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# Socio-economic sustainability of urban and peri-urban agriculture in Kolkata Metropolitan Area: A criteria and indicator approach

Shrabana Mazumder, Kolkata

**Abstract**

*Urban and peri-urban agriculture (UPA) has been advocated as a key to address the challenges of rising poverty, food insecurity, and environmental degradation prevalent in expanding urban cities of the world. However, UPA is under intense pressure from the continuously expanding urbanisation process. Therefore, in order to integrate several economic and social benefits of UPA into urban planning, it is important to monitor the socio-economic sustainability of UPA in an urban area. This paper proposes a Criteria and Indicator (C&I) framework to assess the socio-economic sustainability of UPA. To evaluate the efficacy of the developed C&I framework, it was applied in the UPA areas of the Kolkata Metropolitan Area, one of the expanding megacities of India, and it resulted in some important findings. The current framework was structured based on a simplified Analytical Hierarchy Process and consists of 3 criteria 9 indicators and 28 verifiers. Results of the present study indicated that urban expansion and the influence of cosmopolitan culture have affected the characteristics of UPA in the study area, altering farm size, nature of crop productions, and social aspirations of farmers. The findings suggest that the proposed C&I framework can provide a basis to quantify and monitor the socio-economic sustainability of UPA across many similar regions with slight location-specific modifications.*

**Keywords:** *Urbanisation, subsistence farming, sustainable cityscape*

## Introduction

In contemporary urban areas of the developing world, socio-economic advantages are constrained by incessant population growth, which is expected to get aggravated in the near future. In this context, UPA is viewed as a paradigm for sustainable cities. Broadly defined as food production areas located within or immediately adjacent to urban regions (Mougeot, 2000; Hubbard and Onumah, 2001; Zezza and Tasciotti, 2010), many view it as a complementary strategy for achieving a balanced development of urban areas that can contribute significantly towards sustainable urban management (Veenhuizen and Danso, 2007; De Zeeuw *et al.*, 2011). Many scholars advocate UPA as a key strategy to achieve sustainable development goals such as ending poverty (Mougeot, 2000; Veenhuizen and Danso, 2007), zero hunger (Veenhuizen and Danso, 2007), sustainable consumption and production (Pribadi and Pauleit, 2015) and even to combat climate change (Konijnendijk *et al.*, 2004; Merson *et al.*, 2010) and make them functional especially in urban and peri-urban areas (FAO, 2018). Food production in urban and peri-urban areas has long been

a crucial part of food systems in developing nations. In spite of being a crucial part of food systems, UPA often suffers from economic un-sustainability and social acceptance in urban societies (Aubry *et al.*, 2012). According to earlier research, lack of socio-economic sustainability and population pressure have become crucial barriers, which together determine the future sustainability of agriculture in urban and peri-urban areas (Cahya, 2016; Krikser *et al.*, 2019; Mazumder *et al.*, 2021). Therefore, understanding the socio-economic sustainability status of UPA may aid in addressing the current challenges associated with its development. Therefore, consistent evaluation of the socio-economic sustainability of UPA is a crucial component that can have an impact on the overall sustainability of UPA of any region.

Criteria and Indicators (C&I) based sustainability assessment is one of the popular and efficient tools to determine the level of sustainability and consequently planning for achieving sustainability. C&I-based sustainability assessments are increasingly seen as important tools in the assessment and implementation of sustainable farming systems, as these provide the opportunity to build long-term government policies and also suitable measures to incorporate the knowledge of the farming communities within the frameworks of evaluation (Mendoza and Prabhu, 2000). However, there are currently no universally accepted structured C&I frameworks through which the socio-economic sustainability of UPA can be measured. Thus, the primary focus of the present study is to develop an appropriate C&I framework for the assessment of the socio-economic sustainability condition of UPA. The effectiveness of the developed framework was further tested in a case study on the UPA areas in the Kolkata Metropolitan Area (KMA).

## Material and method

The purpose of the present study deals with preparing a C&I framework for evaluating the socio-economic sustainability condition of UPA. To fulfill the above objective, a blend of top-down and bottom-up approaches has been adopted as discussed below.

