ADB

Aid for Trade

An Investment-Benefit Road Map from South Asia

Asian Development Bank

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Aid for Trade: An Investment-Benefit Road Map from South Asia

"A map does not tell people where to go, but it does help them determine their destination and chart their journey towards it. A map empowers by describing opportunities that would not be obvious in the absence of it. If the secret of development is the accumulation of productive knowledge, at the societal rather than individual level, then the process necessarily requires the involvement of many explorers, not just a few planners."

Ricardo Hausmann et al. 2011. *The Atlas of Economic Complexity—Mapping Paths to Prosperity*. Cambridge MA: MIT Press.

"There is a wide agreement that the space-economy may be viewed as the outcome of a trade-off between different types of scale economies in production and the mobility costs of goods, people and information."

Francois Thisse. 2012. "Economic Geography," in Faccarello, G. and H. Kurz (eds). *Handbook of the History of Economic Analysis*. Cheltenham: Edward Elgar Publ.

Contents

Tables, Figures, and Boxes

Tables

Figures

Boxes

Abbreviations

AEO	authorized economic operator (world customs)
AfT	Aid for Trade
BSTI	Bangladesh Standards and Testing Institution
CFC	common facility center
FCB	Foreign Commercial Bank
FDI	foreign direct investment
GDS	Global Development Solutions
GIS	geographic information system
ICD	inland container depot
ICT	information and communications technology
IGCRT	Institute of Glass and Ceramic Research and Testing
IT	information technology
IVCA	Integrated Value Chain Analysis
MDGs	Millennium Development Goal
NCB	nationalized commercial bank
PCB	Private Commercial Bank
PRC	People's Republic of China
SAARC	South Asian Association for Regional Cooperation
SASEC	South Asia Subregional Economic Cooperation
SMEs	small and medium-sized enterprises
SRMTS	SAARC Regional Multimodal Transport Study
TA	technical assistance
TBT	technical barriers to trade
TEU	twenty-foot equivalent unit

Foreword

Aid for Trade (AfT) came to prominence just over a decade ago at the launch of the World Trade Organization's Doha Round. With its focus on helping least developed countries and economies escape the poverty trap, it aims to strengthen their capabilities to meet market demand and to reduce supply-side constraints such as a lack of trade infrastructure.

In accordance with that objective, this report lays out an applied framework for prioritizing potential trade-related interventions and investments according to the expected strength of their combined economic impacts. Along the way, and for the first time, the economic geography of the northeastern part of South Asia has been comprehensively mapped. The use of computer-driven modeling has also provided a dynamic portrayal of the economic geography that is a resource for decision makers and investors.

While such detailed mapping of varied factors that make up the regional production space has never been undertaken before, the analytical approach breaks ground in that it allows the complex connections between aid, trade, and "inclusive" growth to be expressed in mathematic terms in a geographic grid. This is the nub of the matter, since by altering this trade grid—for instance by establishing new and better trade network connections between production sites and markets under a set of possible AfT investments and actions—differential growth effects can be projected over time. The resultant strategic framework for AfT investments in South Asia, and its focus on an investment set which uniquely benefits people in the economic periphery of a geographic area, has applications to those far beyond the region itself. It is a tool that can be applied elsewhere to examine likely outcomes of trade-related investment options aimed at boosting exports and incomes.

This report takes a unique strategic approach to derive a priority road map from many action plans traditionally given in many studies on the subject, at the same time incorporating the national priorities in AfT for Bangladesh, Bhutan, India and Nepal. The consultant team interacted with other key donors in the three economies on their priorities, and also made numerous field visits to production sites and to trade facilities.

By bringing to light new avenues for yielding very high economic benefits for investment and reforms, the framework can give guidance for undertaking trade improvements under AfT on pilot projects within a national setting, between neighbors or spread to partners further afield. In all cases, the endeavor is the same: expressed in the metaphor of hard investment, it is to build bridges to export markets so that people in the economic periphery have a better opportunity to take poverty off their own maps.

Acknowledgments

Many thanks to those in the "field," the government officials, the private sector firms, the nongovernment organizations, and many others too numerous to name, who went through unusual efforts to arrange field visits and contribute directly or indirectly to the knowledge basis for this report. Special thanks to ADB's Office of Information Systems and Technology (OIST) and the resident offices in countries involved—the extraordinary efforts to provide a gamut of tools of communication among the team members spread out over virtually all of the globe's time zones, from the team website to mid-night and early morning video communication arrangements, made this unique effort in coordination and communication succeed. This project is funded under a regional technical assistance for a South Asia Strategic Framework for Aid for Trade Road Map by the Asian Development Bank (ADB) Investment Climate Facilitation Fund under the Regional Cooperation and Integration Financing Partnership Facility (established by the Government of Japan).

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Executive Summary

What countries and regions export, or are able to export in the future, matters a great deal for their economic development and growth in income. Specific production capabilities and the ability to coordinate all necessary inputs and services to gain and maintain market access determines how far they can reach and the range of products they can offer. Countries with few specific production capabilities produce very few products and are mostly characterized by low or lower mid-level incomes.

Countries and regions that are intent on exporting more products in the future, and especially more sophisticated products in the global product space, have to acquire both more production capabilities, and they have to increase their capacity to coordinate more and more inputs and services required to gain and maintain market access in a growing number of markets.

This study is focused on Bangladesh, Bhutan, and Nepal, and also considers the areas of India which physically connect the three economies. This is the northeastern subregion of South Asia. The governments of Bangladesh, Bhutan, and Nepal, have clearly expressed their priority for economic development, to increase both the diversity of the export sectors in the region and beyond, as well as the multitude of export markets they will access with their products. Diversifying export products and markets requires addressing the fundamental coordination problems which South Asia's smaller economies face in the establishment of commercially viable export production chains. These coordination problems are the larger and the more acute when the number of missing production capabilities is larger, and the capacity of coordinating value addition along a production chain from raw material to consumer market, is lower.

In Bangladesh, for example, the manufacturing industry in 2010 contributed approximately 28% to Bangladesh's Gross Domestic Product (GDP) of $105 billion. The country's industrial competitiveness is concentrated in a limited number of sectors—the key being the $22 billion textiles/apparel export manufacturing sector. With the exception of the leather and footwear sectors, most light manufacturing industries in Bangladesh are stuck in a perpetual stage of being *"sectors considered to have export growth potential,"* yet such growth remains limited or unrealized. Ceramics tableware manufacturing, which is featured as a potential growth area in this study, is one such sector. For most of the current decade, the sector was expected to reach the $100 million annual exports by 2010, and become globally significant from there on. Unfortunately, ceramics exports from Bangladesh remain in the $30 million to $40 million range.

The value chain approach employed in this study, identified missing capabilities in serving specific product and market segments for ceramics from Bangladesh and seabuckthorn in Bhutan and Nepal. Furthermore, to add a value chain reference point in the northeastern part of India, the bamboo floor tile value chain from an earlier ADB-financed study was included in summary form in this study report. A value chain is like a "transmission line" from connecting production capabilities to the actual market of consumers. Comparative advantage in the study region largely is confined to some services (i.e., tourism) and natural resource-based productive sectors, so these are the focus of analysis.

Development in the northeastern subregion of South Asia is very much a process of networking the periphery with existing economic activity centers, both nationally and internationally through trade flows. Today's existing country borders have separated the historic trade corridors. As a result, border districts largely occupy the economic and geographic periphery. Geographic modeling of investment scenarios, those combining "hard" infrastructure and "soft" policy changes that are aimed at linking production and population in the periphery to markets beyond, show widely varying district benefit gains, with the poorer districts with the lower population density in the periphery gaining on average significantly more than more central ones from regional integration through AfT investments.

The first achievement of this study was therefore the geographic mapping of the existing product space with GIS software. With this map, the potential growth for existing and future production sites could be analyzed. This was done by examining how such export production sites are connected—both upstream and downstream—by land, air, and water. The flow of trade on the basis of key products was tracked across the region. Existing further resources, for instance human resources and population were also mapped. The maps were overlaid with the current transport and connectivity infrastructure. Key missing connectivity and trade related infrastructure was also overlaid.

By literally locating the comparative advantage of the subregion, it becomes empirically possible to locate nearby further production possibilities, and to map their value chain to potential export markets.

As a second major achievement, this study developed a pioneering framework for the overall economic evaluation of priority Aid for Trade (AfT) investments with the potential to bring about regional integration by solving key capacity and coordination problems that prevent export product and market diversification in sectors where comparative advantage should prevail. By identifying priority AfT investments—those which in combination bring the highest economic benefit to investment cost ratio in a way that the economic periphery in the region can benefit the most—the model yields a set of best possible options for boosting trade and incomes. This constitutes the Aid for Trade Investment-Benefit Road Map from South Asia, which may serve to guide the selection of future project investments in the subregion on a priority basis.

The third major achievement of the study is the use of the agent-based, geographic economic impact model. Very rich results can be gained from such a dynamic conceptualization of the real world. The model framework employed here allowed us to trace the spatial distribution of economic gains from two sets of investments and a benchmark comparison to the "business as usual scenario." Technical details of the modeling approach, including details on the scenarios and investment sets, and the underlying economic assumptions, are discussed. Moreover, the model framework is a new tool for policy makers to more efficiently pursue the overarching development objective of inclusive growth across a region.

1

Introduction

The connections between aid, trade, and inclusive growth form a complex part of the challenge for countries and economies to escape the poverty trap and move their export products to new markets, with a greater portion of the price of finished goods going to local producers.

Simply put, the strengthening of trade capabilities to penetrate new markets, and reduction of constraints to export competitiveness, helps set in motion a virtuous growth cycle. Greater connectivity and trade-related investment, combined with strengthening links for rural small and medium enterprises, and along production networks, leads to a rise in productivity and to a diversification of producer capabilities. This will increase export (unit) values, indicative of higher value being added earlier in the production process. By moving up the value chain—which essentially is a "transmission line" connecting all elements involved in making a product and getting it to consumers—and by expanding market access, opportunities are generated that raise incomes for people in the economic periphery.

In a pioneering approach that makes explicit the complex connections needed to spur growth in trade, this South Asia-focused study details a unique method to assess how Aid for Trade (AfT) investments interact with other agents of economic change, such as consumers and producers and traders of intermediate and final goods and to evaluate their potential to reduce the cost of bringing more products to more markets. Furthermore, it presents a new tool for policy makers to foster regional economic integration and pursue the overarching development objective of more inclusive growth across a region.

An Innovative Approach

The computational system shown in this publication represents the first large-scale agent-based model for trade investments and policies that lead to a reorganization of spatial patterns of production, and the first to map the economic geography of Bangladesh, Bhutan, and Nepal, along with areas of India that physically connect the three economies in South Asia's northeast limb—the area of focus for the study.

This part of South Asia is not fully integrated into the world trading system, lacks adequate network and scale economies, and suffers agglomeration, information and value-chain coordination failures.

To overcome these obstacles to the creation of geographically more balanced, significantly higher productive employment, income and consumption, the four neighbors have embarked on investment measures and policies to restore cross-border corridors and transit and trade links. Investment measures are for specific locations, and are meant to link productive activities in the economic periphery to economic activities in both national and international centers.

Traditional approaches from Trade Theory and Economic Geography have serious limitations when it comes to cost-benefit evaluations of infrastructure plans that support the ability of producers to engage in long-range trade.

While many modeling methods can generate frameworks for measuring the potential benefits of sets of investments in an economy, aspects of programs such as AfT make them less amenable to traditional approaches. There remains a need for an approach that is flexible enough to account for the effect of attempts to optimize specific product value chains. An infrastructure project, such as a bridge or a highway, will reduce the costs of bringing goods to market even if we assume the same spatial pattern of production. However, it may also influence the spatial distribution of production itself. A model is required in which both space and time are explicitly represented to describe the complexity of change in value chains.

The model described in this publication aims to meet such needs. It was developed by ADB technical assistance with the help of "applied agents," and informed by its collaborators' collective years of on-the-ground expertise. Meticulous attention was paid to the spatial location of economic agents, the temporal dimensions of trade, and frictions that impede trade (such as constraints in sourcing inputs, or getting goods to markets). Such a system can be matched to real data on key parameters like price elasticities of trade, consumption and production behaviors, goods parameters, land-use parameters, learning economies, and productivity parameters. In this way, the dynamic evolution of the system characterizes the economic development process.

The model provides a novel methodology and accompanying software platform for policy evaluation of real projects that is simultaneously rooted in real value chains and geographies, *and* is able to capture sophisticated spatial economic dynamics.

While trade-related investments can allow producers to reconfigure their value chains and thereby increase earnings, the effects of investments—such as in logistics—can be both subtle and intricate. Lowering the cost of transporting goods is likely to change production patterns and transform the spatial distribution of economic activity in a region. A reconfiguration of the value chain is likely to occur, with firms making new sourcing, operations, warehousing and sales decisions.

An accounting of such effects plays an essential part in the meaningful evaluation of AfT programs and their contribution to achieving developmental goals. In the northeastern subregion of South Asia that is very much a process of networking the existing centers of economic activity with the periphery through trade flows. As today's country borders have separated the historic trade corridors, border districts largely have become the subregion's economic periphery, where poverty is concentrated, economic agents (labor force and production) are sparse, and incomes from natural resource-based activities are low.

The hope is that investments will enhance underdeveloped exports (as explained in Box 1 below), leading to increased incomes and equitable growth, a reduction in poverty, and attainment of Millennium Development Goals (MDGs) such as hunger reduction. The production, population, and poverty space of each of the four countries in the study is described in Chapter 6.

Box 1.1 Trade Geography

South Asia is comprised of India, Pakistan, Bangladesh, Bhutan, Nepal, Sri Lanka, the Maldives and Afghanistan. Despite being strategically located and having access to abundant natural resources, the region has not been a major player in world trade. The exports from the region amounted to $300 billion in 2008, while global trade crossed $15,000 billion.[a] Though total trade in South Asia has quadrupled since 2000, most of the growth is driven by India's trade with countries outside the region. Trade within South Asia is abysmally low. The domination of the regional landmass and economy by India makes economic integration complex, where the other, relatively smaller member countries are unable to keep pace. Of the small intra-regional trade, India has the largest export share of 66.2%, followed by Pakistan at 18%.[b] Further, India is the significant trading partner of the landlocked Himalayan countries of Nepal and Bhutan.[c] These countries mainly export agro-based products and raw material to India, while importing value added-goods from the latter.[d] In addition, their exports to third countries are routed through India: 90% of Nepal's trade transits India, and almost gall of Bhutan's trade transits India.[e] In order to realize gains from trade for the entire region, it is critical to improve regional cooperation among the countries, build effective channels of communication between custom stations across borders, develop robust transit corridors and strengthen trade institutions and infrastructure.

High trade and non-trade barriers, due to some "political stand-offs" in the region, are considered significant impediments. Key among these is weak infrastructure for trade facilitation. While infrastructure within India is improving considerably, those facilitating trade with its neighbors, such as border posts, rail links, etc. have been weak.[f] International development organizations like ADB and the World Bank have been playing a significant role in improving regional cooperation and intra-regional trade. A particular focus has been on the strategically located but economically underdeveloped and environmentally fragile eastern part of south Asia. This includes eastern India, Bangladesh, Bhutan and Nepal. These four countries have come together to form South Asia Subregional Economic Cooperation (SASEC), as a sub group under the larger South Asian Association for Regional Cooperation (SAARC) to foster greater regional cooperation. The strategic importance arises from the fact that this region links South Asia with East and South East Asia. ADB's assistance to SASEC aims at facilitating greater cooperation within this region in order to leverage its strategic location. Transport, trade, communication, energy, tourism and environment sectors have been identified as key sectors under the program.[g]

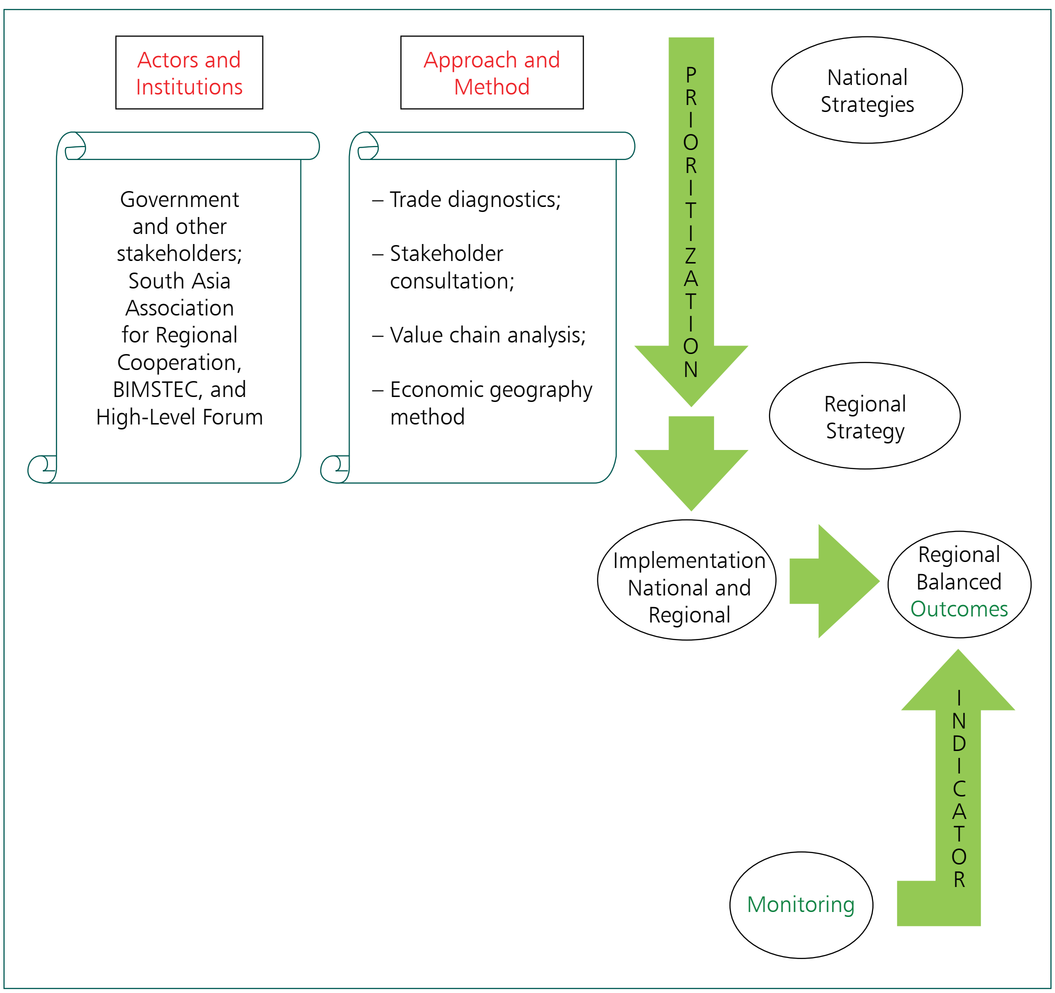
[a] UN Comtrade, International Merchandise Trade Statistics Yearbook, 2008, Volume I.
[b] Asian Development Bank, India's Role in Asian Economic Integration, 2008, [Seminar Report, 2008].
[c] The World Bank, Trade and Transport Facilitation in South Asia: Systems in Transition, 23rd June 2008.
[d] Nepal Central Bureau of Statistics, Nepal Statistical Pocket Book, 2000.
[e] The World Bank, Implementation and Completion Report on Multimodal Transit and Trade Facilitation Project, Nepal, March 2004.
[f] The World Bank, Trade and Transport Facilitation in South Asia: Systems in Transition, 23rd June 2008.
[g] ADB Regional Cooperation in South Asia http://www.adb.org/sasec/assistance.asp

Dynamic Mapping

Large benefits not previously shown to decision makers can become apparent when investments that can raise the production potential of the economic periphery are comprehensively modeled on the economic map. An economic geography model approach, mapping the economic landscape in a dynamic (over-time-cumulative) way, and populating it with economic agents in employment and production space, allows the distribution of benefits accruing across the region in various infrastructure investment scenarios to be computed and displayed. Figure 1.1 provides an overview of the players and processes in South Asia.

The geographic model results of investment scenarios aimed at linking the periphery to markets show widely varying benefits for districts from regional integration through AfT investments; however, poorer districts with lower population density in the periphery gain on average significantly more than more central ones.

Figure 1.1 **Schematic Framework of Inputs for Priority Investments**



Source: Author.

The results of the modeling are very rich. Investment in hard and soft trade-related infrastructure across the northeastern subregion of South Asia is not just additive; the benefits from combined investment sets are multiplicative. This is as recent trade literature would predict: economic gains from being able to combine a larger and larger set of export-production capabilities that accrue from a larger set of (hard and soft) infrastructure investments—and opportunities to coordinate these capabilities with market demand—grow exponentially as the number of capabilities increases.

Value Chains—Identifying Gaps

The economic geography of three product sectors with high export market potential and comparative advantage are portrayed in comprehensive detail in this study: These are the ceramic/tableware value chain in Bangladesh, and a herbal/medicinal product value chain for seabuckthorn which stretches across both Bhutan and Nepal. Furthermore, to add a reference point in the northeastern part of India, the value chain for bamboo floor tiles from an earlier ADB-financed study is included.

Analysis of these natural resource-based products (presented in chapters 8, 9, and 10) pinpointed key missing capabilities and coordination gaps as:

- Important inputs and natural resources (materials, energy, technology, information and finance) cannot be sourced at reasonable time and cost to production sites where value can be added to a competitive product, due to supply-chain coordination failures (upstream integration issues).
- The subregion’s physical and technical capabilities to control and trace product quality from source to customer are inadequate and result in foregone export and market diversification.
- Key production sites for potential high-value export products forego positive agglomeration externalities with the effect that small producers do not attain sufficient scale to satisfy export market cost and quality requirements, and because of inefficient scale there is little incentive for producers to upgrade and invest in sufficiently high standard capabilities in potentially very lucrative export markets (importance of a break-even point which leads to lower export unit costs).
- Inter-agency coordination, inter-modal traffic, and coordination of uninterrupted product flow across the subregion and to markets are not sufficiently assured, resulting in high unit costs of trade (downstream integration issue).

