AGRICULTURAL SUSTAINABILITY IN ASSAM- AN ECONOMIC ANALYSIS

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ABSTRACT

Sustainable agriculture integrates three main goals- environmental health, economic profitability, and social and economic equity which is very important for state like Assam where crop production is done under different environmental and economical stresses. The present study attempts to estimate agricultural sustainability for different districts of Assam with the help of an index namely Sustainable Livelihood Security Index (SLSI).The three indices, Ecological Security Index (ESI), Economic Efficiency Index (EEI) and Social Equity Index (SEI) were the prime components of this SLSI. The study revealed out wide variations in the agricultural systems of all the districts in Assam in regards of their ecological, economic efficiency and social equity aspects. Districts with the SLSI value of 0.40 and above were considered as advanced districts and others were as backward districts. It was seen, 56 per cent of all districts of Assam had an index of SLSI above 0.5, while only one district Dhubri was found as having SLSI value less than 0.40. This study is likely to influence researchers, policymakers and many others for the successful management of natural resources, biodiversity, food and nutritional security, ecosystem balance and other challenges on the way of supporting sustainable agricultural development in the state Assam.

Key words: Sustainability, Livelihood Security Index, Assam

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INTRODUCTION

Sustainable development in agriculture and its allied sectors is the management and conservation of natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development conserves natural resources is environmentally non-degrading, technically appropriate, economically viable and socially acceptable (FAO,1992). Conservation of energy, soil, and water is regarded as the basic element of sustainable agriculture. Sustainable agriculture integrates three main goals- environmental health, economic profitability, and social and economic equity. The success of sustainable agriculture depends on seven aspects viz., Crop diversification, Genetic diversity, integrated pest management (IPM), integrated nutrient management (INM), post harvest technology and sound extension programmes. Lack of sustainability in production under modern agriculture system or especially when it is subjected to the stress or perturbation, can be cured by adoption of sustainable agriculture. This has a great relevance for the state like Assam where crop production is generally performed under stress or perturbation.

The economy of Assam is predominantly agrarian. About 99 per cent area of total land mass of the State is rural and almost 50 per cent of the total land area is used for cultivation. The net cultivated area of the State is 28.11 lakh hectares, which is 35.83 per cent to total geographical area (2010-11). The contribution of the agriculture sector to the GSDP (at constant 2004-2005 prices) was 18.22 per cent in 2011-12(Quick estimate) (Economic Survey, 2012-13). This sector continues to support more than 75 per cent population of the State directly or indirectly providing employment of more than 53 per cent of the workforce and accounts for more than a third of Assam’s income. Assam accounts for a fairly significant share of the country’s acreage and output of many crops. Even though the state is richly endowed in natural resources, such as abundant rainfall, alluvial soil, rich and diverse plant and animal genetic base, development of agriculture in Assam has been slow over the decades. Consequently, the state is not just lagging behind most others in the country but is unable to meet its own requirements in many agricultural commodities. Agriculture in Assam exhibits most of the characteristics of underdeveloped/backward agriculture, namely, a high dependence on agriculture for livelihood, widespread practice of traditional farming techniques and correspondingly low usage of modern farm inputs, low level consumption of fertilizer (88 kg /ha) as compared to national level, inadequate irrigation facility, low levels and low growth in productivity and incomes in the sector, widespread prevalence of subsistence cultivation, poor / inadequate agricultural infrastructure, lack of assured water supply constraints the farmers to use better varieties of seeds and other complementary inputs and so on. Assam is purposively selected for the study because it faces wide inequality, inadequate management, over exploitation of natural resources and problems related gradually increased population which have created a threat to ecological, economical as well as social balance in different districts of Assam. This persistently increasing inequality has raised a big question mark on the successful development of sustainable agriculture in different districts and in the state as a whole.

In the present study, an attempt has been made to evaluate the existing status of agriculture of Assam and based on this, agricultural sustainability for different districts have been analyzed.

METHODOLOGY

The present study was conducted for 23 districts of the state for the year of 2010-11. Other four newly constructed districts of the state viz., Baksa, Chirang, Kamrup metro and Udalguri were not included in the study due to non availability of desired data. The whole study was conducted on secondary data collected from different published sources.

