

Characterizing rural food environments in South Asia

Research Note 2, Work Package 3
December 2022

ABOUT THIS NOTE

TAFSSA (Transforming Agrifood Systems in South Asia), a CGIAR Regional Integrated Initiative, addresses food system challenges by delivering actionable evidence and scalable innovations in South Asia. This brief provides an overview of TAFSSA's study on "Characterizing the rural food environments in South Asia". The evidence generated from this study would promote reshaping of rural food environments to improve access to affordable nutritious foods in rural South Asia.

BROAD RESEARCH QUESTIONS

1. What factors in the food environment influence access to and purchase of nutritious food?
2. How can food environments be improved in rural South Asia?

BACKGROUND

South Asia's agricultural systems are dominated by millions of smallholder farming households (Devendra et al. 2002). Most are unable to participate in markets due to diseconomies of scale, weak market linkages, unsustainable supply chains, and high price fluctuations, which lead to low farm diversification and compromised farmer incomes. At the consumer level, TAFSSA focuses on improving access to healthy food for the poor through changes in food retail environments (Lytle et al. 2017 ; Ver Ploeg et al. 2018).



Above: Informal street markets in Nalanda, Bihar.

Photo Credit: Anirban Kumar and Tanweer Alam

RESEARCH AIMS

The research aims to identify which factors in the rural food environment influence access to and purchase of nutritious food for poor consumers, and how these environments can be improved. This study examines two specific types of food environments in three countries in rural South Asia (Bangladesh, India and Nepal): (1) traditional markets (*mandis* or *haats*) for fruits and vegetables and other farm produce including livestock, eggs, fish and grains, and (2) small village retail or grocery shops or food outlets (restaurants, tea stalls, food vendors). While there may be other outlets where people acquire food from, these two types are considered the most popular and would therefore be most likely to influence local diets.

The traditional *mandis* or *haats* operate primarily on a periodic (most often weekly) basis and are where most households conduct their weekly grocery shopping (Nuthalapati et al. 2020). They offer a greater diversity of fresh food (including fruits, vegetables, fish and meat), often at a more affordable price. In contrast, village retail shops typically offer relatively fewer fresh

foods and are more focused on sales of packaged foods and everyday household items. The data collected will be used to describe these food environments in terms of the availability of different foods and their prices.

OBJECTIVES

The objective of this study is to conduct a market census and survey of the market and retail food environment, involving the following:

- 1) geospatial mapping of traditional markets, rural retail shops and associated clusters of habitation
- 2) collecting information from traditional markets such as *mandis/haats* and small village retail or grocery shops or food outlets, on various market functionality dimensions affecting the food environment (e.g. assortment of essential goods, viability, price, resilience of supply chains, competition, infrastructure, services, food quality, access and protection) (WFP 2020).
- 3) developing tools for food retail design to increase the purchase of sustainably produced and nutritious foods