Aid for Trade investments aimed at solving such capacity and coordination problems have the effect of reconfiguring regional production patterns and transforming the spatial distribution of economic activity in the region.

When agents of change within value chains are comprehensively modeled on the economic map, alternative investment choices can be compared for economic impact across a number of dimensions, revealing large and previously unrealized benefits. By offering a method to evaluate the efficacy of different investment options for spurring production, the agent-based geographic and dynamic economic impact model helps overcome issues that impede export growth and market diversification.

Taken to its full potential across a region, the end result of this assessment is a strategic framework for a set of priority investments intended to drive growth in exports of specific products that enjoy a comparative advantage in production.

The identified priority investment set constitutes the South Asia Strategic Framework for an AfT Road map, which can serve to guide the selection of future project investments in the subregion. Moreover, the model and its methodology have great potential for the creation of similar road maps for the development of efficient value chains that bring income and employment benefits to people in geographic and economic peripheries elsewhere in the world.

2

The Modeling Approach to Priority Investments

The scope of this study is limited to the North Eastern Region states and West Bengal in India, Bangladesh, Bhutan and Nepal, forming the bulk of the South Asia Subregional Economic Cooperation (SASEC) region, a subgroup under the larger South Asian Association for Regional Cooperation (SAARC). Geographic mapping of the existing product space in the subregion was done using Diva GIS,[1] an open source geographic information system (GIS) desktop software, to locate the production centers of the region's principal exports.

The strategic framework for an Aid for Trade road map for developing export trades in the northeastern part of South Asia is intended to provide an approach to identify and prioritize possible interventions to promote trade flows of products that are either emerging or dormant yet show significant potential.

Once the existing product space in the modeling area has been mapped, the potential growth for existing and future export production sites can be analyzed. This is done by an examination of how such sites are connected—upstream and downstream—by land, air and water. Product space as it represents comparative advantage in trade drives forward connectivity, and connectivity improvements enable the development of product space.

The model then uses the mapping methodology introduced on page 85 as the basis to trace the flow of specific products through entire value chains from points of product origin to points of consumption. Existing further resources, for instance human resources and population, are also mapped and overlaid with current transport and connectivity infrastructure. Key missing connectivity and trade-related infrastructure are placed on top. This produces a picture from which the costs of trade and distortions hindering the competitiveness of specific products and industries can be quantified.

Such an agent-based, geographic and dynamic framework for modeling can help policy makers make informed choices to maximize the benefits of trade-related investments. It can be used for comparison in two ways: First, to examine the incremental effects of infrastructure investments in terms of gains in per capita income. (Policy makers, who will be aware of the costs of the investments, can then determine if benefits justify costs). Secondly, in cases where there is a choice between two alternative investment projects, the likely gains in income and costs under each can be compared. Both methods require a calibration against a benchmark—how the economy would perform without the additional infrastructure investments.

[1] www.diva-gis.org

The "Tile" Concept for Mapping Local Economies

In understanding the modeling approach, it is important at this stage in the explanation to stress that actual model computations to determine the likely effect of project and policy interventions are done in data layers "behind the map," which are known as "tiles." These may be thought of as representations of the interactions between elements, or agents, that influence the productive capacity of a local economy.[2] Neighboring data tiles are filled with population, employment, economic output, export goods prices, and income data; and also contain information on land use, project investment, distance labels to adjacent tiles, travel time and cost labels to adjacent tiles.[3]

Applying the tile concept to change key parameters of activity, we have developed a novel methodology and constructed an accompanying software platform that simulates the effects of investment on an economy, including production. Full dynamic simulation movies, showing changes on the map over time, can be requested from principal authors of the publication.

Being an independent economy, production, consumption and trade can take place within tiles. Trade can also occur between tiles. However, costs of transportation and connectivity need to be taken into account for inter-tile trade.

The features of a tile allow us to represent all phases of the value chain for goods, from inbound logistics to operations, outbound logistics, marketing and sales. Production can be dispersed geographically, as well as in time. The model also allows direct assessment of the potential impact of infrastructure investments that affect the cost of transportation across tiles.

(We return to the advantages of this areal conceptualization in the next chapter, where the features of a tile are presented alongside technical details of the computational formulae and assumptions at the heart of simulations produced by the agent-based model.)

The use of tiles to conceptualize the real world—and the effect of changes in one location on the economy of another location—is illustrated by Figure 2.1, which zeroes in on two value chains as they relate to regional priority corridors. ADB's focus for investment in the northeast subregion of South Asia is along those corridors, and in connection with potential trade-related infrastructure investments to enhance three product value chains in the region that have been identified for their export potential: bamboo floor tiles, ceramics, and the seabuckthorn medicinal plant.

The value chains for bamboo floor tiles and seabuckthorn plants have been traced through tiles in the study area in Figure 2.1. Each tile is mapped with coordinates A to N from North to South, and 1 to 23 West to East.

The investment corridors as they relate to both seabuckthorn and bamboo are spread across tiles. Yellow dots represent key existing seabuckthorn harvest areas, and pink triangles are the existing important bamboo growing sites. Related to these production areas are planned investments, highlighted by orange dots, and in the case of transport infrastructure, by purple and orange lines across the landscape tiles. The green lines represent existing connectivity for which no investment is needed.

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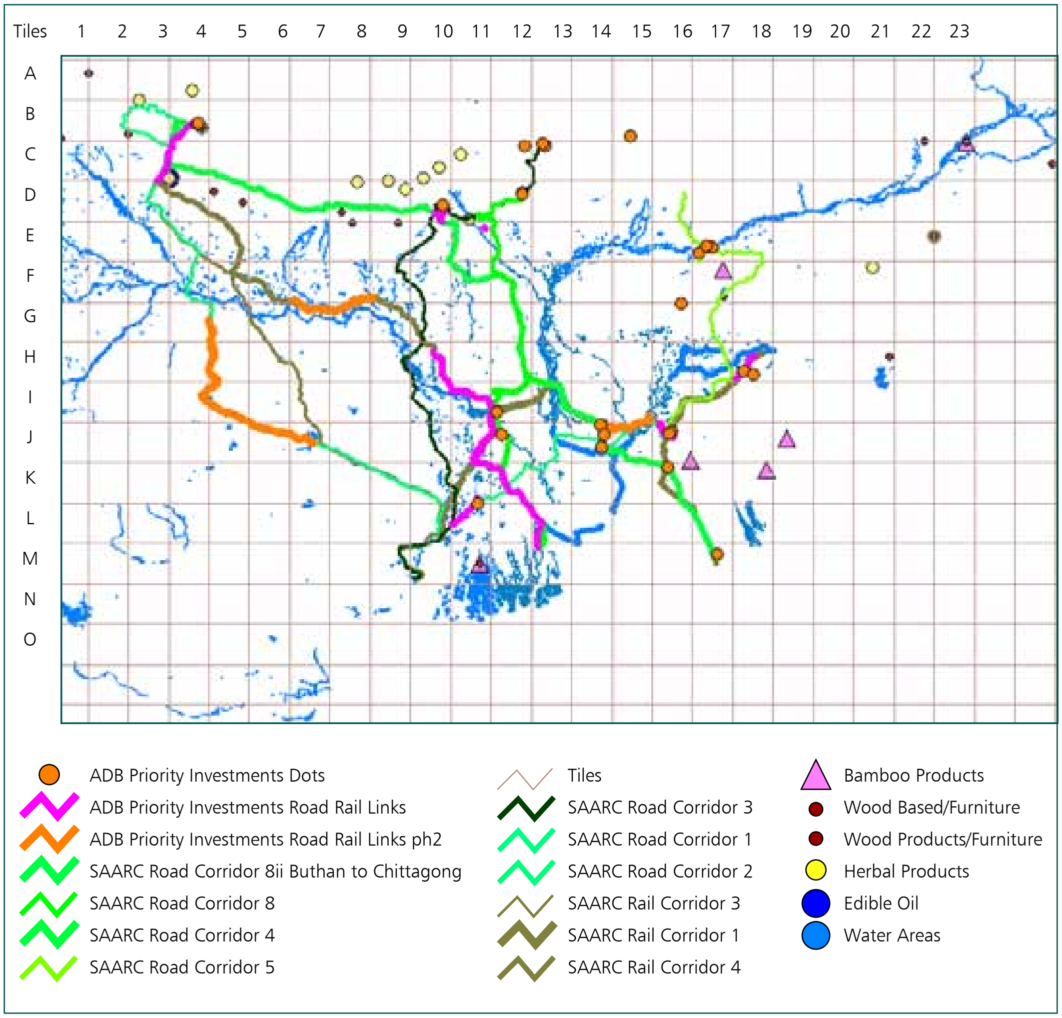
[2] For a pioneering study on this, see Brunner and Allen, 2005.

[3] Hidalgo, Klinger, Barabasi, Hausman, 2007, *Science*, http://www.chidalgo.com/productspace/country.htm

Figure 2.1 Value Chain Tracing for Bamboo Floor Tiling and Seabuckthorn



Source: Author.

Investments are normally strung along production chain/value chains for "tradeables." Therefore tiles present a way of trace how changes in economic activity or infrastructure in one area reverberate along the value chain to other areas linked by an investment corridor.

Goods transport, travel times and cost matrices are computed using data collected from the field in cases with and without future project investment. Thus different investment scenarios can be compared; for instance, a scenario could focus on one particular regional trade and transit corridor to see how the result is different over time, and compared with alternative corridor investments. By locating the comparative advantage of the northeast South Asia subregion, it becomes empirically possible to locate nearby further production possibilities, and to map their value chain to potential export markets.

Base Layers for Mapping Data Sets

The products themselves are identified from existing studies and technical assistance reports, supplemented by country-level Product Space Maps.[4] While the production centers are identified at the district level, existing trade nodes and transit corridors, especially those detailed in SAARC studies (the "SAARC corridors") are also mapped in order to assess the region's infrastructure situation. A spatial database is also compiled of ongoing investments in trade-related infrastructure and trade facilitation in the region, funded by national and international agencies—mainly ADB and the World Bank. The final piece in the data set is the generation of a spatial database of potential future investments, derived from consultations in the field.

The base layers for the mapping exercise of existing features are obtained from Diva's free spatial database, which includes the following layers:

- Administrative divisions up to the district level
- Population density
- Poverty intensity at district levels
- Road network
- Railway network
- Altitude
- Rivers/Water Areas

Data tiles are filled with population, employment, economic output, export good prices, and incomes data; with land use information, project investment information, distance labels to adjacent tiles, travel time and cost labels to adjacent tiles.[5] Each tile represents a "geography" of 51 square kilometers (km^2), an area small enough for transportation costs to be deemed negligible. Goods transport, travel time and cost matrices between tiles are computed using data collected from the field. Different investment scenarios can be computed. The focus for instance could be a scenario where investment in one particular regional trade and transit corridor produces differences in these matrices over time, comparing this with changes resulting from not making this specific corridor investment or with the expected results from alternative corridor investments.

The basis for the infrastructure mappings in the South Asia study was the ADB-financed SAARC Regional Multimodal Transport Study (SRMTS), and further ADB analytical work (discussed at regional and transport forums), which prioritized the infrastructure investment proposals under SRMTS. In the background, the poverty intensity map by district or equivalent administrative unit was added as another layer to trace the economic impact of several AfT investment program package.

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4 Hidalgo, Klinger, Barabasi, Hausman, 2007, *Science*, http://www.chidalgo.com/productspace/country.htm

5 Tiles have assigned central nodes, and geographic distance among tiles is measured from/to central nodes. Nodes are also strung along key transit corridors, where applicable.

The detailed list of investments includes their precise digital locations, their estimated investment cost, and location specific cost and time reduction impact "guestimate" of any new infrastructure or policy.

Lighter areas (administrative units) have less poverty and dark areas the highest poverty concentration; poverty measures across countries are not exactly comparable.

The cost data that underlies the maps in this study was gathered from primary sources; ground experts provided information on travel times and freight costs, which are reflective of the current condition of the transportation infrastructure. It is presented in Chapter 7.

Examination of the likely effect of lowering the cost of transporting goods from one point to another across a region helps answer the question of whether the benefits generated for each investment (in terms of increased incomes, consumption or welfare) justify its cost. Additionally, an investment will have different effects for different goods, for instance on perishable versus non-perishable products.

Advantages of Agent-Based Models

The spatial and temporal dimensions of economic activity and trade are critical for understanding the impact of Aid for Trade-related investments. In the agent-based model, the production of a good is physically dispersed, a variety of production chains are feasible, and there is also potential that trade infrastructure investments will reconfigure the chains. This gives the model the strong advantage of the explicit representation of real space, as an economic geography can be matched along key variable dimensions with the actual geography of the region.

Agent-based models—characterized by heterogeneous, autonomous, and boundedly rational agents interacting in an explicit space and time[6]—are well suited to represent agents moving activities such as the trade of goods across a geography. Feedback effects through agglomeration, information exchange and coordination along value chains can be especially well represented. Interventions such as specific investments in logistics that lead to better integration with the rest of the region and the world can be introduced into the model and their impact simulated in terms of their effects on the decision-making of households and firms. The model also allows measurement of the benefits and costs of investments to individual households, or for these to be aggregated across regions and through time.

The central experiment using an agent-based model consists of examining the effects of changes in cost-structure, brought about from investment projects and policy interventions—wherever they are located—on consumption and incomes (hence welfare) in local economies. For each intervention, the question is whether the benefits in terms of increased incomes or consumption justify the costs of the investment. An investment will have different effects for different goods, and we can deduce which goods an investment would benefit most.

Comparison of different sets of investment scenarios derived from regional economic mappings in South Asia using the tile concept is expounded in Chapter 3, which describes the integration of the model with layers of geographic analysis in a base case scenario (of the economic performance in the absence of additional infrastructure) and in terms of the additional economic impact of two key investment scenarios across the study area.

6 For additional information including applications, see Joshua M. Epstein, Generative Social Science, Princeton University Press, 2006.

3

Investment Scenarios and Model Simulations

Trade-related investments fall broadly into two sets. The first consists largely of hard physical transport and trading infrastructure that would initially enable additional trade in non-perishable export products across a region—those types of products where time to market is essentially not much of an issue. The second set of investments consists of those that make it possible to bring goods to markets in reliable, predictable time and quality. Time-sensitive goods "spoil" if they are delivered to the market either too late, or if their quality does not meet required phyto-sanitary, technical or other such hurdles.

The experiment described in this chapter is driven by the two varieties . We establish a benchmark, and then examine the gains in the linear economy that arise from two kinds of infrastructure investments. The focus of both is on incomes, their geographic distribution, and the dispersion of prices as a measure of the benefits of infrastructure investments, and on gains in trade flows.

Investment Scenarios

Three specific scenarios are simulated, in accordance with the need for a benchmark in which changes with no additional infrastructure are described. The benchmark is a starting point in the computational methodology for assessing the potential effects of project and policy investments on data tiles across a value chain. The three scenarios are:

(**S1**) The existing (present day) network of roads and trains—the benchmark.

(**S2**) The transport network in S1 is enhanced by a set of non-perishable road/rail infrastructure investments such as additional road lanes (the investments in the South Asia are detailed in Table 3.6 on pages 28–31 at the end of the chapter) alongside precise digital locations, the cost of investments and a "guestimate" of their impact on reducing travel times.

(**S3**) The transport network in S2 is enhanced by a set of infrastructure improvements in perishable [P] trade supporting infrastructure improvements (e.g. refrigerated or automated warehouses or stockpile storage locations, also shown on pages 28–31).

The results of comparison between the three scenarios S1–S3 are described for administrative districts, at the level of individual tiles, and in aggregate for the entire population affected by AfT investments. They can be made both in final equilibrium outcomes (costs, welfare, etc.) and in the dynamics leading up to equilibrium.

Model Simulations by District

A first set of analyses allows for comparison of outcomes at the district level across the three infrastructure scenarios (S1–S3). Results are presented for income growth, and for prices and efficiency.

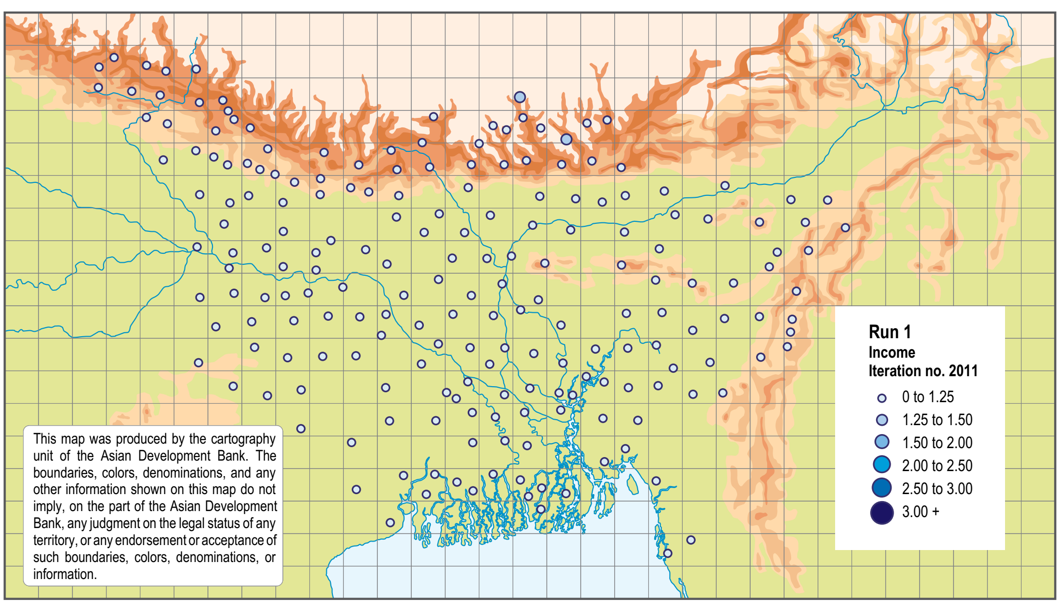
Progression of Incomes

GIS maps 1 to 3 show the progression of incomes across S1, the baseline scenario where no infrastructure investment takes place. Some income growth is observed, but most increases in income occur early (by the mid-point of the run). Many districts experience little or no income increases.

Box 3.1 How to Interpret the GIS Maps

For ease of illustration, results are shown in the form of a geographical map of the entire AfT area. The maps depict the study area which covers a subregion of the SASEC area, falling along identified SAARC corridors, covering Bangladesh, Bhutan, Nepal and select parts of eastern India including Bihar, West Bengal, Sikkim, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. Each map displays district centroid dots, and individual tiles. The size and color of the centroid dots capture the average income change for each district at each point in time. All runs begin with the same starting income distribution across the districts, but diverge as income effects due to trade infrastructure investment take shape. Full dynamic simulation animations showing changes in the map through time can be shown on screen, and—as mentioned earlier—can be obtained from the principal authors of this publication.

Figure 3.1 GIS Map 1: S1, STARTING District-Level Incomes

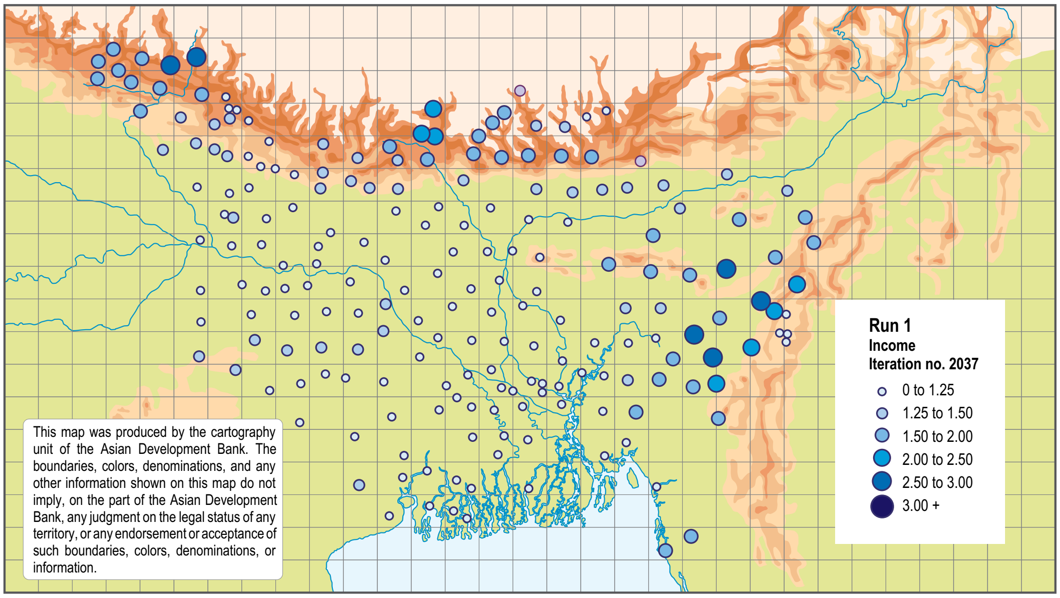


south asia 12-3079 HR

Note: Color shading reflects altitudes.

Source: Author.