### Procedure for developing the C&I framework

#### *Hierarchical organisation of the problem*

In the present study, the C&I structure was developed in a hierarchical manner based on the simplified Analytical Hierarchy Process (AHP) method which had been widely used as a multi-criteria decision analysis technique for optimizing solutions to complex multi-attribute problems (van Cauwenbergh *et al.*, 2007). In a C&I framework, a multi-attribute problem is first broken down into successive hierarchical orders, such as criteria, indicators, and verifiers (Mendoza and Prabhu, 2000). A criterion is the benchmark by which success in achieving the main principle can be assessed (Chattopadhyay and Datta, 2010). Indicators form the next level of hierarchy (Chattopadhyay and Datta, 2010). These are the variables of any type against which the compliance of a specific criterion can be checked in order to measure the same (van Cauwenbergh *et al.*, 2007). At the next lower level of the C&I hierarchy, verifiers provide highly specific details about the desired condition of an indicator, which adds meaning as well as precision to an indicator (van Cauwenbergh *et al.*, 2007). For this study, all the criteria, indicators, and verifiers

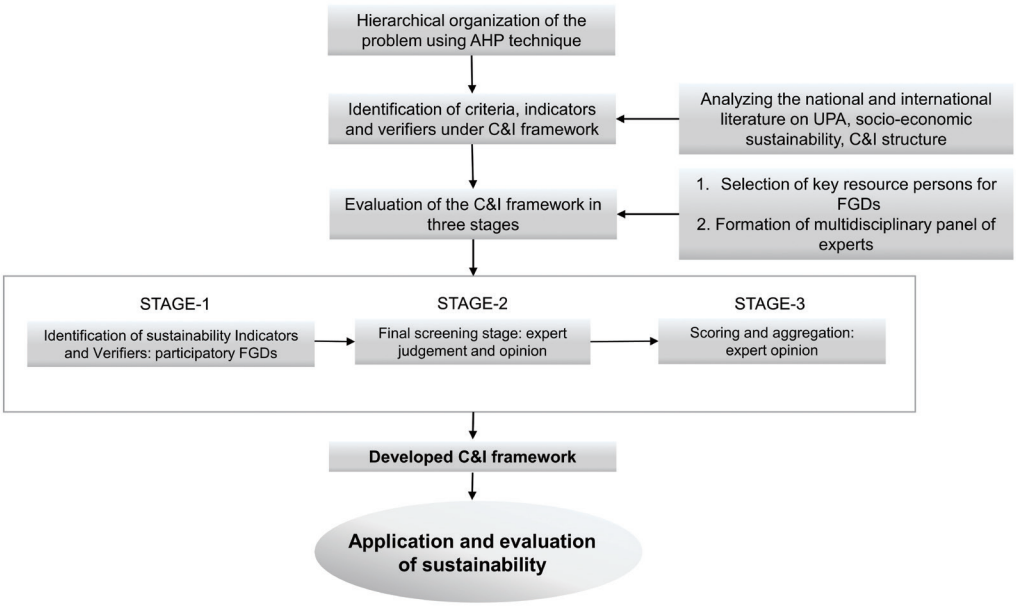


Fig. 1: Methodological structure of the study

are developed under the main principle which is the socio-economic sustainability of UPA (Fig. 3).

### *Selection of criteria, indicators, and verifiers*

Initially, a wide array of relevant criteria, indicators, and verifiers under the theme of 'socio-economic sustainability of agriculture' was compiled from the review of authenticated literature (Fig. 1). Various indicator frameworks of several organisations, *viz.*, the Organization for Economic Cooperation and Development, World Resources Institute, European Union, etc., as well as related literature (Woodhouse *et al.*, 2000; OECD, 2001; van Cauwenbergh *et al.*, 2007; FAO, 2014; Reytar *et al.*, 2014; Królczyk and Latawiec, 2015; Latruffe *et al.*, 2016; Kareemulla *et al.*, 2017), were consulted for selecting the criteria. The following principles were taken into consideration while choosing the indicators namely, indicators that needed to be quantitative and variation-sensitive, and they needed to be directly related to the theme (Gomontean *et al.*, 2008).