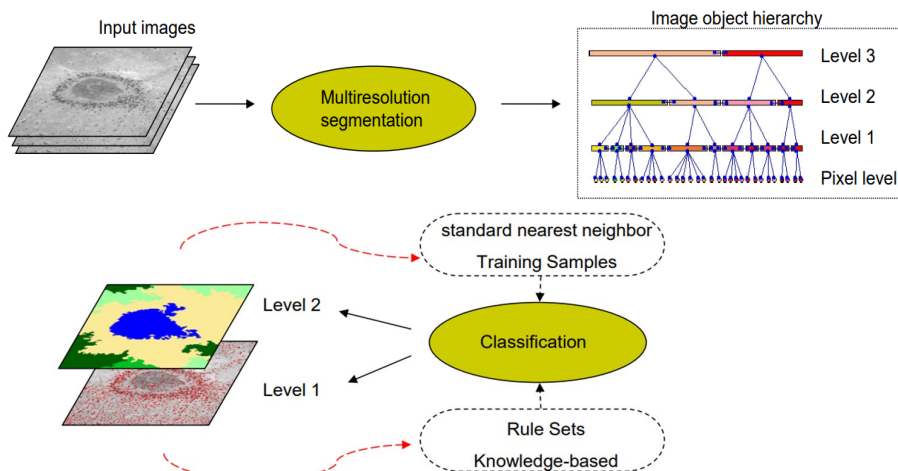


Figure 1: Object based image segmentation hierarchical flow

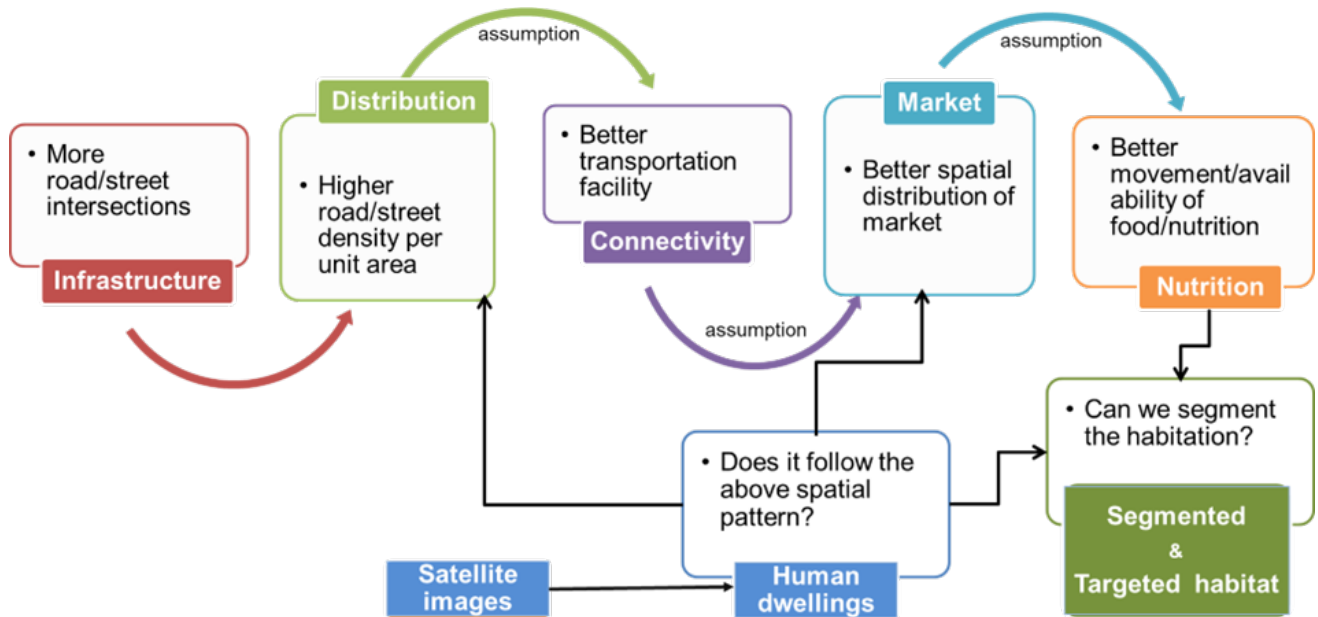


Figure 2: Conceptual flow diagram to design market-oriented habitats

MAPPING OF HABITAT-RURAL MARKET CLUSTERS

Earth Observation data, in particular very high temporal resolution Cartosat-2 and 3 satellite imagery (1.1m) and Google earth imageries (0.5 m) were used to create habitat segments. We brought together information from habitat distribution clusters, road density models, Market spatial locations and food accessibility maps to assign habitat types to these segments in a rule-based approach. The habitat clustering models used in the assignment procedure were developed in an integrated approaches derived from the Object based segmentation of multi resolution satellite images derived from Cartosat-2 & 3 (1.1m), Google earth images (0.5m) and other ancillary datasets.