Figure 3.2 GIS Map 2: S1, MID-RUN District-Level Incomes

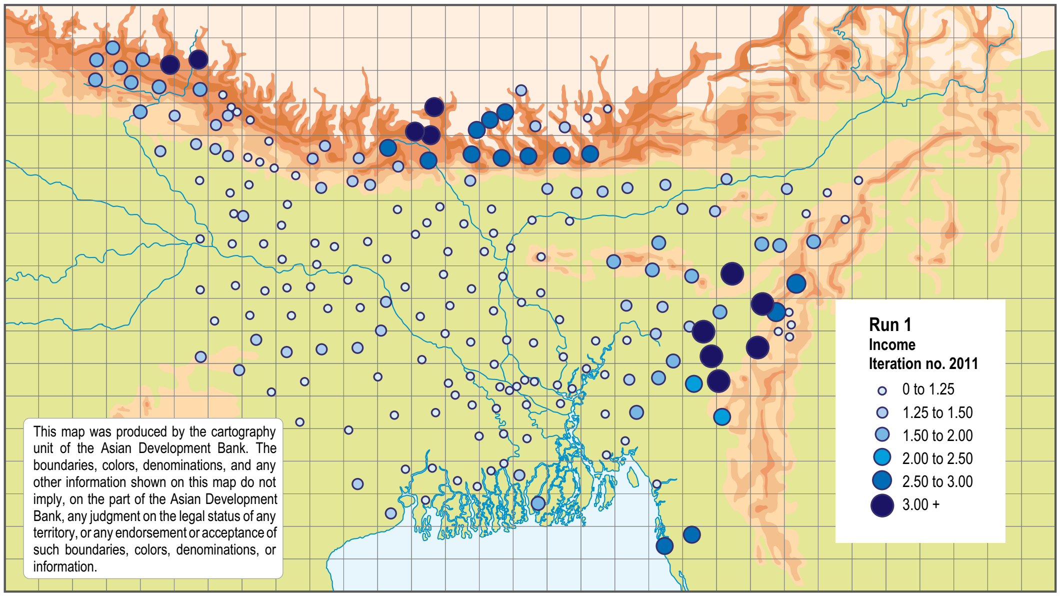


south asia 12-3079 HR

Note: Color shading reflects altitudes.

Source: Author.

Figure 3.3 GIS Map 3: S1, ENDING District-Level Incomes



south asia 12-3079 HR

Note: Color shading reflects altitudes.

Source: Author.

For clarity of display in a static, non-digital medium like this printed report, it is best to show the *differences* between the S1, S2, S3 simulations. We plotted the difference in income observed at the ending time step in each scenario to measure growth achieved through investment. Scenario S1 (the benchmark) is compared to Scenario S2 (non-perishable investments only) [GIS Map 4], S2 is compared to S3 (perishable and non-perishable investments) [GIS Map 5] and the overall growth from S1 to S3 is calculated [[GIS Map 6]. As before, each map displays district boundaries, regional color-coding, and geographic centroid dots. The size and color of the dots in the figures below now represent the magnitude of observed *change* in ending income (computed as average ending income from scenario N+1 *minus* average ending income from scenario N) for each district. Note that dots that change from red to pink are still improving, but at a lower rate.

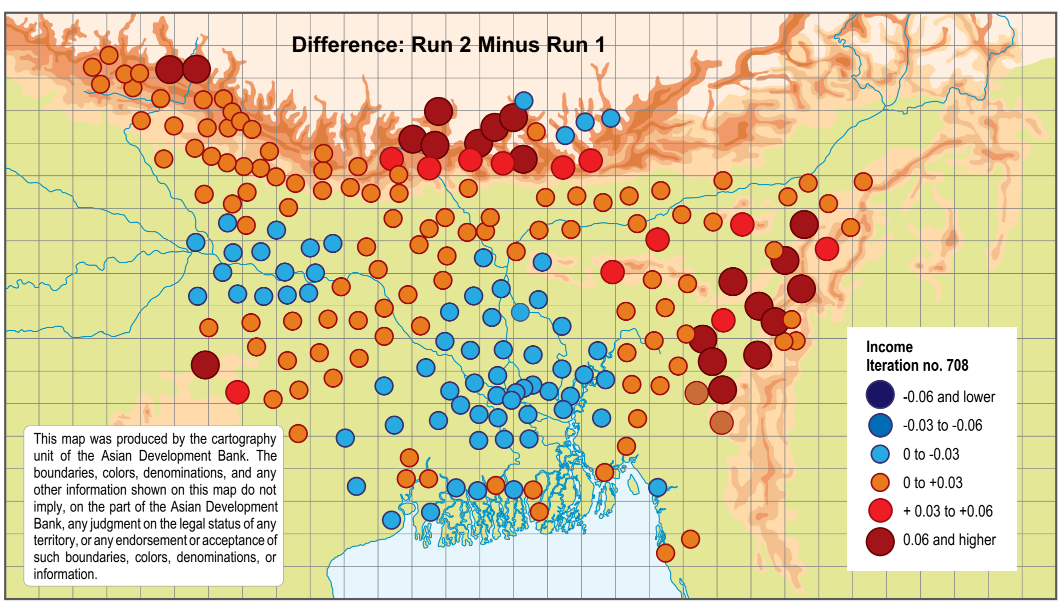
The level of infrastructure investment in S2, in comparison to S1, leads to higher incomes in some districts (especially peripheral districts), and incomes continue to increase between the mid-point and end of the run. The full AfT investment package (S3) shows further income increase beyond those observed in S2, with the vast majority of districts experiencing income increases by the end of the run.

GIS Map 6 shows the *change in* Income from baseline (S1) generated by the full implementation of the AfT (S3).

Three central conclusions are: *no district is significantly worse off after AfT investment; a vast majority of districts show measurable improvement in income; and many districts in the economic periphery enjoy dramatic improvement*.

In the analysis below, we will show the dynamic results in GIS Map 6 over time and with the visible income dispersion across tiles. We will then also add up income gains of tiles to an aggregate, country-by-country income gain.

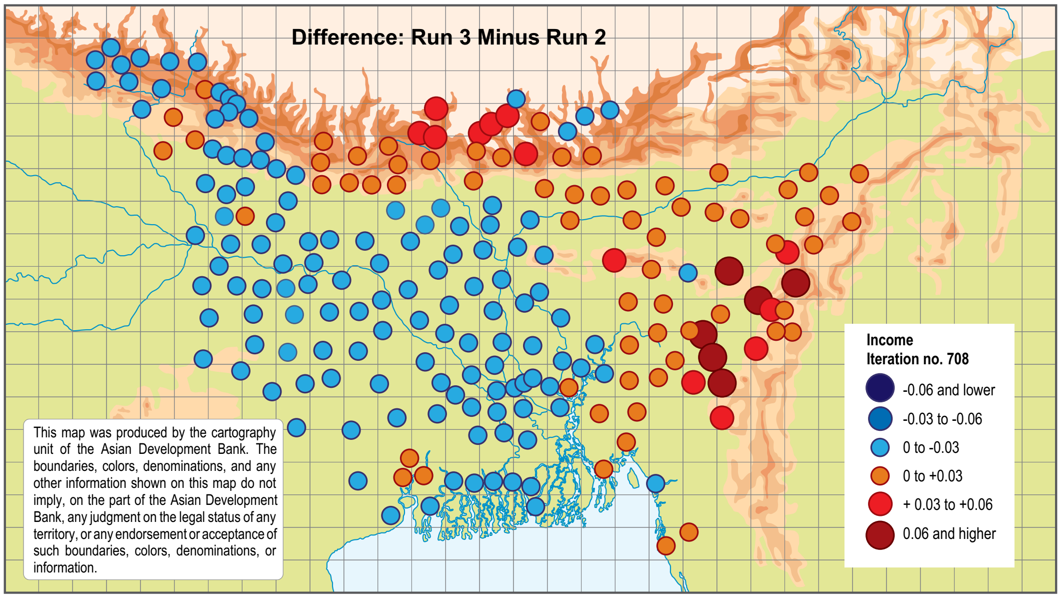
Figure 3.4 GIS Map 4: District-Income Growth above Baseline S1, due to S2 Investments



Note: Color shading reflects altitudes.

Source: Author.

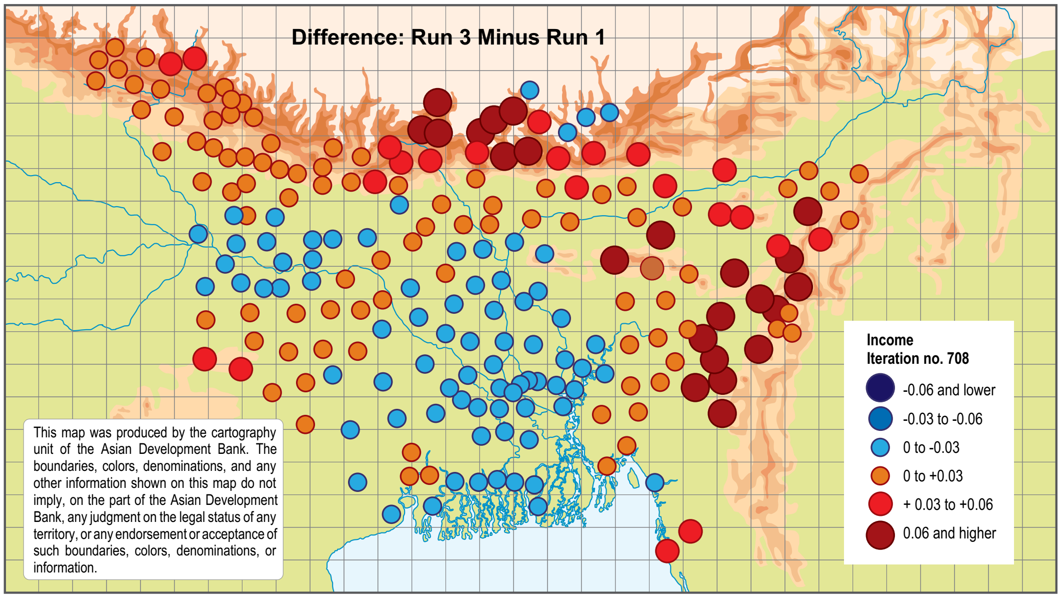
Figure 3.5 GIS Map 5: District-Income Growth above S2 due to S3 Investments



Note: Color shading reflects altitudes.

Source: Author.

Figure 3.6 GIS Map 6: District-Income Growth above Baseline from Full AfT Investment Package



Note: Color shading reflects altitudes.

Source: Author.

Progression of Prices

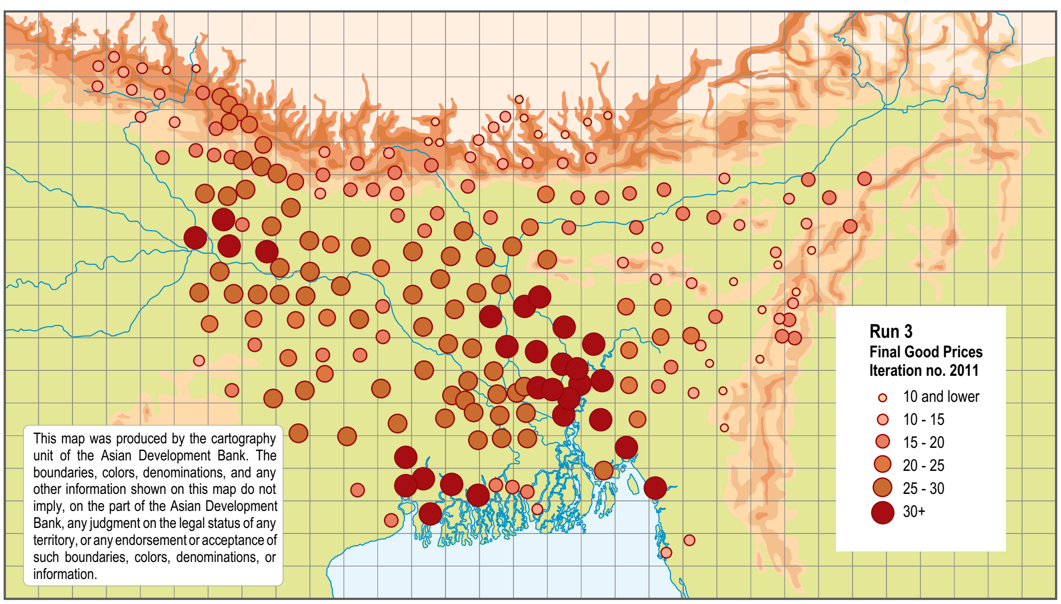
Analysis of goods prices at the district level shows convergence over the course of a run similar to that observed at the tile level—dispersion in prices declines (over iterations) as the effects of the transportation and trade infrastructure and across tile trade is incorporated into prices. This is understood to show that, *in addition to rising incomes, AfT supports increasing (competitive price) efficiency*. Trade is modeled at the level of final goods, as well as at the level of intermediate goods. The intermediate goods are inputs in the production of final goods in other tiles and other countries.

Final good prices in Scenario S3 are used as an illustration of this convergence in the Figures below. GIS Map 7 shows starting prices, while GIS Map 8 shows ending prices. Substantial convergence is apparent. As before, district boundaries and regional coloring are displayed as background, with geographic centroid dot sizes and coloring in foreground representative of average prices in each district.

Comparison of ending prices in S3 with those at baseline (S1) shows that improvements in infrastructure and trade lead to higher ending prices in some low-price districts and lower ending prices in some high-price districts. GIS Map 9 and GIS Map 10 show the comparison for final good prices.

As can be shown, a similar pattern arises from comparison of the price of intermediate goods between S3 and S1—again, infrastructure and trade investment leads to higher ending prices in some low-price districts and lower ending prices in some high-price districts.

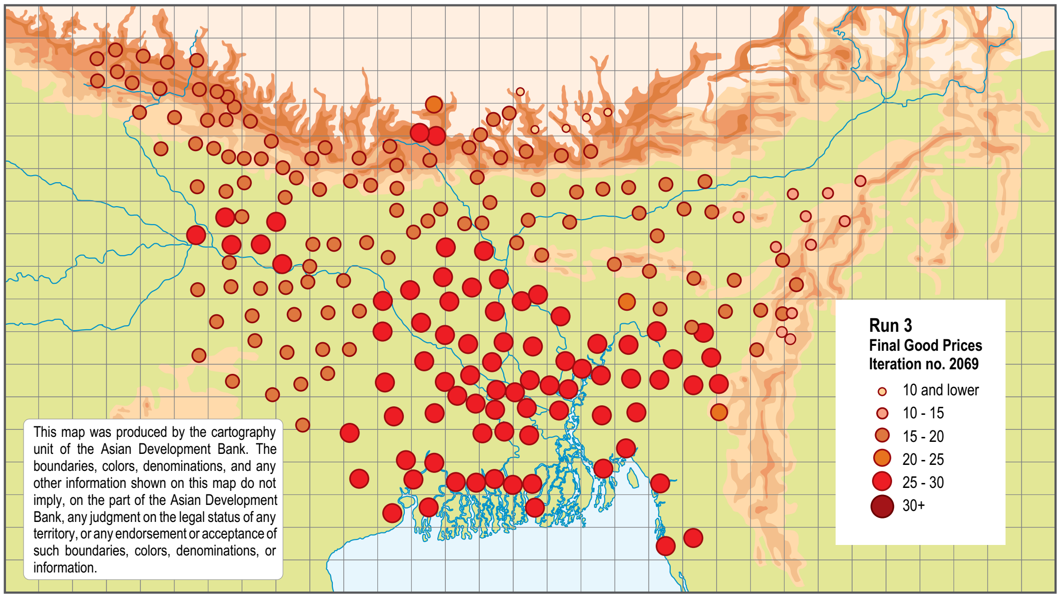
Figure 3.7 GIS Map 7: Average District-Level Final Good Prices at Start of S3



Note: Color shading reflects altitudes.

Source: Author.

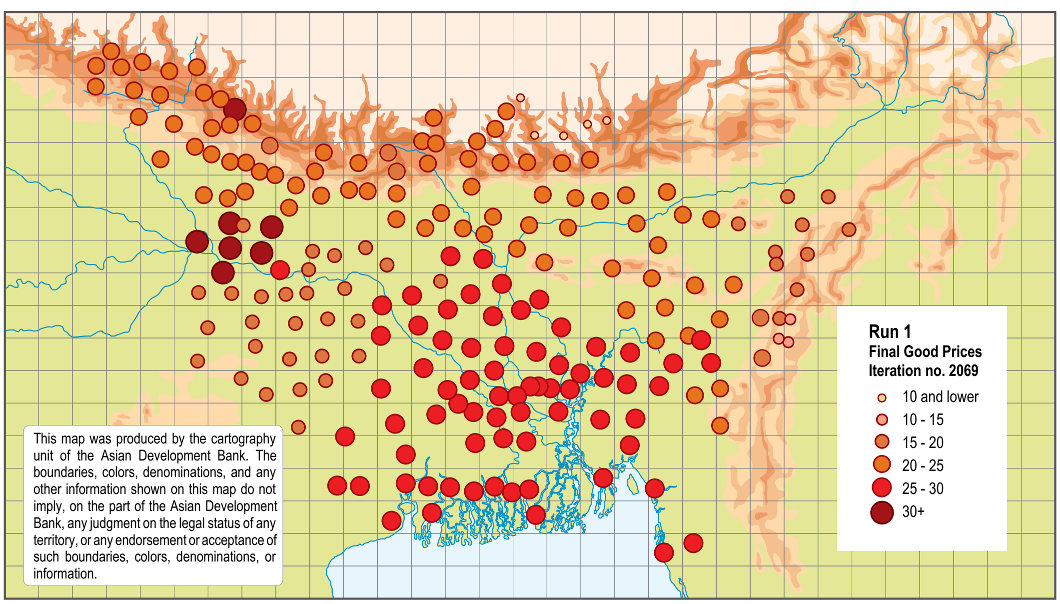
Figure 3.8 GIS Map 8: Average District-Level Final Good Prices at End of S3



Note: Color shading reflects altitudes.

Source: Author.

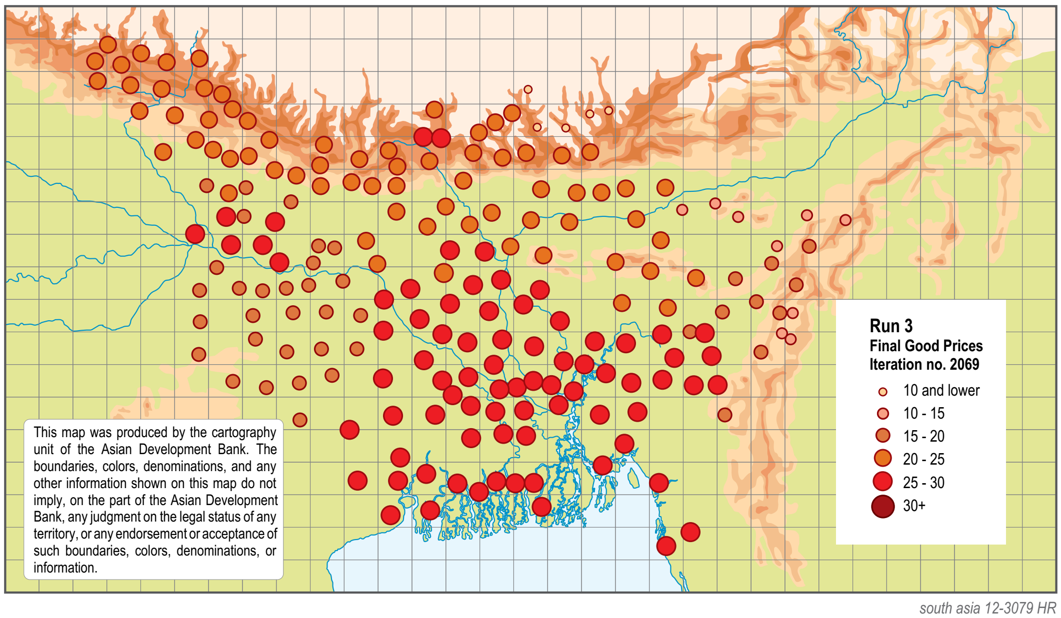
Figure 3.9 GIS Map 9: Average District-Level Final Good Ending Prices at Baseline (S1)



Note: Color shading reflects altitudes.

Source: Author.

Figure 3.10 GIS Map 10: Average District-Level Final Good Ending Prices after Investment (S3)



Note: Color shading reflects altitudes.

Source: Author.

Model Simulations by Tile

The second set of analyses compares outcomes across the three model scenarios (S1–S3) at the tile level.

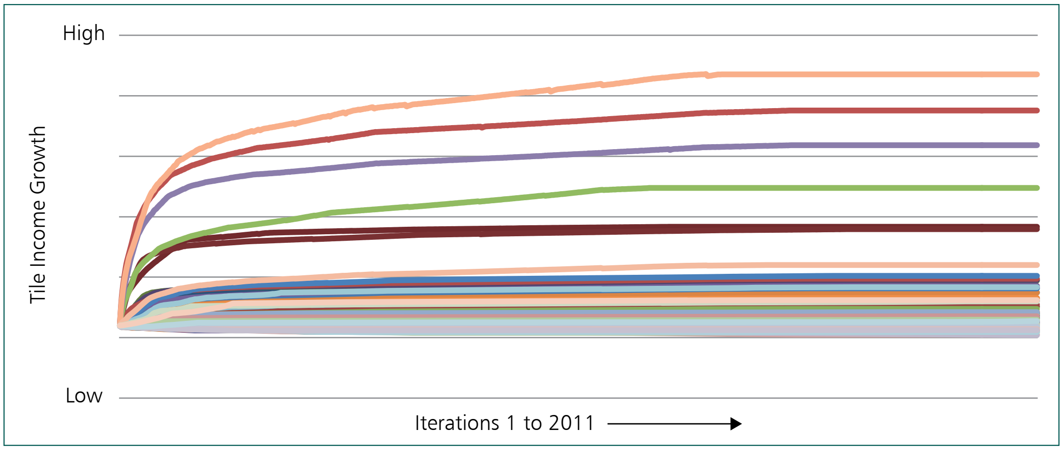
Income Growth

Disaggregation of the population-level results by tile and examination of the dynamics through time yield important insights. Figure 3.11 plots income trajectories by tile, from model initialization until equilibrium is reached. Significant variation is observed across the region in the benefits from AfT transport and trade investments. Preliminary analysis suggests that the tiles with the highest income growth are those with the lower population density—suggesting that *the poorest may benefit disproportionately from AfT investments*.