In the present study, an index namely Sustainable Livelihood Security Index (SLSI) was used for analysing agricultural sustainability and evaluating existing status. The SLSI methodology is a generalization of relative approach underlying the Human Development Index, developed by the United Nations Development programme (UNDP, 1992).The sustainability Livelihood Security Index (SLSI) was proposed by Swaminathan (1991) as an educational and policymaking tool to evaluate the potential of sustainable development. Swaminathan (1991) defined the concept of Sustainable Livelihood Security as 'livelihood options which are ecologically secured, economically efficient and socially equitable.' Based on this definition it can be concluded that SLSI is a composite of three indices viz., Ecological Security Index(ESI), Economic efficiency index (EEI) and Social Equity Index (SEI) (Hatai and Sen, 2008).

ANALYTICAL FRAMEWORK

Let X_{ijk} and $SLSI_{ijk}$ denote the value of the i^{th} variable, j^{th} component of k^{th} district and index for the i^{th} variable representing the j^{th} component of the SLSI of k^{th} district respectively. Then, we have:

$$SLSI_{ijk} = \frac{X_{ijk} - \min_k X_{ijk}}{\max_k X_{ijk} - \min_k X_{ijk}} \qquad \text{....... (1)}$$

$$SLSI_{ijk} = \frac{\max_k X_{ijk} - X_{ijk}}{\max_k X_{ijk} - \min_k X_{ijk}} \quad \text{...... (2)}$$

Where,

i =Variables (1, 2, 3...................., I)

j = Components (1, 2, 3..............., J)

k = Districts (1, 2, 3..................., K)

Equation (1) is applicable to variables having positive implications for SLS and Equation (2) is applicable to variables having negative implications for SLS. The numerators in Equation (1) and (2) measure the extent by which the k^{th} district did better in the i^{th} variable representing the j^{th} component of its SLSI as compared to the region(s) showing the worst performance. The denominator is actually the range, i.e. the difference between the maximum and minimum values of a given variable across districts, which is a simple statistical measure of total variation evinced by that variable. The denominator, in fact, serves as a scale or measuring rod by which the performance of each region is evaluated for a given variable.

Having calculated the $SLSI_{ijk}$ for all variables, the indices for various components of SLSI were calculated as a simple means of the indices of their respective variables, i.e.:

$$SLSI_{jk} = \frac{\sum_{i=1}^{I} SLSI_{ijk}}{I} \quad \text{.......... (3)}$$

Where,

j = 1, 2, 3.........................., J and

k = 1, 2, 3........................., K

Then, the composite indicator for each region was calculated as a weighted mean of the component indices obtained from Equation (3), i.e.

$$SLSI_{jk} = \sum_{j=1}^{J} \frac{SLSI_{ijk}}{W_{jk}\, J} \quad \text{................ (4)}$$

The W_{jk} in Equation (4) denotes the weight assigned to the jth component of SLSI of k^{th} region, and has the property that: W_{ik} +……………………+ W_{jk} = 1. If the weights are identical and sum up to unity, then SLSI is calculated as a simple mean. But, when the weights are different across all js and ks, then SLSI is calculated as a weighted mean. For distinction, the former has been denoted simply as 'SLSI' and the latter as 'SLSI*'. Since SLSI is composite in nature and the relative significance of its components varies across districts, there is also an inherent need to assign appropriate weights to different components according to their significance. In the present study, the proportionate contributions of ESI, EEI and SEI to SLSI were first obtained and then, used them as the weight to be assigned to each component.

Selection of variables for analysing agricultural sustainability

To empirically estimate SLSI, a simple approach was followed involving the selection of a set of variables or indicators having the ability to indicate more relevant and substantial information about the ecological, economic and equity aspects of sustainable development of agriculture (SDA). For instance, twelve variables have been selected to illustrate the three dimensions of SDA.

Ecological security is assessed based on four variables, viz. population density (per km^2), proportion of forest under geographical area (per cent), cropping intensity (per cent) and livestock density (per km^2). Effective utilization of human resources and improvement in the overall quality of life of households are important for the sustainable development. Human resources hold the key to breaking the stagnation in agricultural growth and productivity. Thus, the variable population density was selected in view of its capacity to reflect the extent of human pressure on the overall ecological security. High population density is expected to have a negative impact on ecological security. Forests play a vital role in maintaining ecological balance and contribute significantly to the state economy. Forest activities contribute significantly to the food security and livelihood of people living around forests. Since forest occurrence and growth is governed by regional specific geophysical conditions, the critical minimum forest cover essential for ensuring the ecological security does vary across regions. For instance, the respective critical minimum forest cover norms suggested by FAO for the plains, plateau and hills and mountainous regions are: 20 per cent, 33.3 per cent and 66.6 per cent, respectively. Hence, the variable forest cover was selected for ensuring ecological security. Cropping intensity measures the extent of land-use for cropping purposes during a given agricultural year. With a view to assess agricultural sustainability in the context of ecological security, cropping intensity variable has a significant contribution. Livestock sector plays an important role in the socio-economic development of a nation by contributing significantly to not only value-added products in agriculture and allied sector but also providing employments, incomes and nutritional security to both urban and rural households. Thus, livestock density was selected in view of its capacity to reflect the extent of animal pressure on the overall resources of environment.