The Object based segmentation was performed in eCognition environment for pre-processing and detailed classification of habitats clusters using decision rules implementation (Kohli et

al, 2016) and the subsequent translation of these classes to cluster classes are also described. The first step towards identifying the habitats using Object Based Image Analysis (OBIA) is to generate segments, *i.e.*, an automatic division of an image into coherent groups of pixels (segments, objects) and the criteria used to segment an image is a degree of homogeneity within each particular object and heterogeneity among neighboring objects. It was done by using Multi resolution segmentation algorithm using Estimating Scale Parameter (ESP) tool. The segmentation used all image layers, as OBIA is capable of using multiple data types during analysis to create meaningful segments. Segmentation is an important step preceding the classification of image objects. The classification process can include a variety of information, ranging from spectral mean values for each object, to measures of texture, context and shape.

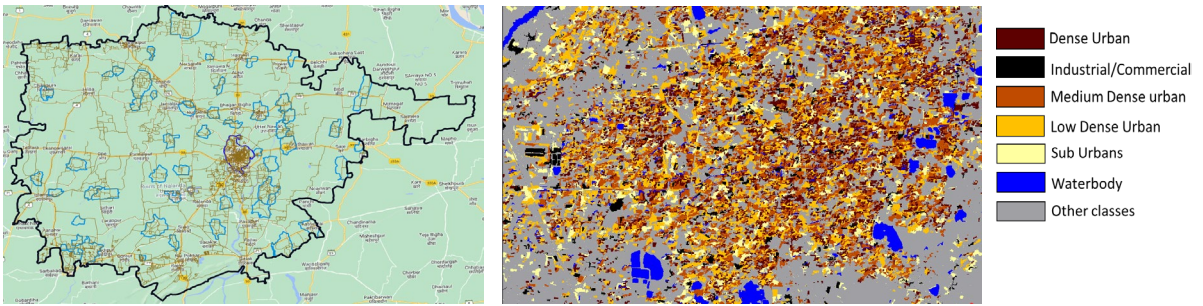


Figure 3: Villages and road intersections in Nalanda, Bihar (left) and urban habitat clusters classification output (right)

Grid based Road density maps are derived based on the intersection of the roads/streets and road types which have well connectivity with food market locations , transportation and food accessibility.

MARKET CENSUS

A census of all markets in 200 clusters in Bangladesh, India and Nepal was done using Kobo questionnaire. We collected information from all the organized and informal markets, retail shops and food outlets from all these clusters. In addition, we collected information from city markets selling different types of food products. The listing of these markets, managers and vendors along with information on important characteristics such as type of market, mobility, etc. allowed for stratified random sampling in the detailed market survey.

MARKET SURVEY

Market survey questionnaires have been grouped into observation-based and interview-based surveys. Modules on various market functionality dimensions have been adapted from WFP’s Research, Assessment & Monitoring and Supply Chain divisions.

WFP the Market Functionality Index (MFI) is a quantitative measure to benchmark market functionality along the following nine dimensions: 1) assortment of essential goods, 2) availability, 3) price, 4) resilience of supply chains, 5) Competition, 6) infrastructure, 7) services, 8) food quality, and 9) access and protection (WFP 2020). The survey will also collect prices (minimum, maximum and modal (disaggregated) of foods in the retail and traditional markets in the study locations (a total of 200 clusters in South Asia).



Above: Market survey. Photo Credit: Fajjul Kabir

Table 1. Modules in the TAFSSA Market survey

Modules	Interview	Observation
Retail & store information	✓	✓
Assortment of essential goods	✓	✓
Customer and sales	✓	
Infrastructure		✓
Service	✓	✓
Food quality & hygiene		✓
Marketing and promotion	✓	✓
Availability	✓	
Prices	✓	✓
Resilience of supply chain	✓	
Competition	✓	
Food wastage and management	✓	✓
Food sourcing (supply)	✓	

SAMPLING

Based on GIS information, initially the density of different types of traditional markets and village retail shops (habitat clustering, road density and market spread using geospatial analytics) will be obtained, followed by a census of markets in these habitats as well as in-depth interviews of the sample vendors, village shop retailers and market managers in the same locality.