### *Evaluation of the C&I framework*

A core list of indicators that are pertinent in determining the socio-economic sustainability of UPA in KMA is sorted from the raw list in two phases. At the first phase, the preliminary set of indicators that were considered for the C&I framework was conveyed to the key resource persons to assess their regional suitability in a Focus Group Discussion (FGD) environment. Four FGDs were conducted for the study (Fig. 1). Out of these, two had 6 resource persons each, and the remaining two had 8 and 10 resource persons respectively. These resource persons were carefully selected based on their occupation, educational background, and gender. This group included representatives from various

stakeholders like conveners or secretary of farmers' and fishermen's cooperatives, Panchayat (village administrative council) representatives, graduate students of the locality, local teachers, and NGO representatives. This approach was conceived to enable the researcher to integrate the enriched knowledge of the resource persons on agriculture into a structured C&I framework. These resource persons reassessed the preliminary indicators and, on the basis of their suggestions, indicators were modified and added accordingly to the developed framework. In the second phase, the C&I framework was validated by a panel of experts1[1] who had in-depth knowledge of agro-ecosystem functioning as well as of the study area (Fig. 1). This panel was composed of members who hailed from the Department of Geography, Zoology and Botany of Jadavpur University, Alia University, Barasat Government College. The panel also had a former faculty of the Indian Institute of Technology, Kharagpur, and the Chairman of the West Bengal Pollution Control Board as distinguished members. In accordance with their reviews, additions, and alterations of the indicators were done to suit the current study.

### *Preparation of scoring guide*

An appropriate scoring guide was then prepared enabling the normalization of the data received from several parameters at the verifier level (Datta *et al.*, 2010). To prepare a legitimate yet simple scoring method for the current C&I structure, the scores were assigned to each verifier based on interviews conducted with the panel of experts (Fig. 1). In this study, a five-point scoring method was used to standardise data containing measurements in different units and in different scales. Each verifier was tagged with one of the five possible options *viz.*, 'A', 'B', 'C', 'D' and 'E' indicating 'very strong', 'strong', 'moderate' 'weak', and 'very weak' respectively. Each option from 'A' to 'E' was assigned a score in terms of 5, 4, 3, 2 and 1 respectively. These scores were assigned on the basis of the influence of each option over the socio-economic sustainability of UPA. Scores could not be assigned to a few of the verifiers with five options since the responses to these questions could be either 'yes' or 'no'. Hence, to maintain the five-point scoring system uniformly, all these binary questions were assigned a score of 5 for 'yes' and a score of 1 for 'no' respectively. Finally, as per the recommendation of the experts, all the scores of each verifier were added up under the respective indicator groups to get the cumulative score for every indicator. For aggregation of the scores of indicators, a simple summation method was recommended to be used implying that all the indicators were equally important.

### *Developing a composite sustainability index for UPA assessment*

In order to evaluate the socio-economic sustainability condition of UPA sites, a composite UPA sustainability index (UPASI) was developed in the current study. In order to compute the UPASI, the relative weights for each of the three criteria were assigned by applying the Principal Component Analysis (PCA) technique. Finally, the UPASI of a particular UPA site was calculated by multiplying the aggregate score of each

[1] These experts were drawn from a variety of disciplines including geography; architecture and planning; botany and zoology apart from some eminent scholars from the West Bengal pollution control board, Kolkata; and a (former) regional chair for South Asia of the IUCN Commission on Ecosystem Management.

criterion with the corresponding relative weight of that criterion (ai) derived from PCA and then adding them together. This weighted scoring technique was applied to assess the actual contribution of each criterion in explaining the socio-economic sustainability condition of UPA. The method for computing the UPASI is as given below:

$$UPASI = \sum_{i=1}^{n} a_i \times C_i$$

Where,

$a_i$ = 1st PCA value of ith criteria; (i =1, 2,..., n),

$C_i$ = composite score of ith criteria; (i =1, 2,..., n).

The higher UPASI score indicated greater sustainability and progress towards meeting the societal and economic viability and vice versa for all the surveyed sites. Based on the mean (μ) and the standard deviation (σ) values of the composite scores of all UPA sites, the entire study area had been classified into five sustainability classes, i.e. very high [> (μ+ 1.5σ)], high [(μ+ 1.5σ) to (μ+ 0.5σ)], moderate [(μ+ 0.5σ) to (μ- 0.5σ)], low [(μ- 0.5σ) to (μ- 1.5σ)] and very low [< (μ- 1.5σ)].