Figure 3.12 shows increases in income obtained in scenario S3 (perishable and nonperishable investments) over the levels measured in baseline scenario S1—e.g., the growth in income attributable to the AfT investments considered here. The results are disaggregated by tile, and shown over time from model initialization until equilibrium. Overall income growth is positive for most tiles, despite initial turbulence due to simultaneous implementation of all investments. Substantial variation between tiles in income gains can also be observed.

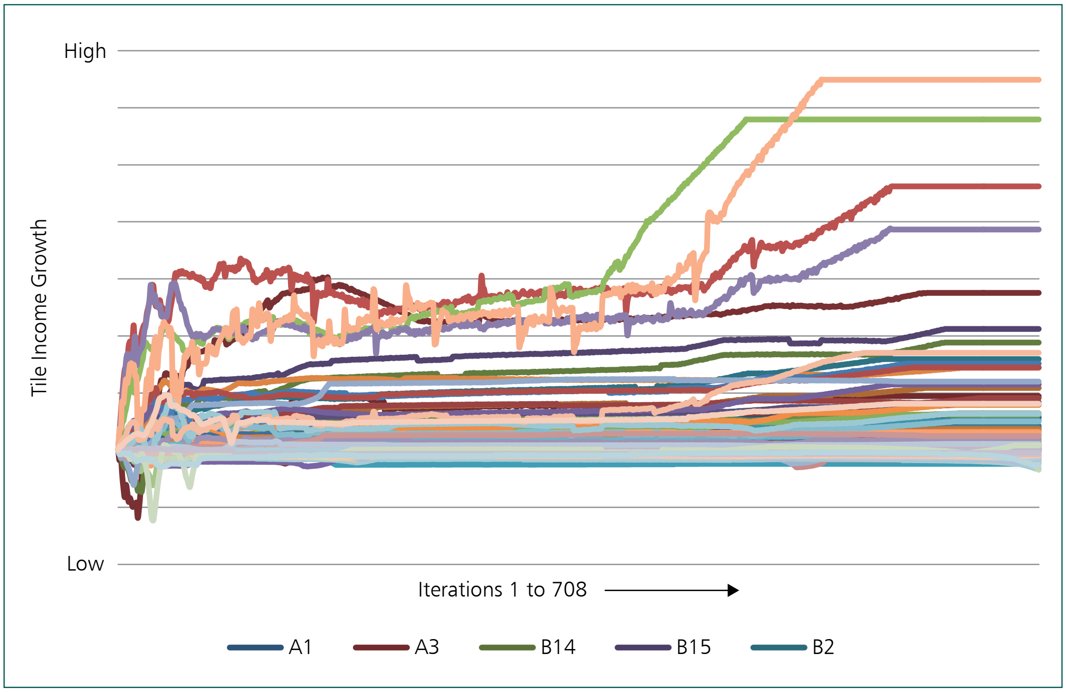
In Figure 3.13 on page 22 we depict the average of average tile incomes, grouped by tiles, for the first and last iteration of Run 1 (the graphs for Run 2 and 3 are similar). The first category is that of the 15 tiles with the lowest average incomes, the next category (16–30) then depicts the average for the next 15 tiles, and so on. We notice small decreases in the averages of the tiles with low incomes, but large increases in the incomes of the tiles with high incomes. The overall average, as we observed above, increases. The comparison between the first and last iteration are interesting. Incomes in the first iteration do not reflect the location advantages of a tile. The (small) differences across tiles are indicative of population differences (the only parameter we vary initially). Incomes in the final iteration reflect the effects of the transportation and trade infrastructure. Tiles that are better connected have higher incomes. A smaller population is also an advantage, because (absent additional information) we allocate all profits and rents to the residents of a tile.

Figure 3.11 Tile Income Trajectories



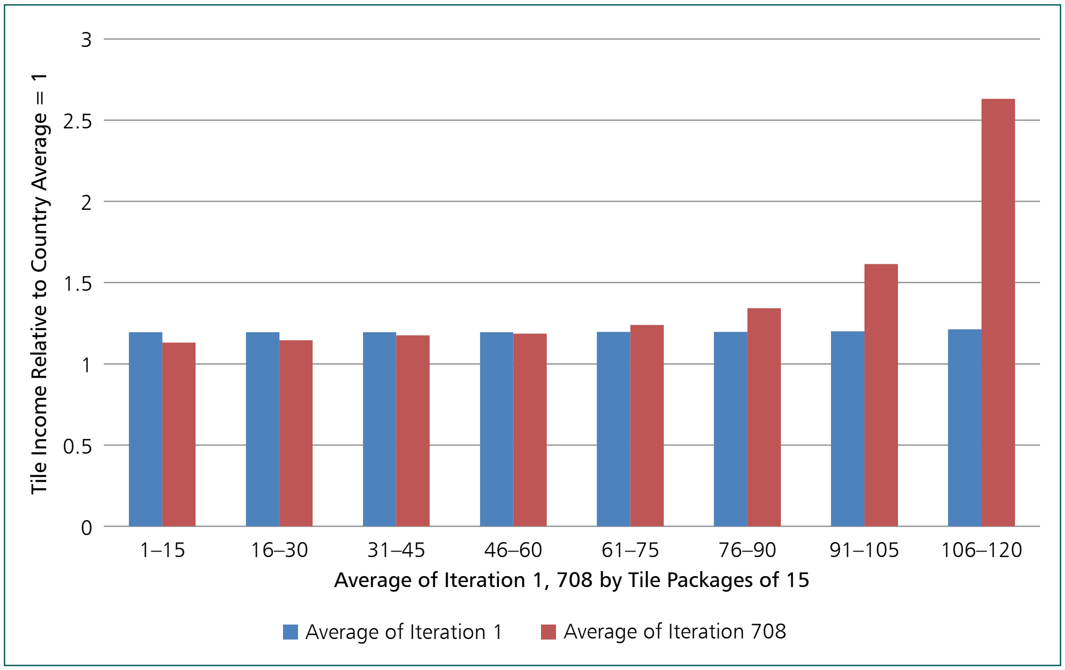
Source: See figures 3.3, 3.4, and 3.6.

Figure 3.12 Income Gains Relative to Base, by Tile (Run3–Run1)



Source: See figure 3.6.

Figure 3.13 Average of Average Tile Incomes, Run 1



Source: See figure 3.1.

In Figure 3.14 we depict the average of average tile incomes, grouped by tiles, for each of the three runs. We find that the improvements in incomes that result from better trade infrastructure are broad-based, but gains are concentrated in tiles with higher incomes. Recalling that the high-income tiles were those with better connections, it is reasonable that benefits from improvements in trade infrastructure should disproportionately affect this group.

Efficiency

Economists often consider wide price dispersions as indicative of inefficiency, since they represent potential trading gains that have gone unrealized. Our simulations show increased efficiency in this sense. The dispersion of prices is depicted in two ways:

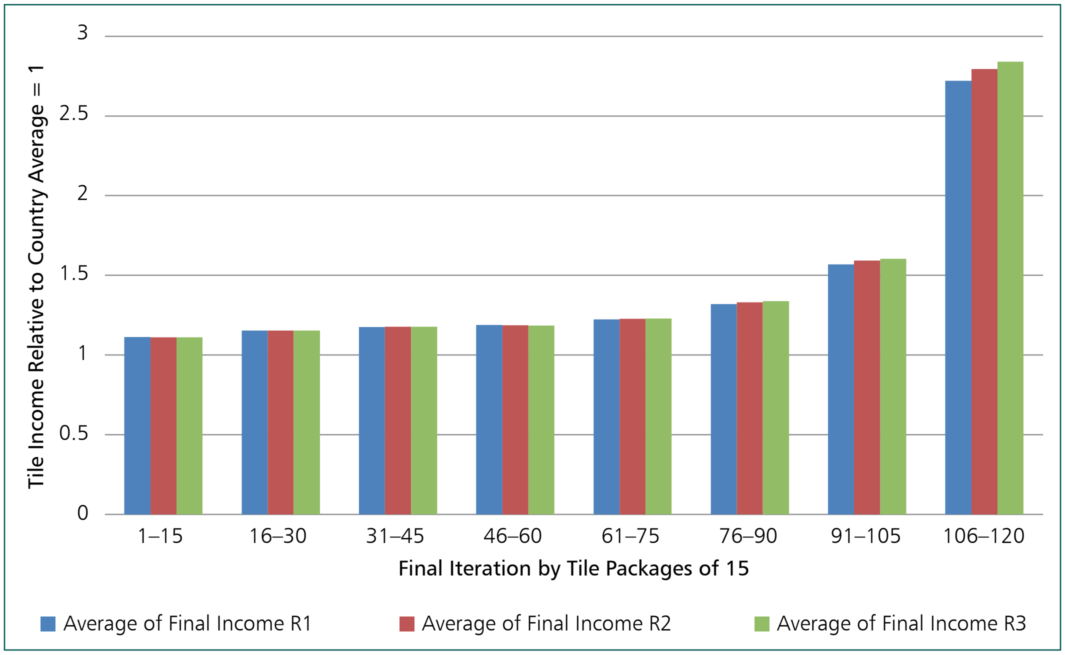
- We examine the standard deviation of final and intermediate good prices for each iteration (Figure 3.15 and Figure 3.16).

- We examine the distribution of average ending prices in each run.

The first set of graphs depicts how the dispersion in prices declines (over iterations) as the effects of the transportation and trade infrastructure and across tile trade is incorporated into prices and incomes. We also observe that data series for the runs are ordered—with better infrastructure corresponding to lower dispersion in prices (hence, greater efficiency).

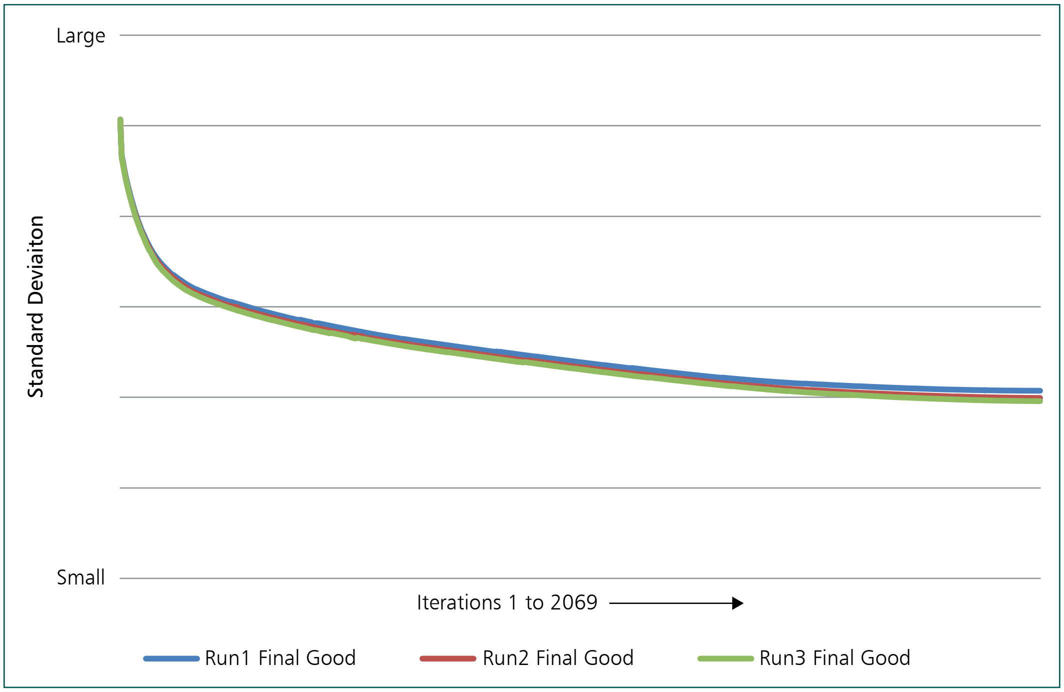
In Figure 3.17 and Figure 3.18, we compute the average of prices grouped by tile. The first category is the average price for the 15 tiles with the lowest price in Run 1, then the next 15 prices, and so on. In general, improvements in infrastructure are seen to lead to higher prices in the low-price regions, and lower prices in the high-price regions.

Figure 3.14 Average of Average Tile Incomes, 3 Runs



Source: See figures 3.3, 3.4, and 3.6.

Figure 3.15 Standard Deviation of Final Good Prices

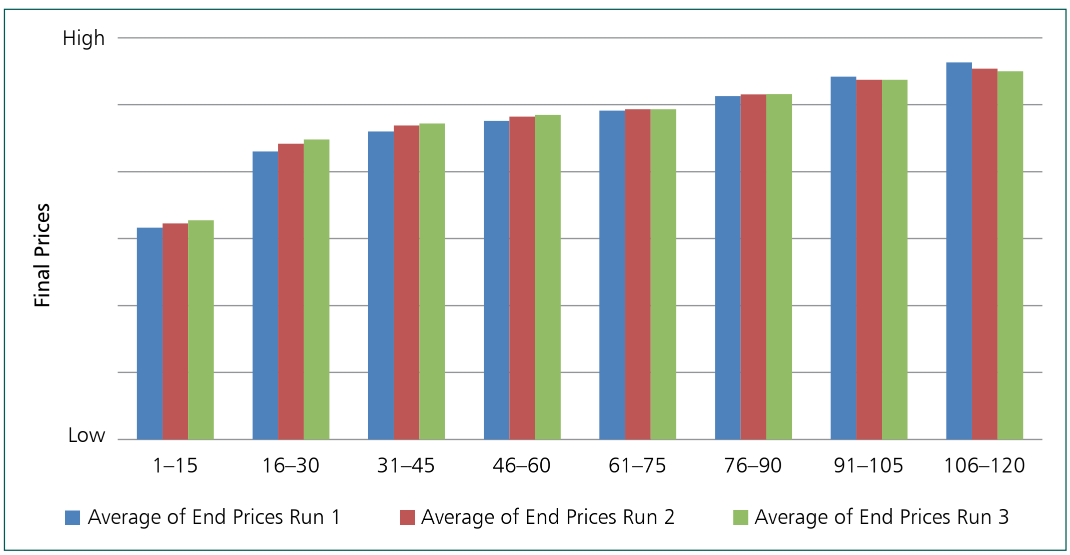


Source: See figures 3.7 to 3.10.

Figure 3.16 Standard Deviation of Intermediate Good Prices

Source: Author.

Figure 3.17 Final Good Prices



Source: See figures 3.7 to 3.10.

Model Results in Aggregate (Entire Population)

Income growth

Table 3.1 provides population-level equilibrium income results for all three scenarios. These are real incomes computed via simulations involving only the real economy (specifically, we do not model monetary phenomena). We use the wage rate as a

Figure 3.18 Intermediate Good Prices

Source: Author.

numeraire, so that rents and profits are measured in units of labor. Consequently, the income numbers below may be interpreted as being quoted in units of labor. The initial endowment of each worker is one unit of labor, and wage income has been normalized to be one. Consequently, an average income of 1.5 would be interpreted as income being 50% higher than the average wage rate. Scenario S2 (non-perishable investments) generates higher average income at equilibrium than the baseline scenario S1. The addition of perishable investments (scenario S3) increases equilibrium average income further. *This demonstrates progressive improvement at the population level as the AfT infrastructure packages are implemented*.

Table 3.1 Income in Units of Labor, by Simulation Runs

	Equilibrium Avg Income	Equilibrium Income Stand Dev	% Improvement
S1	1.433133333	0.650341297	–
S2	1.447044167	0.678879785	0.009706587
S3	1.45508	0.699308208	0.015313765

Source: See figure 3.14.

Next, income units of labor are converted into currency units. Since they are used to evaluate living standards, in the following two tables, for comparability we use per capita income in PPP dollars. For eastern India, we corrected the numbers to account for the fact that the included regions have lower incomes than the average for India. PPP dollars can be readily converted into local currency units (approximate conversion factors: India (17), Bangladesh

(29), Bhutan (20), and Nepal (30)). In Table 3.2, we compute the average for the region being studied (appropriately weighting for the population). Table 3.3 averages the income in the tiles by country, and for eastern India. Note that the labor unit to PPP dollar conversion uses the same multiple for all countries.

Table 3.2 PPP Dollar Average Income

	Run 1	Run 2	Run 3
Average Income (p. c.)	2,388.56	2,411.74	2,425.13
Standard Deviation	1,083.90	1,131.47	1,165.51

Source: See table 3.1.

Table 3.3 PPP Dollar Average Income, Country Details

	Run 1	Run 2	Run 3
India	2,522.34	2,554.26	2,574.03
Bangladesh	2,027.54	2,028.80	2,030.49
Nepal	2,575.61	2,603.06	2,607.06
Bhutan	2,431.13	2,467.33	2,492.33

Source: Author.

Trade Flows

At the tile-to-tile level, and at an aggregate country-by-country level, the reduction in trade costs leads to substantial increases in trade flow. Table 3.4 shows in percentage terms the trade-flow increase within a country among those tiles that overlap with a specific country territory. All countries substantially increase their trade across their territory at high annual rates, of course with differences as landlocked countries benefit relatively more. As shown in Table 3.5, the trade increase across country borders is even starkly higher for all countries except Bangladesh. The differences among countries are even larger than in the intra-tile case, with eastern India and Bhutan seeing trade flows grow at high, even double digit percentages, with Bangladesh lagging. Since Bangladesh is already with open sea access to markets, opening inland borders does increase Bangladesh cross-border trade flows at a modest rate of 3.5% per annum. However Bangladesh can become a large beneficiary with the provision of comprehensive cross-border trade flow services to the countries using these services. Interestingly, the Bangladesh trade flow growth can be further enhanced to above 4%, with an imposition of a modest user fee of 1%–2% of the goods value on a per ton basis. So while appropriate investment in trade flow services can bring some handsome benefits to Bangladesh—enough to cover requisite investments—the increase in trade flows adds substantially to the country's economic benefits.

Table 3.4 Percent Increase in Total Volume of Inter-tile Trade

	Run 2	Run 3	Increment
India	4.74	7.22	2.48
Bangladesh	2.62	4.42	1.79
Nepal	4.05	5.24	1.19
Bhutan	9.10	15.97	6.86

Source: Author.

Table 3.5 Percent Change in Net Exports (Inter-Country Flows)

	Run 2	Run 3	Increment
India	33.64	49.27	11.70
Bangladesh	3.24	3.69	0.44
Nepal	6.52	7.96	1.35
Bhutan	9.47	16.98	6.86

Source: Author.

Robustness of the Model

The simulation model has been extensively tested for robustness. As will be detailed in the technical descriptions in chapters 4 and 5, we used an incremental developmental approach—starting with a one tile model, moving on to two tiles, then to tiles located along a straight line, before moving to the complete general model. This allows us to test diverse aspects of the model before we move to the next layer of complexity. At each stage the model is run with a range of parameters. Economic laws make the model easy to test; for example, for convergence to one price across regions when costs are zero. Then costs are added, which led naturally to price dispersion. Upon increasing costs, we expect the price dispersion to increase—another test of the model against economic intuition. Our tests of the model in the 10 city linear case are presented in Chapter 5.

In a model of this size and complexity one would expect convergence to be circumscribed by special conditions. Remarkably, this model almost always converges to correct results (the rare exceptions have been in cases where demand curves are too close to the axes—a problem that is easily circumvented by appropriate scaling). This assurance of convergence is a result of the judicious choice of parametric forms and algorithms. In light of the robustness of the current model, we are extremely confident it can be generalized to incorporate additional complexities present in the real world.