Economic efficiency is explained by the four variables: yield rate of rice (q/ha), per capita output of food grains (kg/annum), fertilizer consumption (kg/ ha), and per capita income (Rs).

Being the main staple food, rice is widely cultivated in Assam. It covers around 90.57 per cent of the net area sown. Yield rate of rice influences directly or indirectly to the soil fertility, climate, irrigation, technologies and market performance. So the variable yield rate of rice was selected to assess the economic efficiency for agricultural sustainability. Food security at the household level is the ability of households to meet their daily food needs from their own production, or from off-farm sources (FAO, 1997). Hence the variable per capita output of food grain can explain food security status when it is contrasted with the critical minimum per capita grain availability i.e.180 kg/capita/ annum, suggested by Brown (1981). Food security is one of the most important concerns in Assam because of non availability of agricultural land and low productivity as compared to ever-increasing population. Again, optimum use of fertilizer at the appropriate time is an essential component for increasing agricultural productivity. It also protects land fertility by meeting the nutrition requirement of crops. Thus, the variable fertilizer consumption plays a crucial role in agricultural sustainability. Per capita income has a vital role in the process of national development. It also reflects the picture of the overall standard of living, economic strength and prosperity. So the variable per capita income has a good capacity to represent economic efficiency for agricultural sustainability. In the present study per capita Gross District Domestic product (GDDP) at constant 2004-2005 prices is used to serve as per capita income due to non availability of data on district wise per capita income.

Social equity is represented by the following four variables: female literacy (per cent), infant mortality rate, rural road connectivity (km) and villages electrified (per cent). Female literacy rate plays a vital role in the process of women empowerment and national development. It shows the existing status and potentiality not only for women's social and economic participation but for population stabilization also. So, the selected variable female literacy is capturing social equity for agricultural sustainability. Another selected variable infant mortality rate reflects the picture of health awareness scenario. So a high infant rate implies the poor health status. On the other hand, poor road connectivity reflects the backwardness of the region. So it is significant to address the important issue of rural infrastructure required for economic growth. About 99 per cent area of total land mass of the state is rural and around 86 per cent of total population live in rural area. So, village electrification in the state continues to be a matter of concern. It is an essential pre-requisite of social equity for achieving overall sustainable agricultural development. Despite variations and limitations, the selected variables do have a good capacity to reflect the picture of overall ecological, economic and equity aspects of a district's agricultural systems. (Table 1).

RESULTS AND DISCUSSION

The study revealed out wide range of sustainable status of different districts in those three aspects. The study showed that the values of sustainability status ranged from 0.23 to 0.73 for ESI, 0.11 to 0.71 for EEI and 0.13 to 0.78 for SEI (Table 3). This shows that the agricultural systems of all the districts in Assam display wide variations in their ecological, economic efficiency and social equity aspects. The SLSI of the districts ranged from 0.33 to 0.56 and SLSI* indicated a range from 0.34 to 0.62. The results indicated that there was a significant variation between SLSI and SLSI* values. The SLSI* ranking of various districts differed significantly from their SLSI ranking. The relatively narrower range of SLSI and SLSI* as compared to their component indices described that the performance of districts was not consistent across the three aspects (ESI, EEI and SEI) of sustainable development of agriculture (SDA). The SLSI* ranking appeared to effectively identify the advanced and backward districts. Districts with better SLSI* ranks were described as advanced districts using other ecological, economic and social indicators. On the other hand, the districts with the lower SLSI* ranks were named as backward districts, i.e. districts with poor conditions for sustainable development of agriculture during the reference period. Hence, SLSI* reflected the picture of overall performance of a district. The SLSI* ranking implied that the district having the best conditions for sustainable development of agriculture was Kamrup occupying the first rank, followed by Jorhat, Sivasagar and Karbi Anglong. Kamrup district having the state's capital was seen to possess a high economic efficiency as well as the highest social equity status which implied indices of more than 0.55. The districts having the least desirable conditions for SDA were Dhubri, followed by Karimganj, Morigaon and Dhemaji. Dhubri showed a very poor condition regarding all components status having indices value of lower than 0.35(except EEI).In case of simple SLSI rank, Karbi Anglong reached the top position, followed by Kamrup and Jorhat district, whereas Dhemaji and Dhubri had the last position followed by Morigaon and Karimganj (Table 3).