## Data collection

The data collection process was done by interviewing key members of the farming

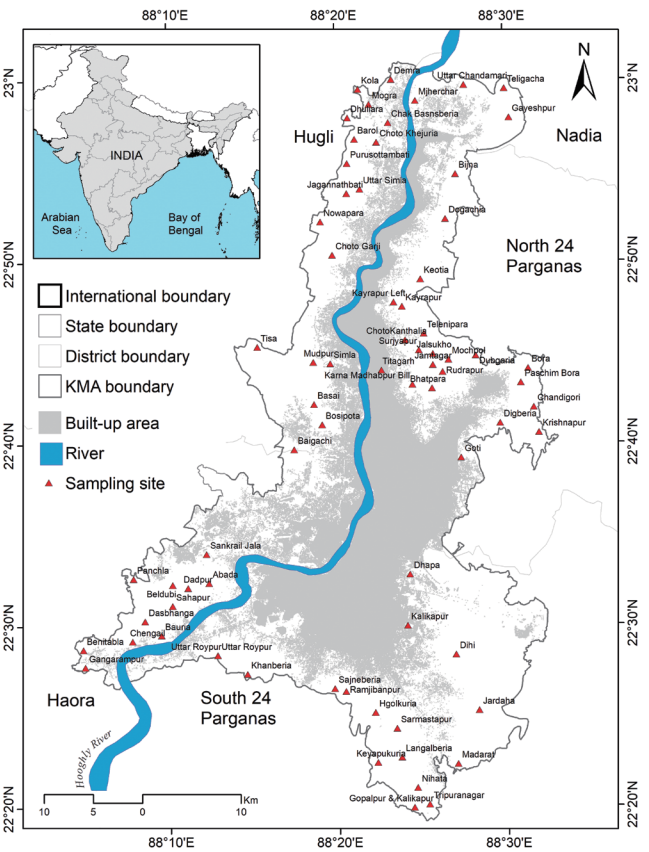


Fig. 2: Location of the study area

and fishermen community through structured questionnaires at 72 UPA sites of the case study area identified by the researchers through the detailed ground survey.

## Case study

In order to check the effectiveness of the developed C&I framework, a case study was carried out in the agricultural sites of KMA (Fig. 2). The KMA, which has a total area of 1380 $km^2$ that fall under the jurisdiction of the KMC as well as its neighbouring municipalities, suburbs, and rural areas that are economically and socially connected to the city of Kolkata (KMDA, 2005). The agricultural lands were present in the peripheral parts barring a few core areas of KMA. These UPA areas are the main reservoir of biodiversity in the study area (Ghosh, 2010). Additionally, the agricultural produce of these UPA areas is a vital source of food for the population of the KMA. With the gradual spread of urban areas, many of the erstwhile agricultural lands, which were once the conspicuous land use in peri-urban areas of KMA are now being converted to non-agricultural land to accommodate the ever-increasing population (Mazumder *et al.*, 2021). UPA has not been considered an essential part of the urban planning process of KMA because agriculture has never been seen as a viable source of income for the urban populace. Therefore, the UPA's continued existence is gravely threatened by high population pressure combined with inadequate support from local planning authorities.

## Results

The developed C&I framework and the results of the socio-economic sustainability assessment of those sites using the framework have been explained in the following paragraphs.