Table 3.6 AfT List of ADB Investments

Nodes	Country	Investment Activity	Finance	Cost $ millions
Stage One				
Ishurdi	Bangladesh	Transshipment center	Public	7.5
Karimganj	Bangladesh	Transshipment center	Public	7.5
Kulaura, Shahbazpur	Bangladesh	Rail rehabilitation	Public	30
Akhaura/Agartala	Bangladesh/ India	Rail track	Public	60
Akhaura/ Dharkhar	Bangladesh	Road widening	Public	20
Brahmanbaria/ Akhaura	Bangladesh	Road widening	Public	20
Tongi	Bangladesh	Rail ICD	PPP	5
Tongi to Bhairabbazar	Bangladesh	Rail doubletrack	Public	142
Birganj to Kathmandu	Nepal	Road upgrade	Public	100
Puthalaiya/ Hetauda	Nepal	Road bridge widening	Public	10
Phulbari, Banglabandh	India	New access road	Public	10
Barasat to Petrapole	India	Road upgrading	Public	125
Petrapole/ Benapole	India/ Bangladesh	Trade facilities	Public	10
Phulbari customs	India	Trade facilities	Public	50
Naobhanga/ Petrapole	Bangladesh/ India	Bridge	Public	10
Changrabandh to Burimari	India	Access road upgrade	Public	10
			total	617
Dhaka to Jessore via Padma Bridge	Bangladesh	New rail	Public	1,271
Stage Two				
(T) Mansi to Katihar	India	Rail upgrade	Public	60
Bihar 180 km road (corr. 2)	India	Road upgrading	Public	100
Rohanpur to Ishurdi	Bangladesh	Rail rehabilitation	Public	60
Darshana to Ishurdi	Bangladesh	Rail upgrade	Public	30
Ishurdi to Mongla Port	Bangladesh	Rail track	Public	250
Chittagong port facility	Bangladesh	Logistics	Public	61
Rangpur to Mongla	Bangladesh	Road rehabilitation	Public	100

District and Center	Associated Tile	Status	Tile Impact (cost decrease %)	Perish/ Non-Perish	Implem. Time Frame
Pabna	I 12	Dot (rail corr.1)	33	NP	M
Sylhet	H18	Dot (rail corr.1)	–	–	M
Moulvibazaar	H 18	Rail corr. 1 line	66	NP	M
Brahmanbaria	J 16	Rail corr. 1	66	NP	S
West Tripura	J 16				
Akhaura	J16	Road line corr. 1	29	NP	S
Dharkhar	J16				S
Brahmanbaria	J16	Road line corr. 1	–		S
Akhaura					S
Dhaka	J 14	Dot (rail corr. 1)	33	NP	S
Dhaka, Tangail, Kishoreganj	J 14, I 15	Rail corr. 1 line	66	NP	M
Parsa, Chitwan, Kathm.	C 3, B 4	Road line corr. 2	19	NP	L
Pathalaiya	C 3, C 4				M
Hetauda		Road line corr. 2	–		M
Islampur, Thakurgaon	E 10/11	Road line corr. 4	20	NP	S
Ashokenagar, Petrapole	L 11, K 11 2	Road line corr. 1	29	NP	M
Petrapole	K11		29	P	M
Phulbari	E10	Dot (road corr. 4)	19	P	S
Naobhanga/ Bangaon	K11 2	Dot (road corr. 1)	–		M
Petrapole	L11				
Lalmonihat, Bilasipara	F 12, E 12	Road line corr. 8	0	NP	S
		New			M
Mansi, Katihar,	F7, F 8 , F 9	Rail corr. 4 line	15	NP	L
Barhi, Bihar Sharif, Nawada	F4, G4, H5, I4	Road line corr. 2	19	NP	L
Rajshahi, Ishurdi	I 11, I 12	Rail corr. 4 line	15	NP	M
Darsana, Ishurdi	J 11, I 12	Rail corr. 1 line	66	NP	M
Kusthia, Jhenaidah, Jessore, Khulna, Mongla	J 12, K 12, L13, M 13	New line	15	NP	M
Chittagong	M17	Dot (road 8ii)	10	NP	M
Rangpur, Hatikumrul, Jessor, Mongla	F12 to K12, L13, M13	Road corr. 8/4 line	5	NP	L

continued on next page

Table 3.6 *continued*

Nodes	Country	Investment Activity	Finance	Cost $ millions
Puentsholing	Bhutan	Bypass	Public	10
Jaigaon	India	Freight Hub	PPP	10
Dawki customs	India	Trade facilities	Public	50
Sutarkhandi customs	India	Trade facilities	Public	16
Kathmandu airport	Nepal	Freight Hub	PPP	5
Agartala airport	India	Freight Hub	PPP	10
Dhaka airport	Bangladesh	Freight Hub	PPP	5
Guwahati airport	India	Freight Hub	PPP	10
Guwahati	India	Trade Fac Center	PPP	10
Amingaon	India	Rail/road ICD	Public	10
Bonded warehouses	ALL	Reforms and invest	PPP	10
EDI/Direct trader input	Nepal	Electricity System upgrade	Public	1
UN transit cargo conv treaty	ALL	Transit treaty	Public	0.5
Sealed container infrastructure	ALL	Invest and regulate	PPP	10
Cargo information system	ALL	Trace cargo move	PPP	50
Harmonize laws/regulation	ALL	Assignment of liabilities	Public	0.5
Standards/conformity cap.bldg.	Bangladesh	Capacity building	Public	0.5
Nat. Lab Accreditation	Bangladesh	Institution building	Public	1
TBT enquiry points	Nepal/ Bhutan	Capacity building	Public	1
Regl. Biodiversity training center	Bhutan		Public	2
Value chain processing centers	ALL	Supply-side capacity	PPP	10
		Trade creation		
				723.5

EDI=electronic data interchange, ICD=inland container depot, PPP=public–private partnership, TBT=technical barriers to trade, UN=United Nations.
Source: Author.

District and Center	Associated Tile	Status	Tile Impact (cost decrease %)	Perish/ Non-Perish	Implem. Time Frame
Phuentsholing	D12	Dot (road corr. 3)			S
Jaipaiguri	D12	Dot (road corr. 3)	19	P	M
Dawki	G18	Dot (road corr. 5)	15	P	S
Sylhet	H18	Dot (road corr. 5)	66	P	M
Kathmandu	B 4	Dot (road corr. 4)	19	P	M
West Tripura	J 16	Dot (road/rail 1)	66	P	M
Dhaka	J14	Dot (road corr. 1)	33	P	M
Kamrup	E 17	Dot (road corr. 5)	33	P	M
Kamrup	E 17	Dot (road corr. 5)	33	P	M
Kamrup	E 17	Dot	33	P	M
Kathm, Phuentsholing	B 4, D12	Dots	19	P	S
					S
					S
Akhaura, Chittagong port	J 16, M 17	Dots	66	P	S
Akhaura	J 16,	Dot	66	P	S
					S
Dhaka	J 14	Dot	33	P	S
Dhaka	J 14	Dot	33	P	M
Kathm/ Thimphu	B 4, C 13	Dots	60	P	S
Serbithang (near Simthoka)	C 13	Dot	60	P	S
Mustang, Bhumtng	A 1, B 15	Dots	60	P	M
Thimphu, Paro		More dots			S
Comilla		Dot			S

4

Computations Behind Model Simulations

Having seen how the model has the predictive power of simulating the effects of infrastructure or policy changes in local economies linked by value chains, we now explore the calculations and assumptions which make those simulations possible.

Analytical Framework

The core of the agent-based model of the effect of investments on prices, consumption, and incomes is the single tile. The economy within a single tile is a simple general equilibrium model. Autarky (no trade between tiles) is assumed and the condition is gradually relaxed, permitting trade between tiles. Initial trade is determined by examining price discrepancies between tiles (for each tile, prices are compared with all other tiles).

Since we are interested in value chains for single goods, one final good is included, along with an intermediate good to model a non-trivial value chain. The model includes labor and land as factors of production. As its agents, the model has consumers, firms, workers, and landlords. Individual households provide factors of production to firms, and earn wages and rents in return. Incomes are used to consume the final good. Firms produce final and intermediate goods after the purchase of inputs.

In simulating the effect of an investment, we establish a benchmark, and then examine the gains that arise from two kinds of infrastructure investments. As described in detail, in order to establish the benchmark we first translate the effects of investments on the costs of transporting goods between any two tiles (or, equivalently, on the value remaining after transportation). Then we allow agents to make production and consumption choices, and allow for prices to evolve, until we are at equilibrium. Thus local prices for both the intermediate and final good can be computed as described in this chapter.

We compute the equilibrium for the post-investment cost/benefit configurations. Taking into account the costs of inter-tile trade, the effective price per unit for goods are imported from all other tiles is computed. If any given price difference is big enough to justify paying transport costs to import a good from a remote tile then a small amount of demand will be transferred from the high-price tile to the low-price tile. Slowly this process will lead prices across the tiles to come to equilibrium. This process proceeds slowly to avoid "over-damped" oscillatory dynamics in prices. In equilibrium, remaining observed price differences are due to the cost structure of transportation *imposed by the available infrastructure*.

We can then compare prices, incomes, and other relevant economic variables. Income is, of course, a natural metric for welfare. We are interested primarily in how much per capita income increases. Policy makers may also be interested in the interregional distribution of income and in mitigating disparities.

Another valuable metric of efficiency is the extent to which the "law of one price" obtains. If there were no transportation costs, the prices of goods would be equalized (because of arbitrage). In the presence of transportation costs we will have price dispersion across space. The dispersion is indicative of frictions, and investments that take us in the direction of identical prices reduce the frictions, and hence are desirable. (A useful analogy here is with tariffs, which create price differences across countries. Reductions in tariffs allow prices to become more uniform across regions, producing associated welfare gains).

The model becomes more agent-based in flavor when inter-tile trade is considered. In a model with no inter-tile trade fundamentals determine prices. These prices will differ across tiles depending on factors such as population, incomes, and raw material endowments. Price differences induce movement of optimizing agents into other markets. Since the possibility of migration is excluded, we have individuals moving their demands to markets where a good is cheaper. They consume remotely produced goods if these are cheaper after an accounting for transportation costs. This process is likely facilitated by the profit maximizing actions of arbitrageurs, but such agents are not explicitly modeled here.

Here, as is the norm in agent-based modeling, we assume simple adaptive behavior, with agents moving their demand in response to the spatial distribution of prices. Since there are many goods and prices (at a minimum the tradable goods are the intermediate and final goods), there is no guarantee of convergence of these prices to ones that clear all markets at all locations. The inter-tile trade induced by price differences will cause prices within tiles to change (to fall if consumers start consuming from other markets and to rise if consumers from other markets are attracted to this tile). The new set of prices will reflect underlying transportation costs. Associated with these prices will be inter-tile trading volumes, and consumption and production patterns.

"Tradeable" goods producers have demand for intermediate goods (for instance agriculture inputs)—when located within a tile then this demand does not generate trade, but when located outside a tile, external demand for intermediates generates trade taking into account the logistics costs. Lowering logistics costs increases demand. If labor is (partially) immobile, then higher demand generates higher incomes and wages. The tendency for producers to cluster around economic centers, and where there is sufficiently qualified labor, depends for instance on production externalities, and this is determined in the model by a calibrated parameter. There are final goods (perishable/ non-perishable), intermediate goods, labor and land in the model, and prices associated with these. Prices are determined in terms of excess demand, with markets clearing through dynamic adjustment mechanisms.

Following the sequence from the single-tile to many-tiles, use of the following computational simulations allows us deduce which goods an investment will benefit the most.

Core Model Computations

From the consumers' decision problem, we obtain the demand for the final good and the supply for labor. From the firms' decision problem we obtain the demand for labor and of the intermediate good. The supply of the final and the intermediate goods are also derived. Within each tile, we aggregate demand and supply curves and solve for equilibrium prices. The aggregation allows us to abstract from the process of price formation. Demand and supply functions will typically be functions of all prices.

Since there is no accumulated wealth in the model, consumption differences arise from wages and rents. Differences in these can arise because of ownership of productive factors, and high local demand for labor.

We obtain market-clearing prices for all goods in the model by simultaneously solving a system of equations. This computation is done using the numerical methods now described for both consumers and producers.

Consumers' Decisions

Consumers have identical Cobb-Douglas preferences. There are several classes of utility functions that are frequently used to generate demand functions. One of the most common is the Cobb-Douglas utility function as established by these two economists, but differs in endowments (leading to differences in incomes). This assumption is made primarily because we only have data on income and its distribution. An implication of the Cobb-Douglas assumption is that a constant fraction of income is spent on each good. We assume utility is a function of a final good (X_F) and leisure (L) and there is a fixed total labor endowment for each person (A_L) (which can be allowed to vary across individuals). Labor supplied can be computed from leisure choice as $N \equiv A_L - \mathrm{L}$.

The demand function for final good in a given tile can be computed from the utility function. Once we aggregate across individuals we get the demand curve in Equation 1.

Equation 1 $$X_F = a_s A_X \frac{M}{P_F}$$

The parameter α_S is a population scale factor; M is the total income of households in the tile; A_X captures relative preference for the final good (X_F); and relative preference for leisure is captured by $(1 - A_X)$. Income (M) is the sum of wages and rents:

Equation 2 $$M \equiv wA_L + \Pi\omega_i$$

(Π is the combined profits of all firms, and ω_i is the individual's share—this will be taken to equal $\omega_i \equiv 1/\alpha_s$, but different ownership patterns are also feasible). Note that we can replace by $\alpha_s M$ by $\sum_i M_i$ (when income distribution is of interest).

We will compute an individual's supply (from utility maximization). This will be scaled up by population in the tile (α_s). The total labor supply in the tile then:

Equation 3 $$N = \alpha_s \left(A_X A_L - (1 - A_X) \Pi / w \right)$$

Labor is assumed to be immobile across tiles but mobile across sectors. We can allow for sector-specific labor (e.g. unable to shift from the intermediate sector to the final good sector). This would create sector-specific wages.

Box 4.1 Symbols Used in the Equations

Symbol	Description	P/E
$(_{\downarrow}s$	Population scale factor for tile s	P
S	Total land area of tile s	P
θ_F	Fraction used for the final good	P[a]
θ_I	Fraction used for the intermediate good	P[a]
M	Total income of households	E
X_F	Quantity of final good (per unit of land)	E
C	Quantity of intermediate good (per unit land)	E
L	Leisure	E
A_X	Relative preference for the final good	P
$1 - A_X$	Relative preference for leisure	P
γ^F	Production externality (final good)	P
A_L	Fixed total labor endowment for each person	P
$N \equiv A_L - L$	Labor supplied	E
w	Wage rate	E
P_F	Price of final good	E
P_I	Price of intermediate good	E
Π	Combined profits of all firms	E
ω_i	Individual i's share of profits, e.g. $\omega_i = \frac{1}{(_S}$	P
N_F	Labor demand (final good)	E
a	CES parameter (final good)	P
N_I	Labor demand (intermediate good)	E
d	CES parameter (intermediate good)	P
γ^I	Production externality (intermediate good)	P
π_F	Rental income (final good)	E
π_I	Rental income (intermediate good)	E

[a] Assumed to be a parameter, but can be endogenously determined as well. Parameters are identified in the final column by "P"; Endogenous variables are identified by "E," and values are computed by the model. Calibration requires choosing appropriate values of the parameters.

The key parameters will be the population scale parameters, and the θ 's (fraction of land in a tile that is specialized for the production of final, and intermediate, goods).

Production Decisions

There are two produced goods—a final good (*F*) and an intermediate good (*I*). Both require land and labor for production. Additionally, the final good also requires the intermediate good. Since the intermediate good is tradable, the production of the final good can be spatially dispersed. The intermediate good could be produced in one tile, and then transported to another tile where it is used to produce the final good. We let θ_I denote the fraction of land in tile *s* used for the production of the intermediate good and θ_F the fraction used for the final good. If $\theta_I = 0$ then there is no production of the intermediate good in the tile. Similarly, it is also possible that there is no production of the final good in some tile. Let *S* be the total area of the tile.

We assume CES Production functions. The CES production function is a type of production function that displays constant elasticity of substitution. Key parameters (such as the elasticity of substitution) are unavailable. We will therefore make some plausible assumptions about their values. A parameter γ^F specifies a production externality. It takes higher values when there are other firms in the vicinity producing the same good. The final good output per unit of land is:

Equation 4 $$X_F = \gamma^F \left(N^a + C^a\right) \text{ where } a \in (0, 1).$$

We compute the derived demand for labor and intermediate good (wage is *w*, the price of the final good is P_F, and the price of the intermediate good is P_I). This has been scaled up by $\theta_F S$. This captures, indirectly, the number of firms. If the area used in the production of a particular good increases, then so does production of that good. The demand for labor and the intermediate good are:

Equation 5 $$N_F = \theta_F S \left(aP_F \gamma^F\right)^{\frac{1}{1-a}} w^{\frac{1}{a-1}}$$

Equation 6 $$C = \theta_F S \left(aP_F \gamma^F\right)^{\frac{1}{1-a}} P_I^{\frac{1}{a-1}}$$

The intermediate good output per unit of land is represented by Equation 7.

Equation 7 $$C = \gamma^I \left(N^d\right) \text{ where } d \in (0, 1)$$

Derived demand for labor (scaled up by $\theta_I S$) is:

Equation 8 $$N_I = \theta_I S \left(dP_I \gamma^I\right)^{\frac{1}{1-d}} w^{\frac{1}{d-1}}$$

And total demand for labor is:

Equation 9 $$D_t = N_F + N_I$$

We can determine the supply functions of intermediate and final goods: given the technology above, the marginal cost curve is:

Equation 10 $$P_I = \frac{w}{d}\left(\gamma^I\right)^{\frac{1}{d}} C^{\frac{1}{d}1}$$

Invert and scale by $\theta_I S$ to get the supply curve:

Equation 11 $$C = \theta_I S\left(\frac{w}{d}\right)^{\frac{d}{d-1}} \left(\gamma^I\right)^{\frac{1}{1-d}} \left(P_I\right)^{\frac{d}{1-d}}$$

Given the technology above, the marginal cost curve is:

Equation 12 $$P_F = \theta_F S\frac{1}{a}\left(\gamma^F\right)^{\frac{1}{a}} \left(P_I^{\frac{a}{a-1}} + w^{\frac{a}{a-1}}\right)^{\frac{a-1}{a}} X_F^{\frac{1-a}{a}}$$

Invert and scale by $\theta_F S$ to get the supply curve:

Equation 13 $$X_F = \theta_F S\left(\frac{1}{d}\right)^{\frac{a}{a-1}} \left(\gamma^F\right)^{\frac{1}{1-a}} \left(P_I^{\frac{a}{1-a}} + w^{\frac{a}{1-a}}\right) P_F^{\frac{a}{1-a}}$$

Rental income for each unit of land is calculated as the profit per unit of land for the type of firm that occupies the land. The profit for final and intermediate good firms is, respectively:

Equation 14 $$\pi_F = \theta_F S\left(P_F\gamma^F\left(N_F{}^a + C^a\right) - wN_F - P_I C\right)$$

Equation 15 $$\pi_I = \theta_I S\left(P_I\gamma^I\left(N_I{}^d\right) - wN_I\right)$$

These are computed at the equilibrium values of prices and quantities: we use Equations 5 and 6 for Equation 14, and Equation 8 for Equation 15, but assume scale values of Equation 1. In other words, we compute profit per unit of land, and only in Equations 14 and 15 multiply the scale factor.

Market Clearing Prices

Since the demand and supply for each good has been characterized, we can compute market clearing prices. The following prices need to be determined: P_F, P_I, and w. Given input prices and rental income, P_F is determined from the equality of supply (Equation 13) and demand (Equation 1). Given P_F, w and P_I is determined from Equations 6 and 11. Wages are determined from Equations 2 and 6 (and traded volumes are determined as well (since we have 6 equations and 6 unknowns)). We use a zero finding algorithms (which searches for prices that make all excess demands zero). Finally, rents are computed using Equations 14 and 15. The following issues are also relevant for computation:

- If a vector P is a solution, so is the vector σP for any real number σ. So we need to normalize, and can take $P_F = 1$

- We can drop any one of the three equations above when looking for a zero of the system. We now have a system of two equations in two variables.

- $P_F = 1$, combined with the produced values of P_I and w will be a solution of the original system.

The Single-Tile Model

We find the solution of the system of equations above. The following parameter values are assumed:

- For final good demand $\left(X_F = \alpha_S A_X \dfrac{M}{P_F}\right): \alpha_S = 100, A_X = 1/3, M = w + \pi_F + \pi_I$.

- For labor supply: $N = \dfrac{\alpha_S}{3} - \dfrac{2\Pi}{3w}$.

- Let $a = d = \dfrac{1}{2}, \theta_F = \theta_I = \dfrac{1}{2}, S = 2,$ and $\gamma_F = \gamma_I = 1$.

At this stage we can solve the system of equations numerically. We get the approximate solution: $P_F = 1$, $P_I = 0.9721$, and $w = 1.8375$. Rents are $\pi_F = 0.3932$ and $\pi_I = 0.3932$. If we change the scale parameter to $\alpha_X = 200$ (i.e. imagine a different tile), the new prices are: $P_F = 1$, $P_I = 0.8417$, and $w = 1.1925$.

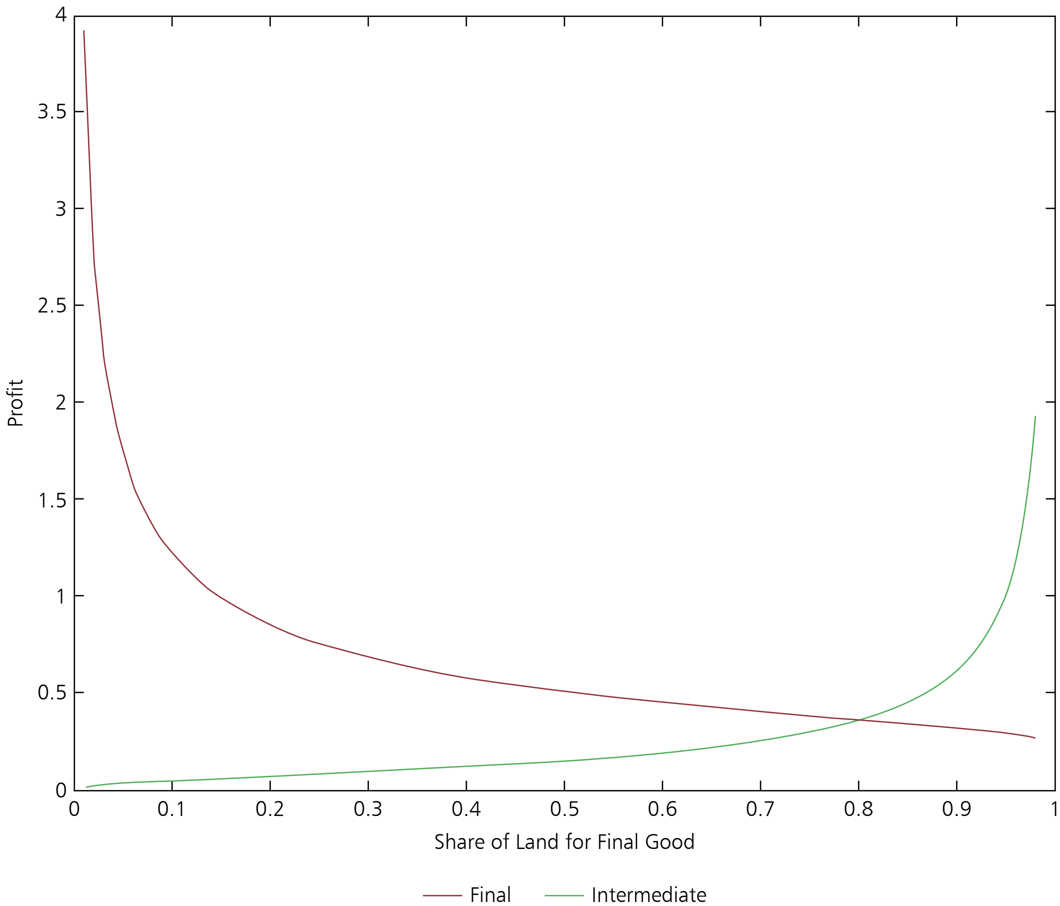
All other things being equal, population differences will result in difference in prices. An implication will be trade between tiles. There will be difference in rent between sectors. Even within one tile, we can allow the fraction of the tile devoted to the production of a good (θ_F, θ_I) to change, with an increase in the fraction of land devoted to the more attractive option. The increases should stop once profits are equalized. We explore how prices, income, etc. vary with the different parameters in the model.