The component indices were calculated from their selected variable indices as described in Table 2. The variable indices were calculated from selected variables under different components as in Table1.The component indices indicated how the districts perform in the three dimensions of sustainability. In the context of inter-district comparison of component indices (ESI, EEI, SEI), in case of ESI, Dima Hasao did better than other districts followed by Karbi Anlong and Kokrajhar accounting for more than 0.50. Dima Hasao was subjected to have the lowest pressure of population on ecology, the highest forest coverage and a higher level of cropping intensity where all those variable indices accounted for more than 0.90(Table 2). The worst performing districts in ecological security were Nagaon, followed by Dhubri and Dibrugarh accounting less than even 0.30.The variable indices under ESI of Nagaon district implied its inadequate forest coverage, low cropping intensity and low livestock density status. Whereas EEI indicated that, Darang was most economically efficient district of Assam followed by Sivasagar and Nalbari. Darrang district showed a good scenario of economic efficiency indicating indices of high rice yield, the highest fertilizer consumption among all districts and high food security ranges from 0.74 to 1.00 (table2). While bottom listed districts in economic efficiency were Dhemaji, Dima Hasao,Karimganj and Nagaon. Demaji was reported to the lowest rice yield, lowest fertilizer consumption, very low level of per capita food grain and per capita GDDP. On the other hand, SEI showed that Kamrup district had better social equity status than any other district followed by Jorhat and Nagaon. Kamrup showed better performance in all variables considered under SEI implying variable indices of more than 0.55. The districts which performed worst in social equity were Kokrajhar followed by Dhubri and Morigaon. All selected variable indices under SEI of Kokrajhar district were less than 0.25 indicating a very poor status of social equity. Consequently, the overall performance of the districts in terms of their SLSI* revealed that thirteen districts out of 23 districts in Assam(about 56 per cent of all districts) had an index of SLSI above 0.50, while only one district (Dhubri) had SLSI* value lower than 0.40.

The study made a divisional comparison among Upper Assam, lower Assam, North Assam and Hills & Barak valley division of Assam regarding sustainable livelihood security status. All divisions showed almost similar performance. All districts of three divisions Upper, Hill & Barak valley and North showed an index of SLSI* above 0.40.In Lower Assam division except Dhubri, all other districts had an index of SLSI* above 0.45. So, Dhubri district demands for more priority to be given. Similar findings have been reported by Bharati and Sen (1997) that in the overall performance of several districts of Bihar in terms of their Relative Sustainable Livelihood Security Index (SLSI*), only about one-fourth of the 40 districts had SLSI* of above 0.50 and about half of the total districts had SLSI lower than 0.40.Another similar study conducted by Hatai and Sen (2008) revealed that as the overall performance of the districts Orissa in terms of their SLSI and SLSI* ,only eight districts out of 30 districts in Orissa (about 1/4th) had an index of SLSI above 0.50, while thirteen districts had SLSI* value lower than 0.40.

CONCLUSION

SLSI* approach helps in establishing inter-districts priorities for the allocation of agricultural resources and prioritizes the activities and programmes relevant to each district for sustainable agricultural development that is why the importance of SLSI (or SLSI*) has been increasing day by day. The districts with an SLSI* of less than 0.4 (poor conditions for SDA) should be accorded high priority in agricultural investment. If a given district has a lower ESI value than those of other two indices, then more focus should be made on afforestation, agro-forestry, cultivated area expansion and productivity enhancement, and livestock development in different economic and social orientation programmes. If EEI of any district is lower than others then priority should be given to increase per capita food grain production, better employment opportunities and adequate fertilizer application. On the other hand, if SEI of a certain district has a lower value as compared to values of other two indices, then more attention towards equity enhancing for better education, health facilities, sanitary living environment, and rural infrastructure for both road connectivity and electrification should be given a higher priority. However, the government of Assam has taken initiatives on expansion of cultivated area through mission double cropping, creation of employment opportunities through various entrepreneurship development programmes, different schemes under health departments that are expected to improve the SLSI to desired level. This SLSI approach of SDA will definitely influence producers, consumers, agribusiness entrepreneurs, traders, academicians, researchers, policymakers, input suppliers, food processors and many others for the successful management of natural resources, biodiversity, food and nutritional security, ecosystem balance and other challenges on the way of supporting sustainable agricultural development in the state Assam.

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