Building on TAFSSA’s local food system assessment (Methods Note 1), market

survey identified 5 locations (districts) in South Asia to initiate the survey in 2022 – Nalanda in Bihar, Rangpur and Rajshahi in Bangladesh, Surkhet and Banke in Nepal. Using PPS method, villages were identified where household and village surveys (a total of 200 villages - 50 each in Nalanda, Rangpur, Rajshahi and 25 each in Surkhet and Banke) will be conducted. Using these villages, market clusters are developed using habitat clustering approach as described in the previous session on mapping of rural markets.

Depending on availability, a stratified random sample of maximum 15 retail shops or food outlets or vendors, village and city markets per cluster, and a maximum of five large wholesale market (*mandis*) per district are chosen for detailed data collection. Respondents will be vendors, market managers (for traditional organized markets such as haats, market yards etc.) and village shop retailers (for local retail shops or food outlets). The study will target sampling of 15 retail or food outlets or vendors, village and city markets per cluster, and a maximum of five large wholesale market (*mandis*) per district.



Above: A retail shop in Nalanda, Bihar.
Photo Credit: Shailendra Kumar

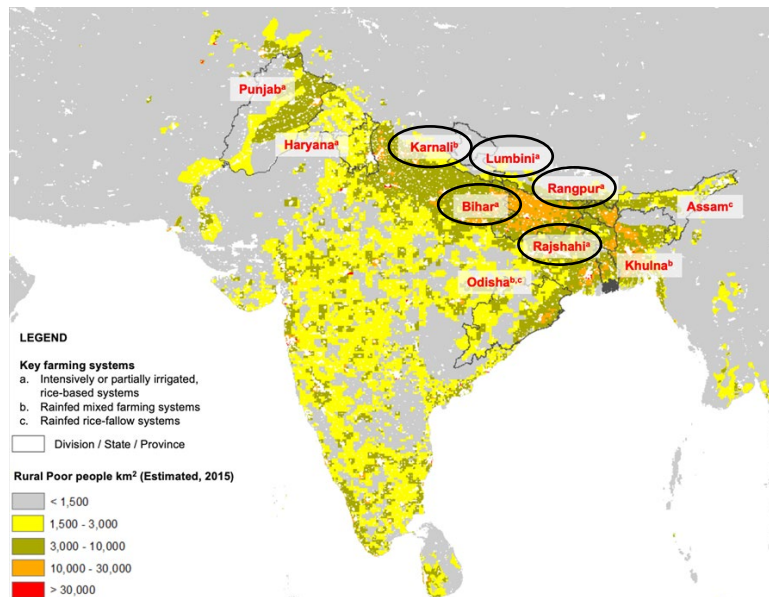


Figure 4: TAFSSA learning locations and market survey locations highlighted in the map of South Asia showing the density of rural poor

EXPECTED OUTPUTS

Mapping of rural markets and different types of food outlets and linking the household's diet to market are two primary aims of this characterization of rural food environment work in South Asia. Along with this, we aim to track the food supply and identify rural food sheds, if available. Several outputs are expected from this work:

1. A toolkit to characterize rural markets using habitat clustering, which can be used in similar settings elsewhere.
2. Local food market maps and market resilience in South Asia.
3. Mapping consumer access to sentinel foods as well as farm gate prices of agricultural products with market prices in different context of habitat clusters.
4. Multistakeholder dialogues on market resilience and delivery of nutritious foods.
5. Scientific papers and reports.

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ABOUT TAFSSA

TAFSSA is CGIAR regional integrated initiative to support actions that improve equitable access to sustainable healthy diets, improve farmers' livelihoods and resilience, and conserve land, air, and water resources in South Asia.

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