We modify (θ_F, θ_I) until we have rent equalization per unit of land (assumption: $\theta_F, + \theta_I = 1$). This captures the idea that higher profits attract new entrants. If we want the number of firms to be explicit, we can specify the area of land required by a firm and compute the number of firms that would occupy the total area.

Numerical computations are summarized in the graph below. As the share of land devoted to the final good increases, the profit per unit of land in the final good sector decreases while the profit per unit of land in the intermediate good sector increases. If less than 80% of the land is devoted to final goods, more land will be converted for producing final goods. If more than 80% is in final good production, some of this land will be converted to intermediate good production.

Not allowing for the θ's to change means that returns are governed by ownership of unique resources (so that entrants cannot compete away profits). This is also a useful model to study—it implies that a good (say the intermediate input) needs to be imported, and cannot be produced locally. Or else, final good production may need to take place in areas close to sources of the intermediate input—and then exported. The intermediate case is where converting land from one use to another is either time consuming, or expensive.

Figure 4.1 Share of Land for Final Good



Source: Author.

The Two-Tile Model

We simulate a two-tile model, using iceberg costs (i.e. some fraction of goods are lost in transportation, and this fraction increases with distance and transportation time). With only two tiles, we can change the fraction, and we can change the distance. The costs will depend upon the nature of the good as well. As we may imagine, perishable goods are more likely to be sensitive to transportation time. There are two potential approaches to modeling inter-tile trade (see below).

Modeling of Costs

Costs are modeled following the iceberg model—in other words, a fraction of the goods perish during transportation. Costs vary with distance transported (freight may additionally vary with weight and volume), time taken, and characteristics of the good (whether perishable or durable). We will model this as follows. Let $exp(V_0)$ denote the value of the good at the point of origin. Then the value at any other location *j* (when the point of origin is *i*), V_{ij}, is given by

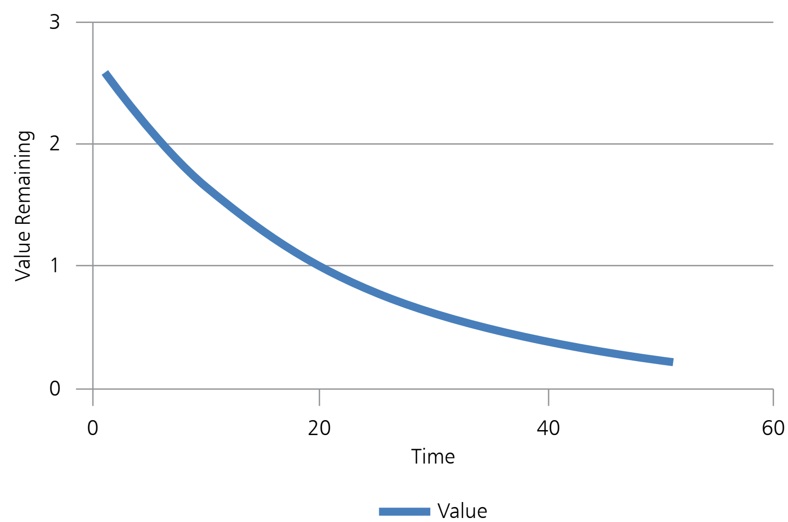
$$V_{ij} = exp\{ V_0 - b_1 t_{ij} - b_2 d_{ij} \}$$

where t_{ij} is the time taken to transport goods, and d_{ij} is the distance traveled. Location indices will hereafter be dropped, and we will use the equivalent formulation,

$$ln(V) = V_0 - b_1 t - b_2 d$$

In this case, $100b_1$ is the percentage loss in value for every period spent in transit. Similarly, $100b_2$ is the percentage loss in value for every unit of distance from the point of origin. We can add to this a hard time T, such that 100% of the value is lost if the good is not delivered by time T. The next graph depicts the depreciation in value at the point of origin ($d = 0$) when the initial value is 1 and the depreciation rate is 5%.

Figure 4.2 **Depreciation in Value**



Source: Author.

The framework can be flexibly extended. For instance, we can include an indicator variable, labeled I, for whether the good is a perishable or not. In which case, we could have

$$ln\ (V) = V_0 - b_1 t - b_2 d - b_3 I - b_4(I^*t) - b_5(I^*d).$$

Here, b_4 and b_5 capture the difference in depreciation rates between durables and perishables. The depreciation over time will be higher for perishables than for durables. However, this model could also take into account differences in freight rates. Suppose, for instance, that multiple means of transportation are available, with different freight rates. For any desired movement of goods between two points, we could compute remaining value under each possible mode of transport. The assumption will be that sellers pick the least expensive means of transportation.

As goods proceed through the value chain they are transported, and processing can change the costs (by changing the characteristics of the good). Consequently, different cost formulae need to be applied for goods at different levels of processing. In particular, there would

Box 4.2 The Infrastructure Mix

New infrastructure has the effect of changing costs. Clearly, a bridge across a river will reduce transportation costs by changing distance as well as time spent in moving goods between points on two sides of the river. At the same depreciation rates, a larger fraction of the value is retained during transit. Similarly, refrigeration facilities will change the rate at which perishables depreciate. In the same vein, a processing plant near the source of, say, perishable fruit pulp will mean that less pulp is lost during transportation to its processing facility. Relatively less perishable jam can be transported with smaller losses. The model is flexible enough to handle something like lead-free certification of ceramics. Absent such certification, we could have an infinite (arbitrarily large) distance between the port of exit and foreign markets. Certification would bring this cost down to the transportation cost with actual distance. An alternative approach would be to consider certification as a form of processing. Then the unprocessed good would depreciate completely during transport to international markets, whereas processed goods would depreciate at the normal rate.

need to be separate cost functions (depreciation rates) for intermediate and final goods. For instance, fruit pulp may be perishable, but once processed into jam it may not perish in the time it takes to transport it to final consumers. In this case, the time depreciation rate for fruit pulp would be different from that of jam.

Consider the following example that illustrates the principle. We start with two matrices which illustrate the time and distance between three locations *A*, *B*, and *C* (that happen to lie on a straight line, 1 unit of distance apart, although the route from *B* to *C* is mountainous).

Time	A	B	C
A	0	10	30
B	10	0	20
C	30	20	0

Distance	A	B	C
A	0	1	2
B	1	0	1
C	2	1	0

Suppose the time depreciation rate is 0.01 and the distance depreciation rate is 0.02. Then the value remaining (given 100 units at the beginning) is

Value	A	B	C
A	100.00	88.69	71.18
B	88.69	100.00	80.25
C	71.18	80.25	100.00

If we had alternative means of transportation, we would need to derive the matrix which has minimum loss in value between any pair of locations (i.e. the value assuming the optimal mode of transport). Now we would be able to solve the model fully. Infrastructure investments lead to new time and distance matrices. Solving the model again, we could compare the effect on economic activity.

Now consider what happens if infrastructure investments reduce the transportation time to the following matrix:

Time	A	B	C
A	0	5	15
B	5	0	10
C	15	10	0

The new value matrix is:

Value	A	B	C
A	100.00	93.24	82.70
B	93.24	100.00	88.69
C	82.70	88.69	100.00

As expected, a much larger proportion of the value is retained.

Modeling Inter-Tile Trade

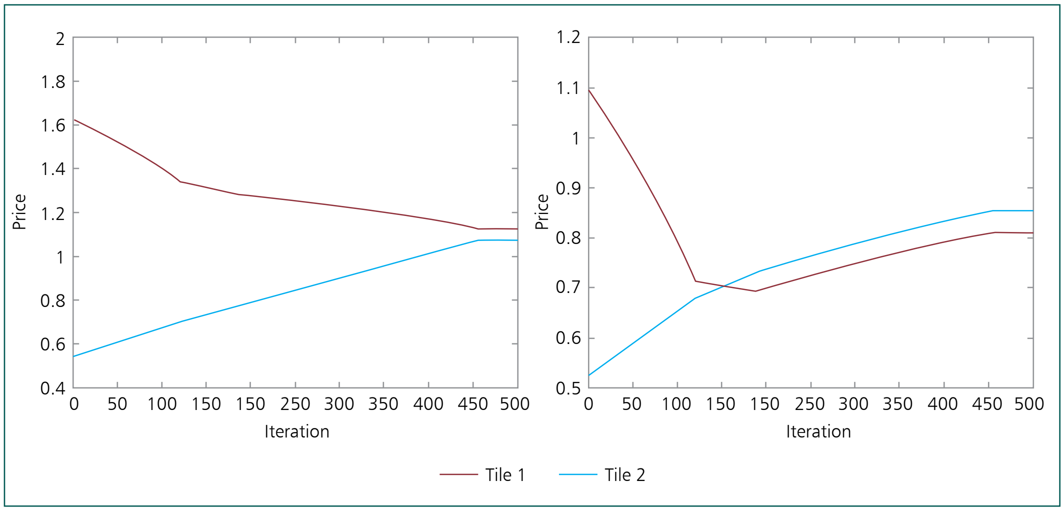
Suppose P_F is higher in Tile 1. Then some people in Tile 1 will buy from Tile 2, where prices are lower. Costs act like a tax—some units of the good are taken away (but unlike a genuine tax, are destroyed). We will take the demand curve of an individual in Tile 1, and shift the demand curves in Tile 1 and Tile 2 by appropriate amounts. This individual's purchases in Tile 2 are subject to a tax, whereas there is no tax in Tile 1. Any market price in Tile 2, buys the agent a fraction r less. This fact needs to factor into the decision regarding which market to participate in.

An individual can buy at price P_F^1 in Tile 1, or P_F^2 in Tile 2. However, any purchases from Tile 2 are subject to a tax (the fraction being r). At the lower price, the agent could buy more, pay the tax, and still come out ahead. The effects can be computed using the following logic. View the inverse demand function—as the maximum willingness to pay for the last unit (X_F) purchased. Then for any unit, the agent would be willing to pay only a little less. If he is willing to pay $100 for the last unit in Tile 1, he is willing to pay only $100(1 – r) in Tile 2, because he is only getting (1 – r) units to consume. $X_F = (1-r) A_X \frac{M}{P_F}$ is the individual's demand when buying from Tile 2, and this needs to be added to the total demand in Tile 2. $X_F = A_X \frac{M}{P_F}$ is the individual's demand, which needs to be subtracted from the total demand in Tile 1.

Continue to shift individuals until the price differential is such that, accounting for the tax, it is no longer worthwhile to buy from the cheaper market. The easiest approach would be to compare buying one unit at price P_F^1 versus (1 – r) units at price P_F^2. The effective price per unit in Tile 2 is $P_F^2/(1 - r)$. We also allow for inter-tile trade in the intermediate good. Once again, price differentials will generate trade. Costs are as above. Trade will erase differentials, although prices will differ in equilibrium because of costs.

The rest of the world can be modeled as a perfectly elastic demand at the world price. A seller's price needs to be lower than the world price (with a margin for transportation cost) before the seller can be internationally competitive. The following is the result of a simulation with two tiles. Note the convergence in prices at equilibrium. The remaining differences are a result of the cost (5% of goods are lost in transit).

Figure 4.3 Price of Final and Intermediate Goods



Source: Author.

The two-tile model generates results including the pattern of trade (exports and imports) between the two tile, the pattern of production and consumption in each tile, comparisons between inter-tile trade and autarky (especially, effect on income and consumption), shifts in patterns due to production externality, and the impact of infrastructure changes that shift transportation costs.

If the two-tile model is extended to 10 tiles it can be tested to check its consistency with economic intuition in a more complicated setting. We turn to this in the next chapter.

5

Transportation-Cost Scenarios in the Linear Economy

This chapter aims to show how the model with 10 tiles and a simple cost structure is simple enough to easily examine what is happening on a tile-by-tile basis and better interpret results across the linear economy of a transport corridor.

In generalizing from 2 tiles to 10, the tiles are assumed to be located along a line, one unit of distance apart. We assume a constant depreciation rate of output with distance (i.e. *r* % of output is lost when transported across one unit of distance). The final model is in two dimensions, matched with actual data on essential parameters.

The only parameters that vary here are the population scale parameters, which are taken to be

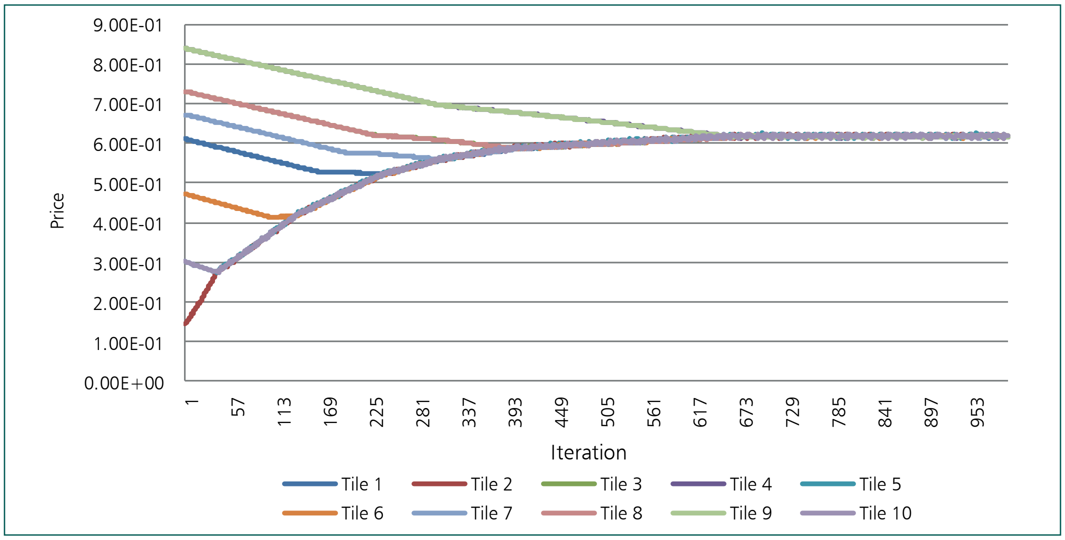
Tile 1	Tile 2	Tile 3	Tile 4	Tile 5	Tile 6	Tile 7	Tile 8	Tile 9	Tile 10
30	10	40	50	10	20	35	40	50	10

In other words, tiles differ in population, and their connectivity with the rest of the economy. In the autarky case, as we may expect, prices will be lower (all else being equal) in locations where population is lower. For instance tiles 2, 5, and 10 will initially have the lowest prices. However, these tiles differ in location (e.g. proximity to high demand tiles). So we would not expect them to have identical final outcomes.
Once inter-tile trade is permitted, we would expect prices to converge *if there are no transportation costs*. Once transportation costs exist, we would expect price dispersion in equilibrium. This is inefficient—a result of the "friction" of costs. In the following pages, we compare the outcome in three scenarios:

- No transportation costs
- Small transportation costs (1% of output loss over one unit of distance)
- Large transportation costs (5% of output loss over one unit of distance)

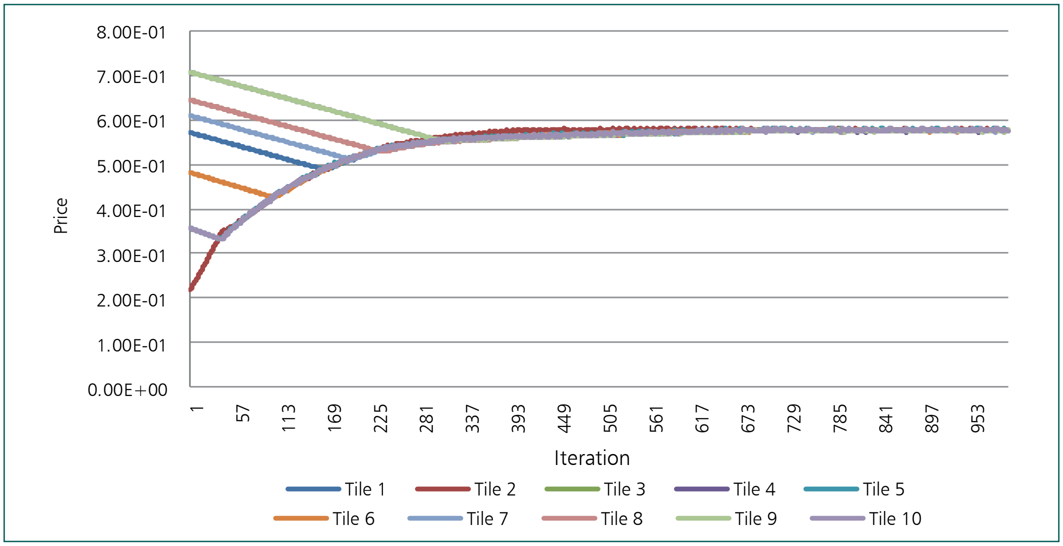
Scenario 1: Zero Transportation Costs

Figure 5.1 Final Good Price



Source: Author.

Figure 5.2 Intermediate Good Price

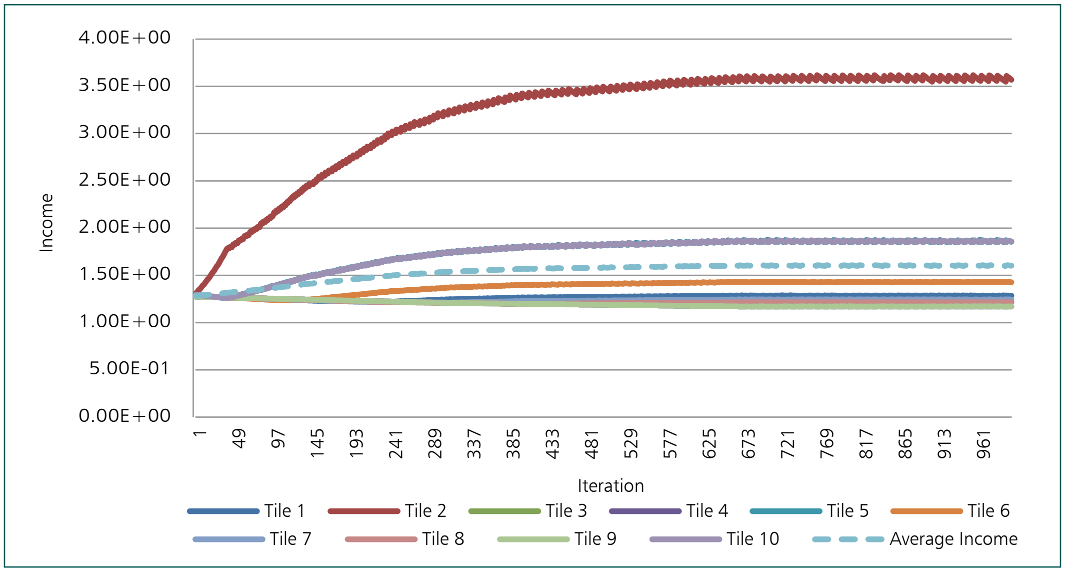


Source: Author.

We observe that final good prices do indeed converge. The same is true for intermediate good price (above).

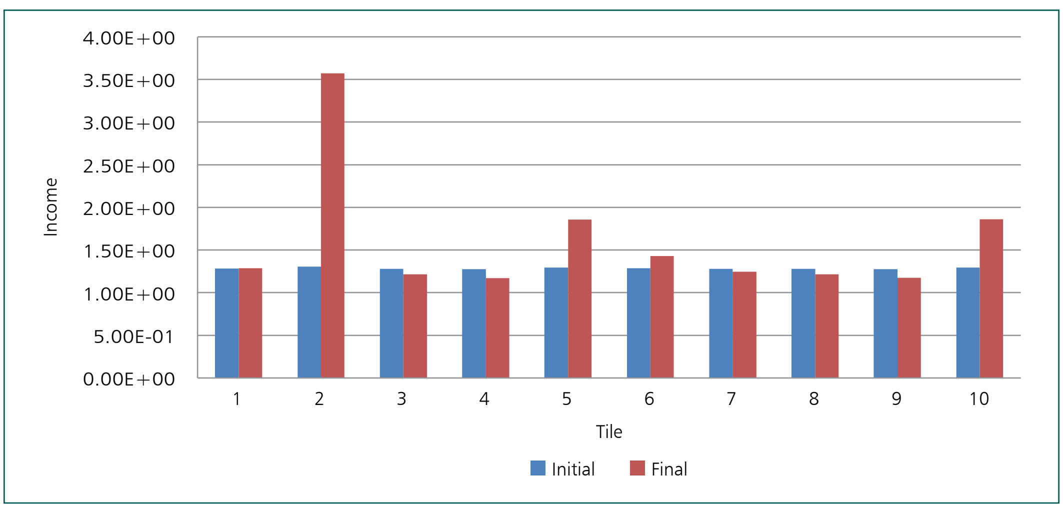
Average *per capita* income (shown as the dashed line below) increases. There are large increases in some tiles (those with small populations and advantageous locations). This is coupled with a decrease in some tiles. Note that the magnitude of the increase compensates for this, with an increase in the average. The next graph depicts the income—by tile—in the initial (autarky) and final (trading) equilibrium. Low population places gain, with the gain being highest in the better connected tiles.