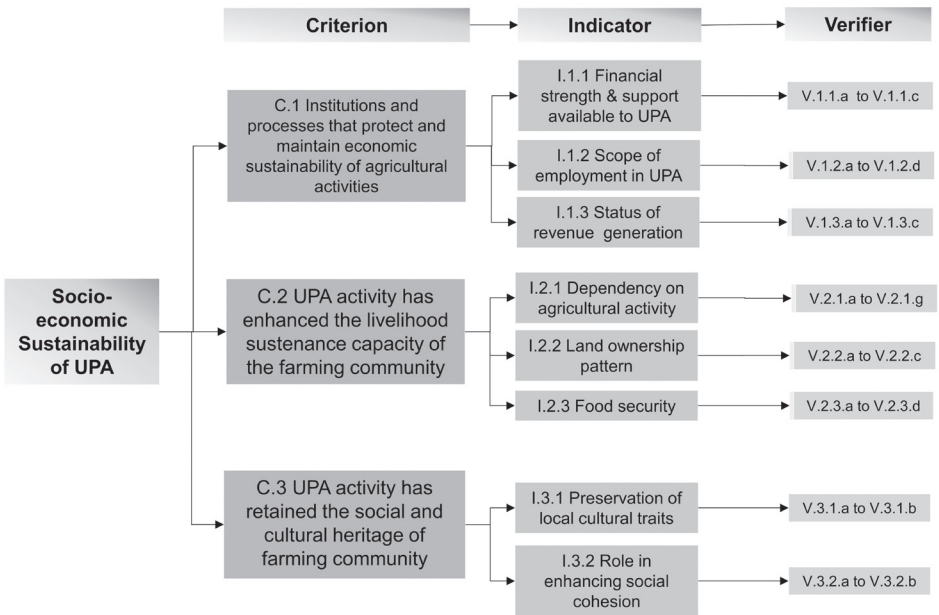


Fig. 3: C&I framework

## Developed C&I framework

From the perspective of UPA, socio-economic sustainability primarily implies that agricultural activities should assure economic sustainability and enhancement of livelihood options (Van Veenhuizen and Danso, 2007). Further, it must be noted that economic viability was often a precondition for social well-being. Many parameters of social well-being (e.g., land ownership, food security, women empowerment, etc.) of the farming community depended on economic well-being. The economic profitability of UPA would provide prosperity to the farming household and, thus, ensure the social well-being of the farming community. The present C&I framework uses three criteria, eight indicators, and 28 verifiers to evaluate the multifaceted relationship in the context of sustainability (Fig. 3).

### *Selection of indicators and verifiers under criteria 1 (C.1)*

The economic unsustainability of agricultural activities was identified as a prime constraint for the survival of UPA. Since UPA activity had to compete with other more profit-making activities in urban areas, the aspect of economic sustainability had become more relevant for the sustainability of UPA. Here, the first criterion (C.1) was selected to evaluate the role of institutions and processes that protect and maintain the economic sustainability of agricultural activities. In order to assess the economic strength, three indicators were considered under C.1. Easy and adequate provisions of finances were perceived as crucial for the sustenance of agricultural activity since agricultural practice demanded constant capital investments. Hence, the first indicator

| Indicators | No. | Verifiers |
|---|---|---|
| I.1.1 | V.1.1.a | Microcredit support for agricultural infrastructure like, farm machinery, seed & fertiliser, irrigation infrastructure, insurance |
| | V.1.1.b | Source of financial support for UPA |
| | V.1.1.c | Provision of contract farming/ direct selling in the locality |
| I.1.2 | V.1.2.a | Number of people employed in the farm in the last one year per unit of land |
| | V.1.2.b | Percentage increase of new jobs per hectare in last one year in comparison to the previous year |
| | V.1.2.c | Percentage of young workers employed in the working group per hectare |
| | V.1.2.d | Increase in number of agriculture related nonfarm activities in last 5 years |
| I.1.3 | V.1.3.a | Cumulative per capita income generated from UPA activities |
| | V.1.3.b | Increase in UPA-based revenue generation from prior years |
| | V.1.3.c | Does UPA activities address all your livelihood needs |
| I.2.1 | V.2.1.a | Share of total family income from UPA |
| | V.2.1.b | Proportion of farm yield kept for own consumption |
| | V.2.1.c | No. of non-working family members depends on unit farm income |
| | V.2.1.d | The group of farmers are organised in a formal way towards the betterment of UPA, e.g., association, cooperative |
| | V.2.1.e | Percentage of women population in the working group |
| | V.2.1.f | Perception of farmers on the future of UPA in their locality in long run |
| | V.2.1.g | Status of non-marketed products/ services/goods used for own household consumption |
| I.2.2 | V.2.2.a | Land ownership pattern of the UPA practitioners |
| | V.2.2.b | Willingness of the successors to continue UPA activities in future |
| | V.2.2.c | Farms co-owned by female member of the family |
| I.2.3 | V.2.3.a | Proportion of the protein consumption (both animal and plant sources) in farming households |
| | V.2.3.b | General dietary composition of the family for the last 7 days |
| | V.2.3.c | Proportion of expenditure spent on buying food from the market/ month |
| | V.2.3.d | Cases of Starving occurred in the family in the last 5 years |
| I.3.1 | V.3.1.a | Perception of the farmers about the connection of the produce from UPA with the socio cultural identity with of the area |
| | V.3.1.b | Perception of the farmers about the usage of any indigenous/ traditional knowledge for crop production |
| I.3.2 | V.3.2.a | How many times in the last one year all the farmers of your Gram Sabha had gathered for a meeting to exchange your views and concern regarding UPA |
| | V.3.2.b | Instances of voluntary collective actions observed while practicing UPA |

