOD FRAMEWORK AND LIVELIHOOD OF LEMON GROWERS

Natural assets (access to lemon land):

There was limited access to the natural assets like forest land, khas land, public water bodies etc. When the landless people got the access to the khas land by registering under the government Department, they are now entitle for the same and using this khas property for their livelihood options of better income and employment opportunity.

Physical assets (improved house built):

While they are engaged in the lemon production, their workforce giving them the opportunity of earning and thus helping them to subsisting their basic needs. Most of the lemon growers (58%) are now self-employed and have improved housing accommodation, sanitation, better physical assets.

Social assets (social networks)

Since, the lemon growers of the study area produced a high of lemon and sold it all over the country; they made a social network among many stakeholders like input supplier, buyer, middle man, other business man, NGO workers and government agricultural extension agent. This social networked always helped and motivated them to produce more lemon.

Human assets (health services, education):

Ten years experience of lemon production in the field and by themselves, the lemon growers are now skilled enough. Their knowledge and awareness also increased. They are now getting better education, health care and other livelihood facilities as well.

Financial assets (capital/income, credit)

Lemon production is year round enterprises which required labor force throughout the year, people of the kathalia village cannot pass leisure time. The people are now getting regular earning from lemon production as well as by selling labor in the same. The financial assets of lemon producers are increasing day by day.

RECOMMENDATIONS

a) Availability of modern variety lemon and of technology to the farmers, yield and production can be increased which may help to increase their income.

b) Farmers require fair price of fertilizers and lemon protection utilities.

c) Farmers desire to get quality disease and insect tolerant variety for getting higher return from lemon production.

d) Extension Facilities should be ensured.

e) Establishment of Sale center and development of Functional Linkage with high value market actors for ensuring fare prices of their produces.

f) Financial institutions development among the lemon producers.

g) Skill development in lemon production, marketing and it promotion.

h) Women empowerment through education, advocacy and awareness building.

CONCLUSION

From the case study, it may conclude that, the livelihood of lemon growers of Kathalia village mainly depends on lemon cultivation. The prime economy the peoples of that locality is lemon production base economy. All of the economic activities move on lemon production base. Before citrus cultivation, the socio-economic situation of Kathalia community was very poor condition. After introduction of lemon in that area, during the year of 2000, the socio-economic situation of the area change gradually. Increasing of economic activity of that locality changes the livelihoods status of the community peoples of Kathalia village. Presently the people of Kathalia village earn more money from the lemon cultivation and spend more money for their family needs. Increase of women participation in the different socio-cultural programs. Women empowerment increase day by day, female members of a family now contribute to make decision for their future planning. Rural poor women like land less women, women headed family member, widow, and these people work in the lemon field and earn 200-400 Taka daily. This helps them to local employment
opportunity. It creates employment opportunities of the other local people like power tiller driver, irrigation pump driver, fertilizers and pesticide retailer, small lemon collector, lemon supplier etc. So, the lemon production contributes to the overall economy in the study area. Besides the above opportunities in that area, there are some limitations also. Lack of cooperative society, financial support, credit facility, technical support, storage facility and marketing support; create some problems to increase their profit. So if they establish cooperative society in their area and started group cultivation they can overcome their problems.

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