Figure 5.3 Income



Source: Author.

Figure 5.4 Income

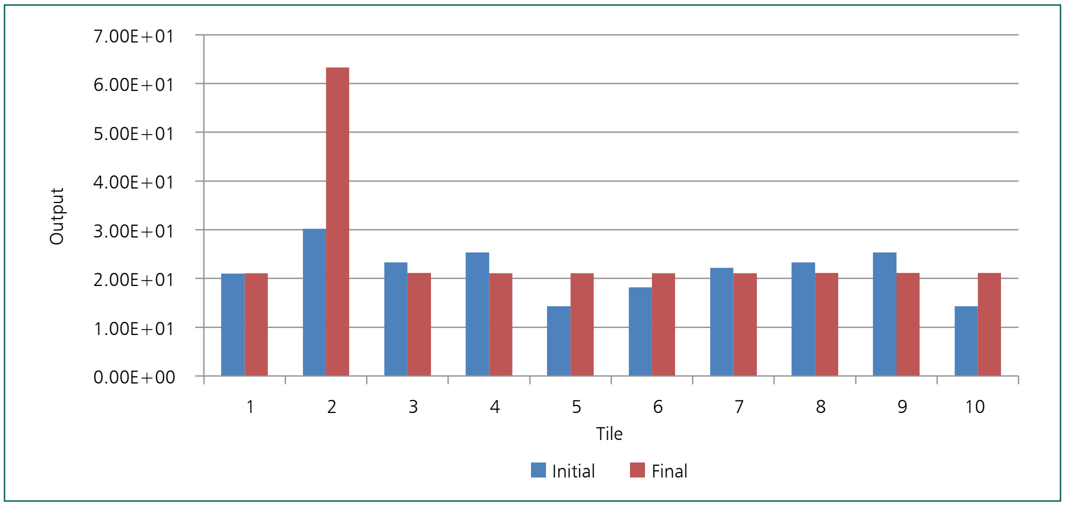


Source: Author.

It is worth observing that the autarky case corresponds to the extreme of no transportation infrastructure.

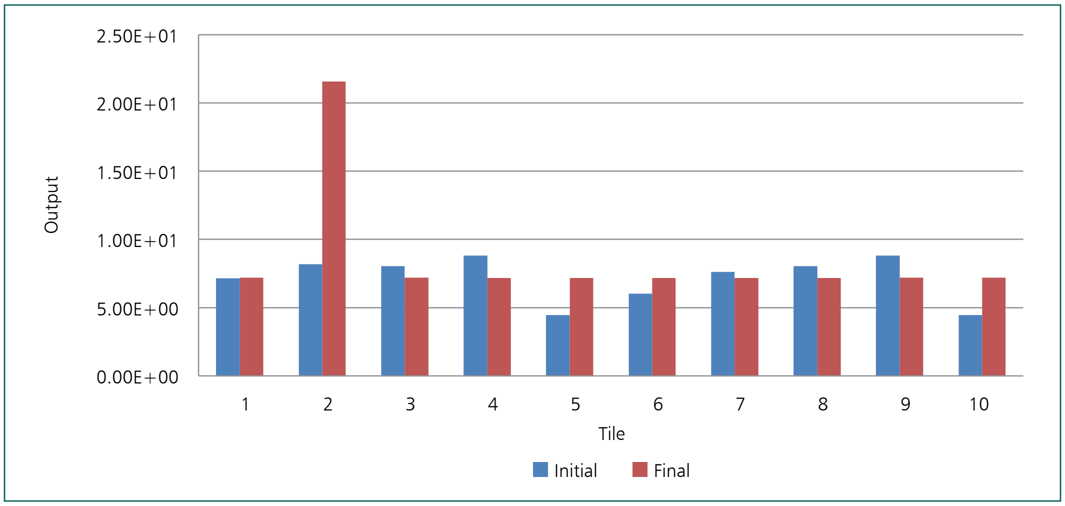
The two final graphs depict the output of the final good and the intermediate good by tile. Production of both the intermediate and final good increase in the tiles where incomes rose. These tiles are net exporters of both goods.

Figure 5.5 Final Production



Source: Author.

Figure 5.6 Intermediate Production

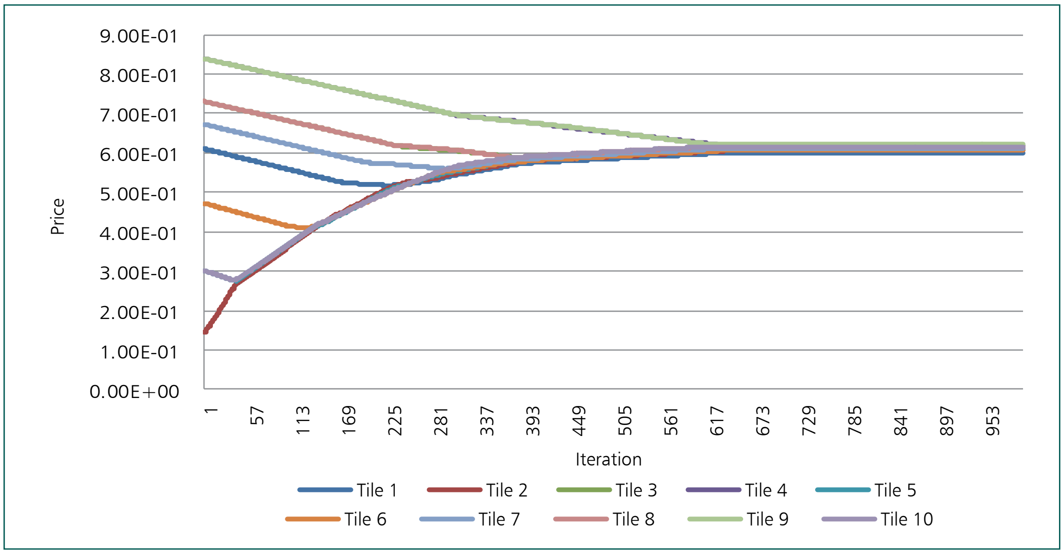


Source: Author.

Scenario 2: Small Transportation Costs

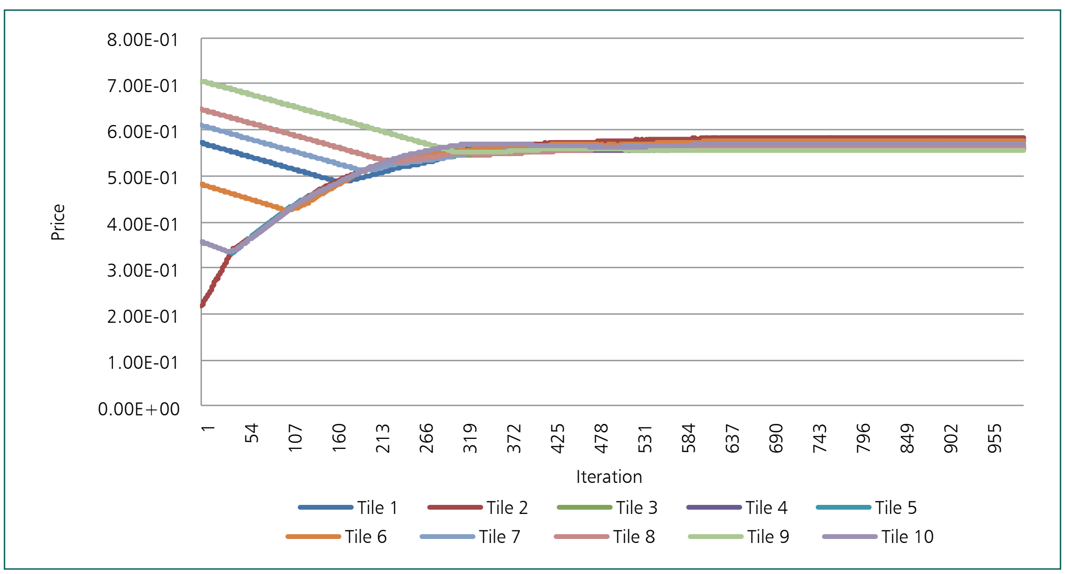
Now we introduce small costs of (1% of output is lost for every 1 unit of distance). This results in price dispersion in equilibrium. But otherwise the qualitative results are the same.

Figure 5.7 Final Prices



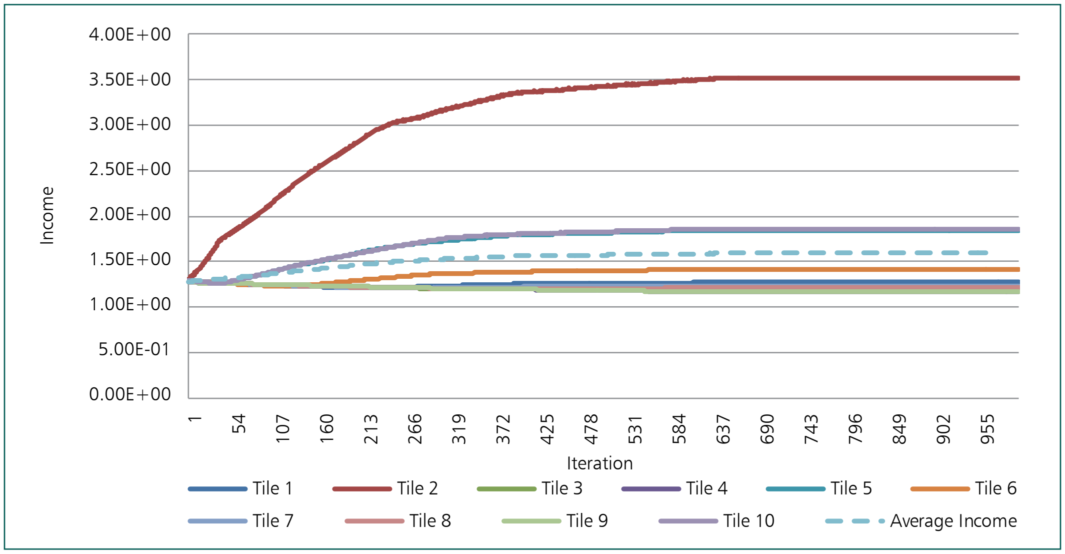
Source: Author.

Figure 5.8 Intermediate Prices



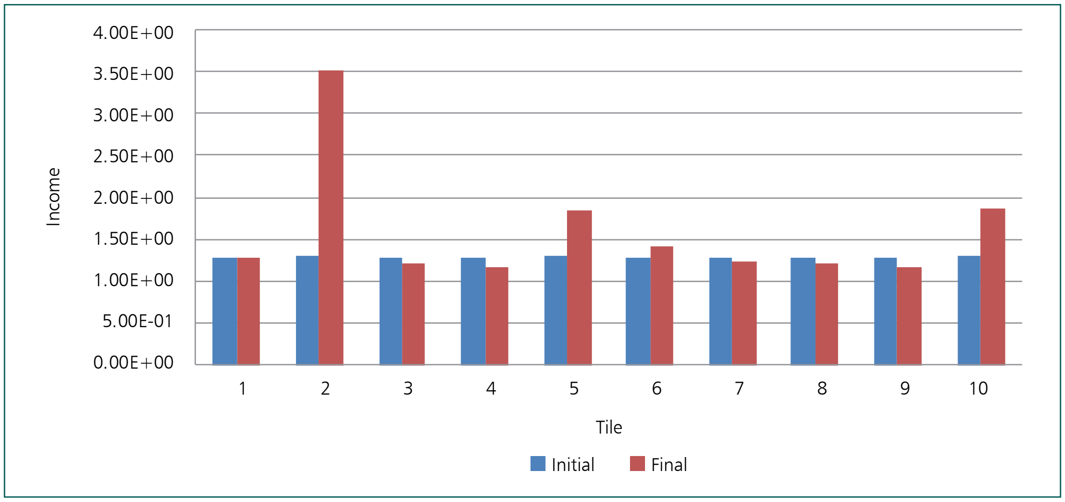
Source: Author.

Figure 5.9 Income



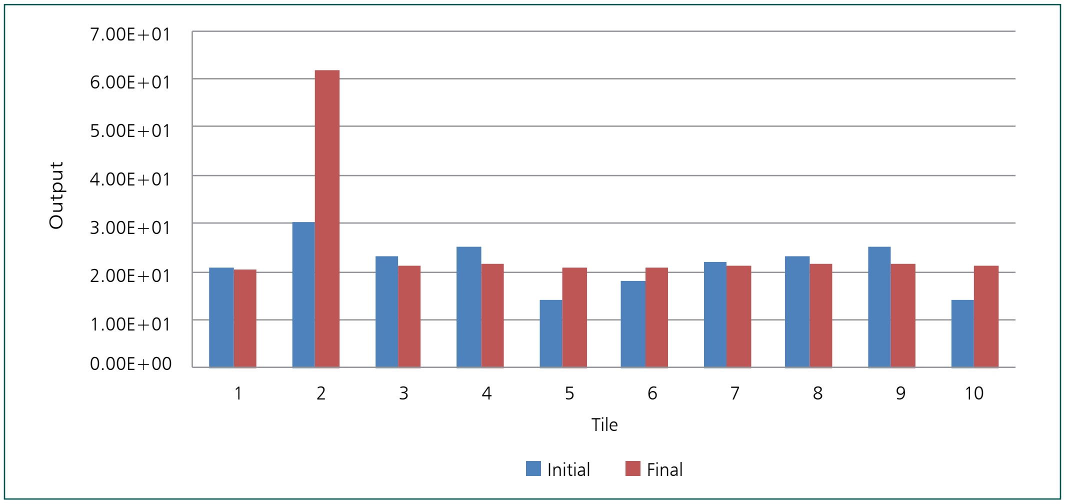
Source: Author.

Figure 5.10 Income



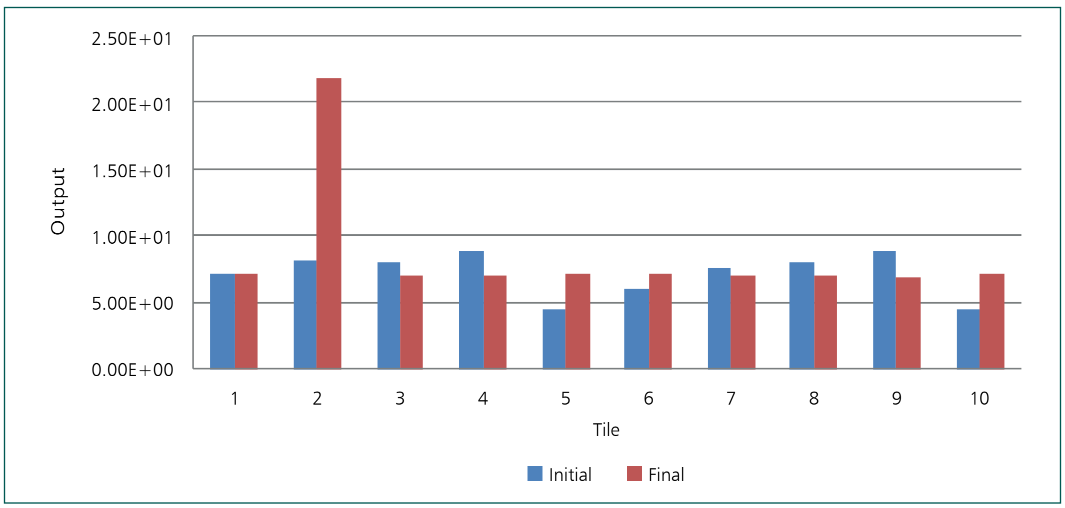
Source: Author.

Figure 5.11 Final Production



Source: Author.

Figure 5.12 Intermediate Production

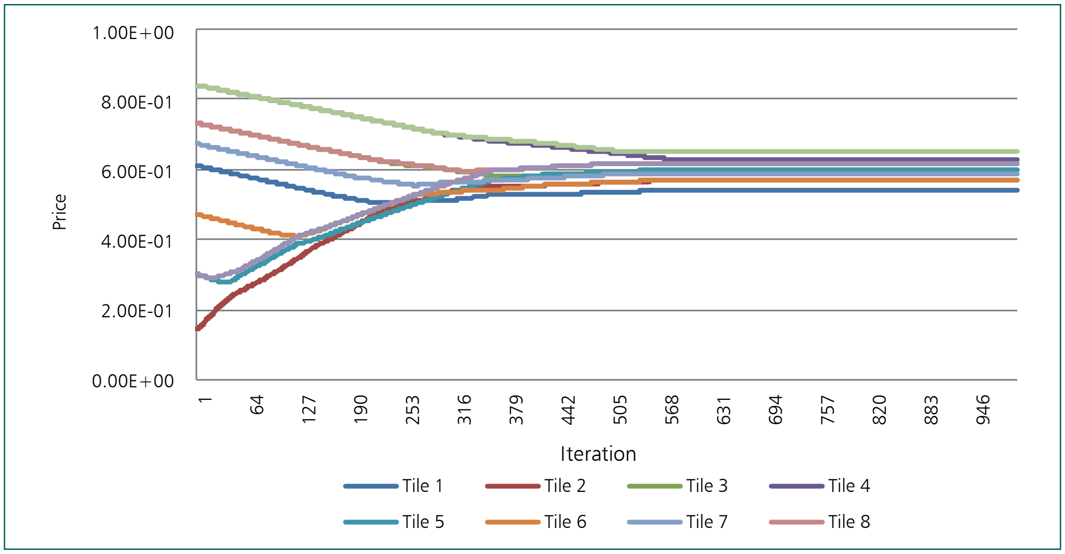


Source: Author.

Scenario 3: High Transportation Costs

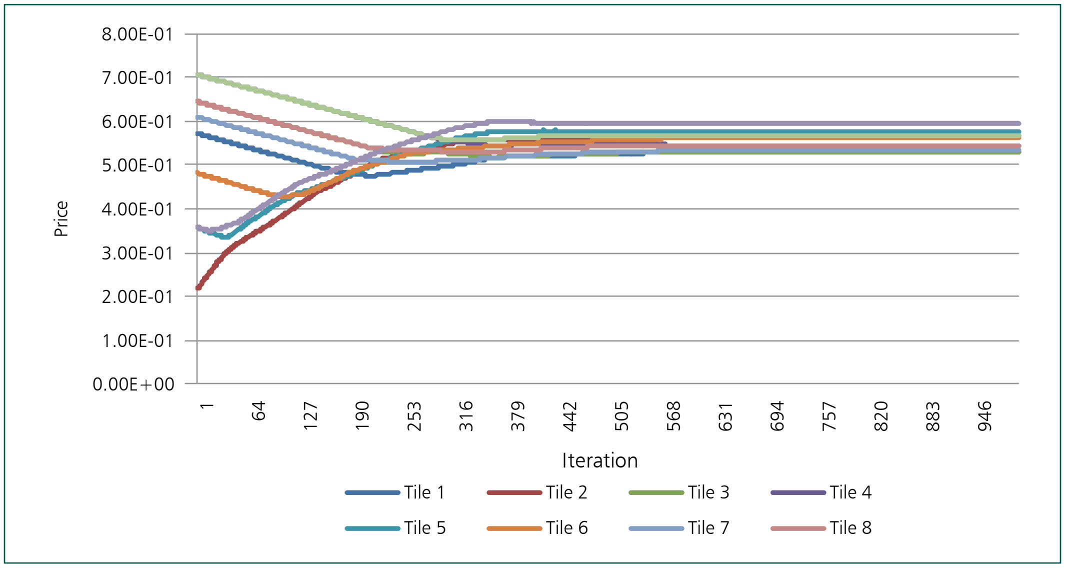
Costs are now larger, with 5% of output lost for every one unit of distance. There is greater price dispersion in equilibrium, but qualitative results are otherwise similar.

Figure 5.13 Final Good Price



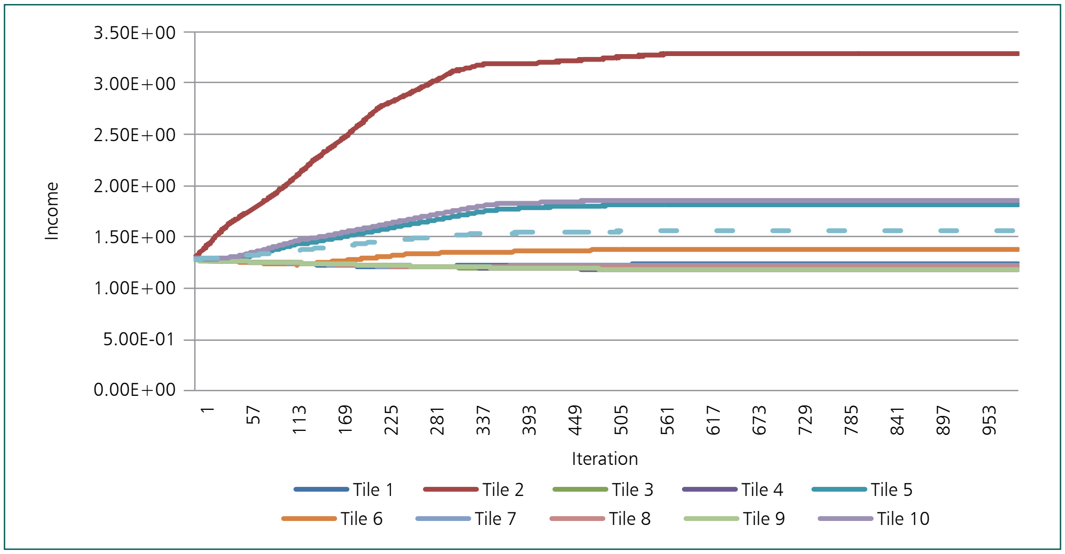
Source: Author.