Fig. 4: List of verifiers

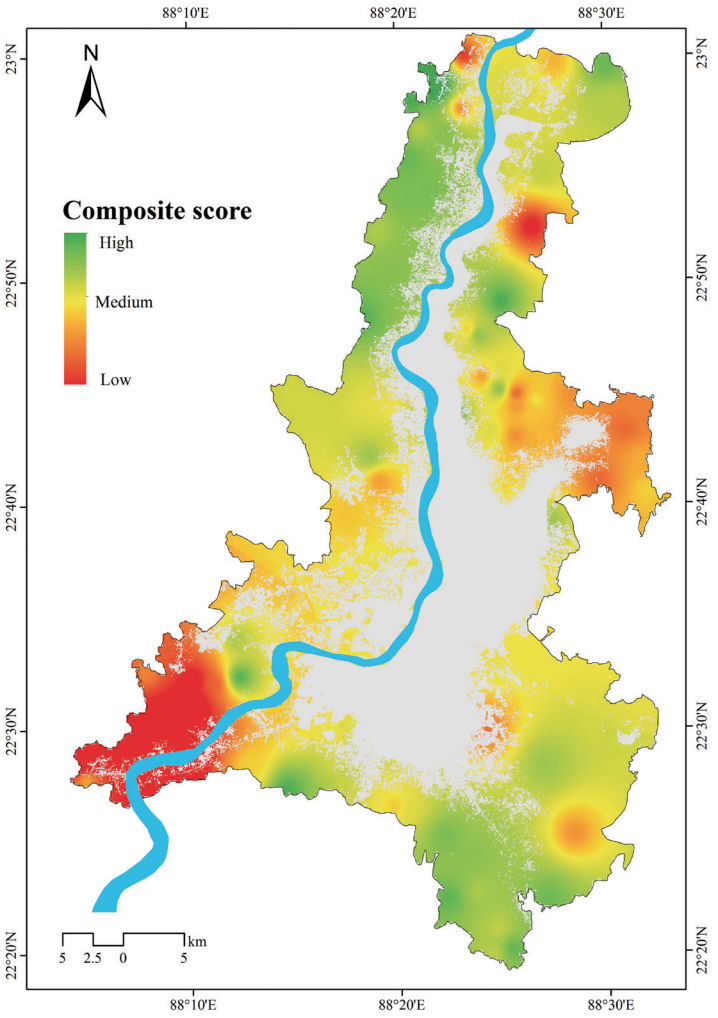


Fig. 5: Socio-economic sustainability status of UPA

recognised was the financial strength and support available to UPA (I.1.1). In reality, several formal and informal institutions would be the source for providing capital through loans, incentives, and even insurance for production and business activities. The roles of Self Help Groups, cooperative banks, and microfinance organizations are important in this regard (Kumar *et al.*, 2015). In this context two verifiers i.e., V.1.1.a, and V.1.1.b were constructed to assess I.1.1 (Fig. 4). Provision of contract farming or direct selling in the locality (V.1.1.c) was carefully chosen as another relevant verifier by the panel of experts to assess financial strength of UPA as these two features would provide additional and stable avenues of earning to the UPA farmers. Further, the experts suggest that capacity for employment generation was a fundamental parameter for the economic sustainability of UPA. In this regard, the scope of employment in UPA was considered

as the second indicator (I.1.2) to assess the economic strength of agricultural activities. To assess this criterion, four verifiers (V.1.2.a, to V.1.2.d) were designed (Fig. 4). The measurement of the revenue generation of a farm had a primary role in the economic sustainability of UPA (Van Veenhuizen and Danso, 2007). While developing the C&I framework it was presumed that the farmer gets motivated to actively engage in UPA if earning from UPA is better. Based on these premises, the third indicator (I.1.3) i.e., the status of revenue generation was developed. For evaluating the status of revenue generation through agricultural production in UPA areas of KMA, three verifiers, i.e., V.1.3.a, V.1.3.b, and V.1.3.c, were constructed (Fig. 4).

### *Selection of indicators and verifiers under criteria 2 (C.2)*

Sustained livelihood generation was identified as an important indicator for assessing the socio-economic well-being of a community (Van Veenhuizen and Danso, 2007). Therefore, to analyse the livelihood sustenance capacity of UPA, the second criterion (C.2) is selected. In cities where other job opportunities are available, UPA can be feasible if the minimum livelihood needs and social aspirations of its practitioners are fulfilled. It was further assumed that sustained livelihood would eventually provide social security to the farming community and ensure the continuity of UPA among the younger generation. Based on these principles, the first indicator, i.e., dependence on UPA activity (I.2.1) was constructed to assess the livelihood sustenance capacity of UPA. Based on suggestions of the experts and local resource persons, seven verifiers (V.2.1.a, to V.2.1.g) were identified to assess this indicator (Fig. 4). The second indicator (I.2.2) under C.2 dealt with the land tenure arrangement which was recognized in FGDs as an important parameter for the farm to be sustainable. Access to land is often influenced by factors such as gender, caste, and economic and political position of the owner which is why these factors were recognised while selecting the verifiers under this indicator. In order to assess I.2.2, three verifiers were constructed i.e., V.2.2.a, V.2.2.b, and V.2.2.c (Fig. 4). Since one of the basic objectives of the UPA was to ensure safe, sufficient and diverse sources of food, the third indicator identified under C.2 was food security (I.2.3). Well-known indicators of food security at household levels (Maxwell *et al.*, 1998; Prain and Lee-Smith, 2010) like dietary diversity, food frequency, behaviours related to food consumption, etc., have been considered. Four verifiers (V.2.3.a, to V.2.3.d) are selected to assess the food security situation of the UPA farming households in KMA (Fig. 4).

### *Selection of indicators and verifiers under criteria 3 (C.3)*

In India, agriculture forms an integral part of society and economy. Here a co-evolution of culture and nature, humans and landscape had been seen through the ages. The third criterion (C.3) identified in this context was UPA activity which had retained the social and cultural heritage of the farming community (Fig. 3). There is a two-way relationship between agriculture and cultural sustainability. On one hand, agricultural practices have moulded the cultural traits of the farming community over time (Wu, 2010). On the other hand, the resilience of the UPA system depended on the traditional farming knowledge of local people (Singh, 2020). Traditional farming knowledge (e.g., preservation of traditional varieties, breeds,

and agricultural techniques) that had evolved through adaptive processes and transmitted over generations by cultural dissemination was found to have a notable impact on the sustainability of farming practices (Reyes-García *et al.*, 2014). Similar knowledge also helped to cope with and adapt to the negative impacts of urbanisation and climate change (Reyes-García *et al.*, 2014). Accordingly, the cultural dimensions of UPA were conceived as an integral part of the overall well-being of the farming community by the panel of experts. These cultural aspects of UPA were evaluated under an indicator (I.3.1) i.e., the role of UPA in the preservation of local cultural traits and heritages. To assess this indicator, two verifiers were chosen i.e., V.3.1.a, and V.3.1.b (Fig. 4).

The survival and prosperity of a community depend on the level of cohesion and mutual understanding between the members regarding the sharing of knowledge and resources. In an agricultural community, a cooperative spirit among the members for developmental activities helps in the survival and growth of the community (Chattopadhyay and Datta, 2010). Hence, the role of UPA in enhancing social cohesion was considered as the second important indicator (I.3.2) to assess the level of mutual understanding among the UPA practitioners. In order to assess this indicator, two verifiers (V.3.2.a, and V.3.2.b) were identified (Fig. 4).

### *Assessment of the socio-economic sustainability condition of UPA sites*

After the collection of data from 72 UPA sites in KMA, a comprehensive UPASI score for each site was prepared by merging the scores of each of the three criteria with the corresponding average relative weights (ai) assigned to each criterion. Finally, based on the composite UPASI, the entire study area was classified into five sustainability zones, i.e., very high, high, moderate, low, and very low (Fig. 5). The composite sustainability score in most parts of UPA ranges from moderate to low. In general, very high to high UPA sustainability was found in the north-western and western parts of KMA like Magra, Kola, Chota Khejuria, Purushattombati, and Dhopapukur (Fig. 5). This zonal pattern of UPA sustainability was also observed in the eastern and south-eastern parts e.g., in areas like Keotia, Kayrapur, Titagarh, Tripuranagar, Keyapukuria, Sarmastapur, Hogalkuria etc. (Fig. 5). This status is attributed to the relatively stable economic condition of the farmers in these UPA sites. Diversification of agriculture through orchard farming or the creation of aquaculture ponds in these areas has increased the livelihood sustenance capacity of the farming community resulting in better performance of these areas. Active involvement of *Panchayats* (and district agricultural offices in implementing sustainable agricultural practices (e.g., soil testing, helping to build composting pits, etc.) in these areas were the other important causes of better performances.

In contrast to this, low and moderate socio-economic sustainability areas were uniformly distributed in KMA which indicated that the vulnerable condition of UPA was not a unique phenomenon confined to any particular part of the study area. The massive growth of urban built-up and consequent reduction in suitable land for agriculture had notably impacted the UPA activity of these regions. Lesser initiatives for the restoration of UPA by the local government, alternative employment opportunities, and increasing scarcity of land were identified as the

major causes behind the low and moderate sustainability status of the UPA in these sites. The lowest sustainability status was found in Bauria followed by Benitabla, Chengail, Sahapur, Dasbhanga, and Beldubi (south-eastern parts of the study area) (Fig. 5). The cascading effect of highway expansion and formation of the retail market complex adjacent to these UPA sites are the primary reasons for deterioration of the agricultural landscape and low sustainability.

## Discussion

For the present research, a hybrid method was adopted combining both top-down and bottom-up approaches for framing the C&I structure. The efficacy of a bottom-up approach lies in its ability to evaluate and monitor local challenges and problems (Mendoza and Prabhu, 2000; Gomontean *et al.*, 2008; Khadka, and Vacik, 2012) as well as to accommodate the perception and knowledge of the stakeholders (Mendoza and Prabhu, 2000). The results of this study clearly show that using a bottom-up approach to choose and fine-tune the C&I framework has propelled the decision-making process that could definitely enhance the scope of framing suitable location-specific policies in the future. However, the indicator selection process for sustainability analysis through a bottom-up approach can be subjective since the stakeholders' opinions are accorded primacy, wherein the stakeholders' perception can have a biased effect on the index. Therefore, to make the framework more objective, experts' opinion was used to fine-tune the list of indicators and PCA was used to assign weights to the selected indicators.

The case study presented here showed that the livelihood sustenance capacity of UPA is the primary motivating factor for the farmers to continue UPA in the study area- a finding widely corroborated by many previous studies conducted in developing countries (De Zeeuw *et al.*, 2011; Aubry *et al.*, 2012). The small and fragmented peri-urban land holdings in KMA were no longer found profitable for commercial paddy farming. However, it was found during the field survey that, integrated farming (i.e., combination of pisciculture/orchard along with rice and vegetable farming) was more economically sustainable than non-integrated farming (i.e., only seasonal rice farming). Therefore, a distinct trend of transformation from seasonal paddy farming to more economically sustainable orchard farming and aquaculture was observed in many parts of KMA. This trend was more prominent in the north-western, north-eastern, and south-eastern parts of the study area. These regions of KMA have a long tradition of orchard cultivation (Mazumder *et al.*, 2021). Therefore, farmers were better able to adjust to this change because of the customary regional knowledge of orchard cultivation. Additionally, since horticultural produce has a high economic value in the local market (Haldar, Pal, and Singh, 2018) farmers gleefully accepted orchard cultivation as a more lucrative farming option. The findings of the field study showed that overall scores of criteria, evaluating livelihood and economic sustainability aspects of UPA, were better than the scores for the cultural aspect of UPA which demonstrates that the UPA farmers of KMA valued general well-being benefits over UPA's cultural advantages. It is true that mobility and economic transactions have considerably increased in peri-urban areas of KMA with more non-farming livelihood options available. The FGDs and field investigation revealed a few additional

factors that contributed to the young generations of these UPA households having less involvement in agriculture, which include non-profitability in the agricultural sector, higher levels of education, and quick monetary gain owing to rapid real estate market growth. Therefore, it can be inferred that the current socio-economic sustainability status of UPA is favourable only in a few pockets of KMA whereas it is unfavourable in the majority of the UPA sites, which may deteriorate in the near future unless appropriate management measures are adopted by the local authorities.

## Conclusion

The concept of C&I was developed as a powerful instrument for facilitating sustainable management of natural resources which addresses a wide variety of issues including environmental, social, and cultural sustainability (Mendoza and Prabhu, 2000; Chattopadhyay and Datta, 2010). However, the application of the C&I framework for the sustainability assessment of UPA is conspicuously absent. Therefore, the most significant outcome of the present study was the systematic formulation of a C&I framework for the evaluation of the socio-economic sustainability of UPA.

The study made it evident that spatial variability of the sustainability status of UPA was effectively determined with the help of this C&I framework even within a limited area as in KMA, due to the variation in different stress factors like population pressure, agricultural land conversion, shortage of labour, seasonality of agriculture, etc. This framework was also effective in highlighting the strengths and weaknesses of UPA activities in KMA. Furthermore, the developed C&I structure can also be used to understand the dynamics of the individual indicators influencing the socio-economic sustainability of UPA. This C&I framework could be applied to any other areas by context-based suitable modification of the indicators after careful consideration of the influence on the outcome of the sustainability assessment.

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## Competing interest

The author declares that she has no conflict of interest.

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**Shrabana Mazumder**
Department of Geography,
Barasat Government College,
Barasat, Kolkata
E-mail: oli.sengupta@gmail.com