Figure 5.14 Intermediate Good Price



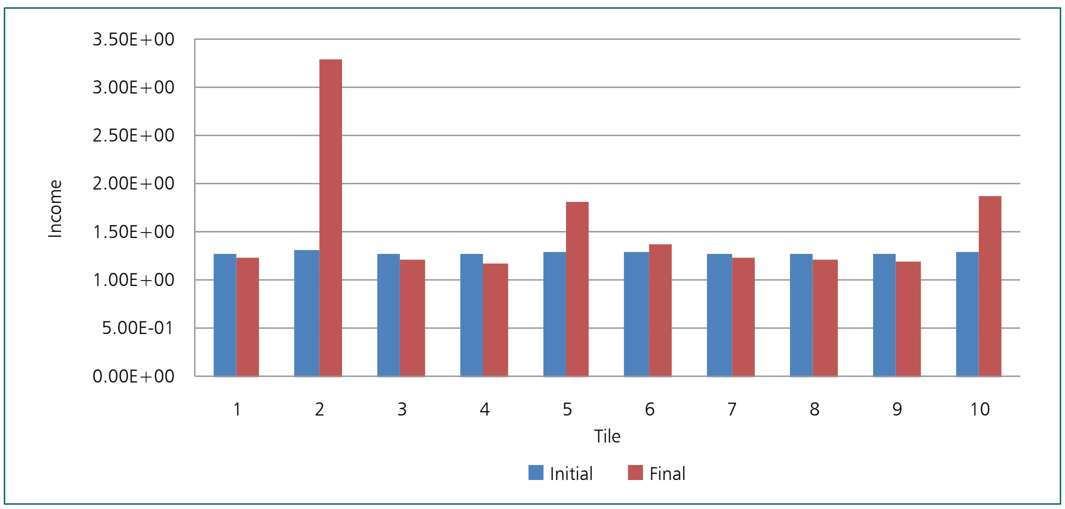
Source: Author.

Figure 5.15 Income



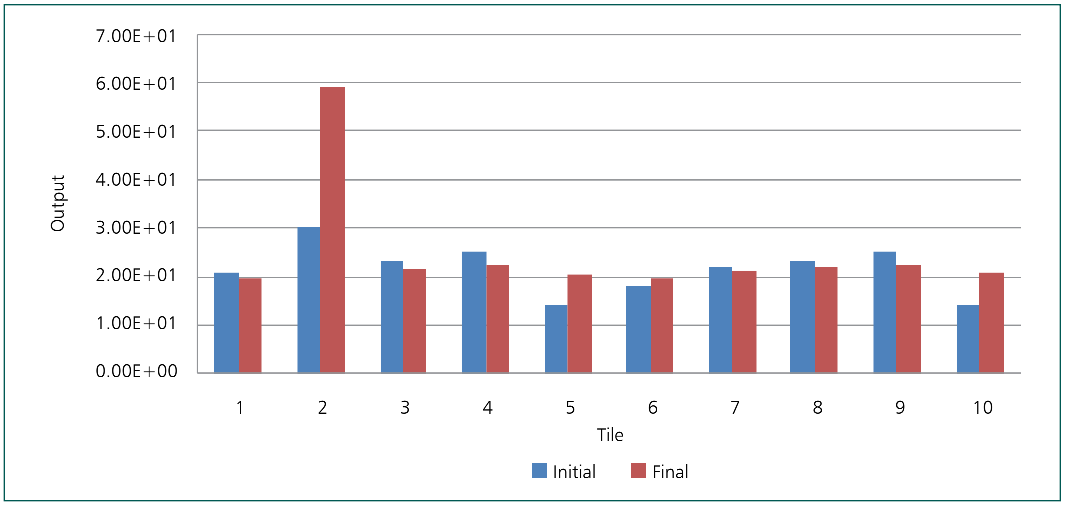
Source: Author.

Figure 5.16 Income



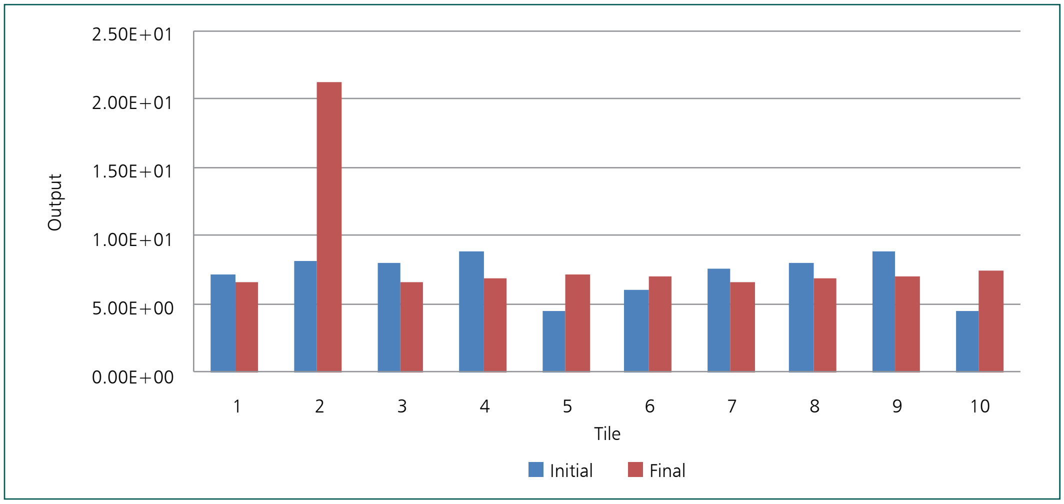
Source: Author.

Figure 5.17 Final Production



Source: Author.

Figure 5.18 Intermediate Production

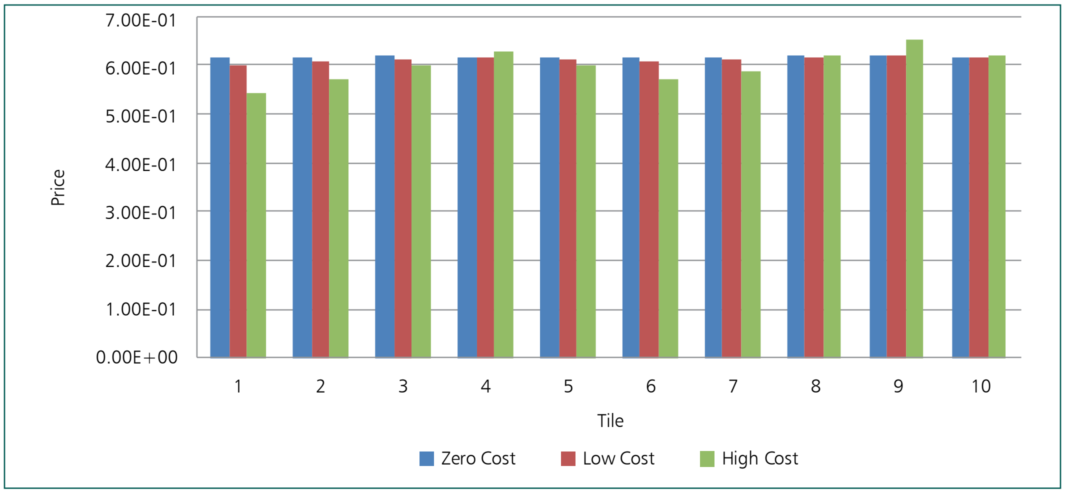


Source: Author.

Comparing the Three Scenarios

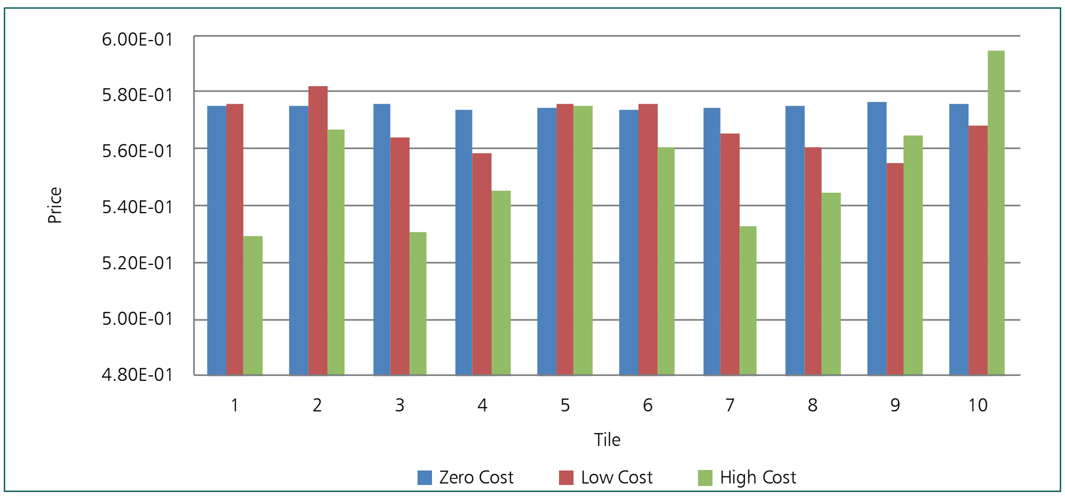
To compare the three scenarios, we look only at the final trading equilibrium (and not the time path to convergence). The most noticeable feature is the fact that price dispersion is smaller when costs are lower.

Figure 5.19 Final Good Prices



Source: Author.

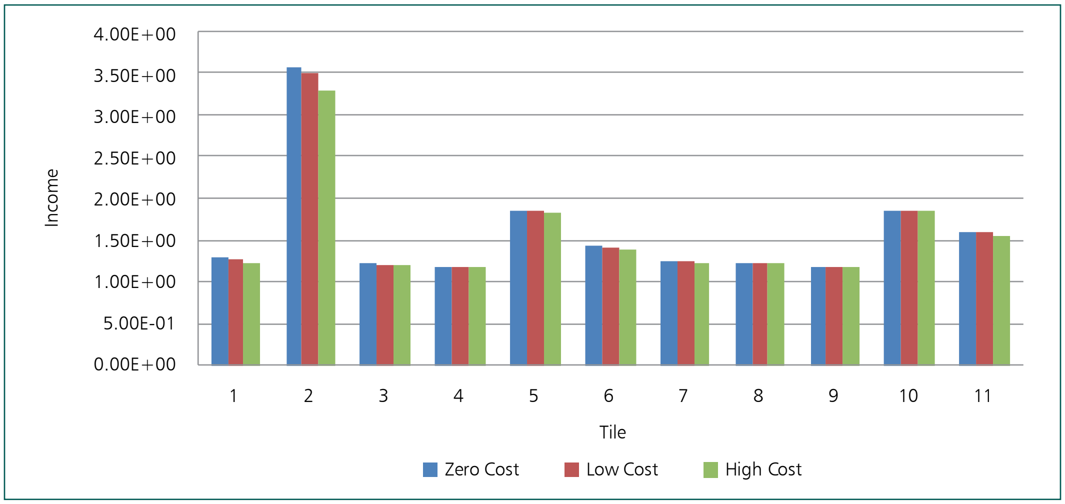
Figure 5.20 Intermediate Good Prices



Source: Author.

For incomes, we observe that reductions in costs create greater benefits for locations that have an advantage in ability to trade. The final (eleventh) set of bars depicts the average per capita income—note that reductions in transportation costs lead to higher incomes. This effect is quite widespread; in general, better infrastructure leads to higher incomes. However, the effect is not universal. Although this is not clearly visible (since the effect is small) in tile 4 there is a reduction in income when costs are zero. The important point is that gains in other tiles outweigh this effect.

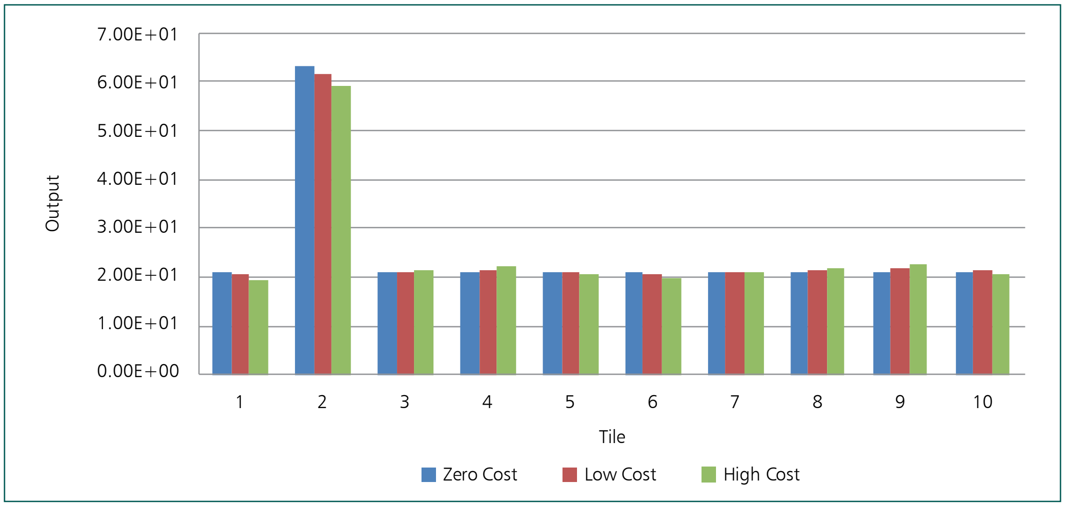
Figure 5.21 Incomes



Source: Author.

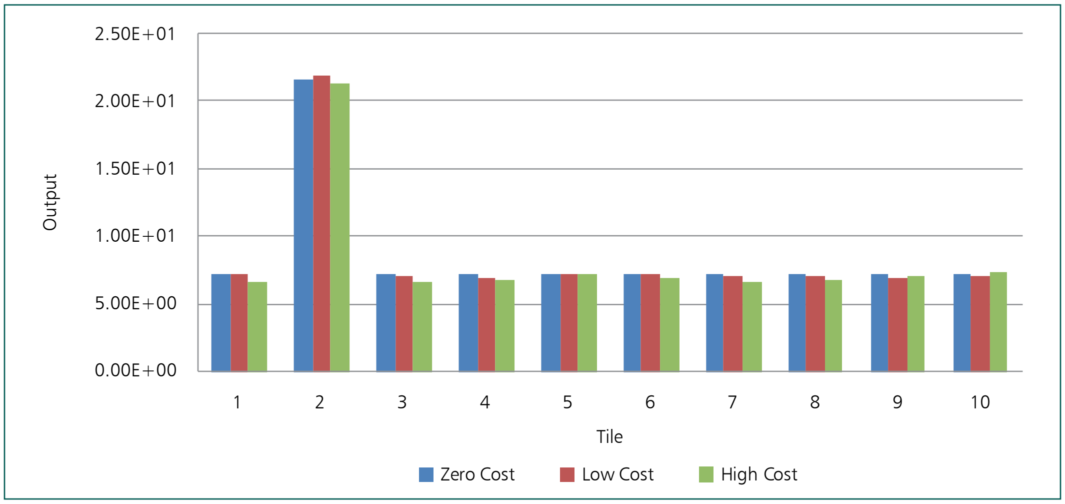
The two final graphs depict the geographical distribution of production. There are no simple patterns present now. For instance, in Tile 2 final good production increases as costs decrease, but in Tile 10 it first increases, and then decreases. There are several instances of such non-monotonic behavior in the case of intermediate good production.

Figure 5.22 Final Good Production



Source: Author.

Figure 5.23 Intermediate Good Production



Source: Author.

6

The Region: Production, Population, and Poverty Space

In this chapter, the features of the economy in the northeastern part of South Asia are examined, paying attention to the available range of products, their value chains, and potential comparative advantage in exports markets. Each of the four local economies is described in turn.

Existing Product and Population Characteristics

India: North Eastern Region and West Bengal

The economic activities in the North Eastern Region of India are primarily forest based, forming a tenth of country's total forest output.[7] The most important forest produce of the region is bamboo. It is found in abundance in almost all the states in the region. The Northeastern states are also known for the production and export of fruits, vegetables and other important cash crops like tea, rubber, jute, etc. However, agricultural practices continue to be of subsistence variety, thus unable to produce to scale to meet increasing export demand in some fast growing markets. The Himalayan state of Sikkim is home to many aromatic and medicinal herbs. Floriculture is another important industry in the state.

The region also has rich mineral reserves, mainly located in the Brahmaputra valley and Meghalaya. The region upstream of Brahmaputra River in Assam holds petroleum reserves and is home to the country's important refineries in Digboi. Limestone and coal deposits are found in Khasi and Garo hills in Meghalaya.

Industries in the northeast are mainly located in Assam, backed by better infrastructure, while value-adding activities in the other seven states are mainly found in cottage industries and handicrafts. The industries in the region are primarily agro/forest based—food processing, tea, rubber, plywood, etc. However, there is a growing potential for textiles and garments, particularly in Assam and Manipur. In addition, labor intensive sericulture is among the important industries of the region, located primarily in Assam, northern districts of West Bengal and Meghalaya. This industry engages nearly 190,000 families in Assam alone, producing three different varieties of silk—Eri, Muga and Mulberry.[8] Plywood and furniture, as well as the production of paper, have been identified as having potential to generate exports. These industries are located mainly in Assam, Meghalaya and Tripura. Meghalaya's cement industry is in Ri-Bhoi, East Khasi, East Garo and Jaintia districts, in the

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7 South Asia Enterprise Development Facility, Jalil, Altaf, *North East India—Bangladesh Initiatives Map*, 2004, http://www.bei-bd.org/nei/pub1.pdf

8 North Eastern Development Finance Corporation Ltd., http://databank.nedfi.com/content/sericulture-asssam

Table 6.1 Principal Industrial Characteristics

States	Factories	Fixed Capital[a]	Productive Capital[a]	Invested Capital[a]	Workers	Persons Engaged	Wages[a]
West Bengal	607.7	265,002.6	351,404.8	400,243.9	42,066.3	51,610.7	26,721.5
Assam	186.4	75,203.5	101,970.0	109,097.6	11,003.6	12,866.2	3,666.4
Tripura	30.7	1,218.6	2,326.9	2,779.3	1,736.9	1,922.1	270.3
Meghalaya	6.6	3,213.3	5,878.3	4,244.4	360.2	433.2	184.1
Nagaland	10.9	289.8	594.4	731.4	245.5	286.2	59.3
Manipur	5.9	84.7	144.2	136.4	173.4	197.0	31.1
All India	14,016.0	6069,402.8	7,914,028.8	9,015,786.1	713,609.7	911,168.0	376,636.6

[a] Figures in million Rs.
Source: Annual Survey of Industries, 2005–06.

Table 6.2 Eastern India Social Indicators

State	Literacy	Per capita Income	Urban Population (millions)
Assam	64.28	14,786	12.9
Manipur	70.53	17,950	25.12
Meghalaya	61.3	18,274	19.58
Mizoram	88.8	19,691	49.63
Nagaland[a]	67.11	18,147	17.74
Tripura	73.2	21,231	17.06
West Bengal[b]	68.6	20,485	28.03

[a] Income data for 2004-05 in Rs.
[b] Income data from Assocham, India www.assocham.org
Notes: Data from NEDFI, based on 2001 Census. Per Capita Income for 2005–06 measured in constant prices with 1999–2000 as base year.

vicinity of an abundance of raw material—lime and coal. This industry is one of the prime contributors to the state's GDP.

Socially, the North Eastern Region fares somewhat better than most other states in India for human development and quality of life. Literacy rates are higher than the national average and poverty less extreme.[9] However, due to lack of investments and infrastructure in the region, the vast human capital is untapped.

On the other hand, West Bengal—the state linking the North Eastern Region to the rest of the country—is one of the key industrial states. It has about 6,000 factories,[10] with industrial activity concentrated along the North-South transport corridor at Kolkata, Hoogly, Haldia,

[9] Asian Development Bank, Preparing the Northeastern States Trade & Investment Creation Initiative, Volume I, 2006, p37.

[10] Government of India, Annual Survey of Industries, 2005–06.

Barddhaman, and Murshidabad. The mineral rich western part of the state on the Chota Nagpur plateau is home to country's important iron and steel plants. Key export oriented industries in the state are textile and garment industry, including sericulture industry in the northern districts, tea, chemicals, pharmaceuticals and engineering industries. The state is also a growing hub of info-tech and software services, primarily located in and around Kolkata.

West Bengal has better trade infrastructure than the Northeastern states, including an international airport at Kolkata, and two seaports at Kolkata and Haldia respectively. The state is critical for facilitating trade from Bhutan, Northeast India and Nepal through access to these ports. Goods from the North Eastern Region travel through the Siliguri corridor along the national highway (NH-34) to reach the ports.

Table 6.3 Eastern India Products with Revealed or Potential Comparative Advantage

Product	SITC Code	States
Pineapple Products	0589	Tripura, Assam, Meghalaya
Processed Ginger	056X	Meghalaya, Assam
Tea	0741	West Bengal, Assam
Cashew nuts	0577	Tripura
Rubber	2320	Tripura
Bamboo Products	635X	All NEI States
Herbal Products	541X, 551X	Sikkim, West Bengal
Orchids/Flowers	2927	Sikkim, West Bengal
Plywood/Furniture	634X	All NEI States except Sikkim
Paper	641X, 642X	Assam, Tripura, Nagaland
Lime	661X	Meghalaya
Coal	322X	Meghalaya
Cement	661X	Meghalaya
Textiles	65XX	West Bengal, Assam
Silk	261X	West Bengal, Assam
Ready Made Garments	84XX	West Bengal, Assam, Manipur
Handloom	NA	All NE States, West Bengal
Handicrafts	6354, 8974	All NE States, West Bengal
Petroleum Products	334X	Assam
Iron and Steel	6727, 6732, 6744, 6770	West Bengal
Pharmaceuticals	5413, 5411	West Bengal
Chemicals	5231, 5233, 5239, 5139, 5911, 5169	West Bengal
Engineering goods	723X	West Bengal
Leather	6114	West Bengal

SITC = Standard International Trade Classification.
Sources: Product Space Map for India, 2000, http://www.chidalgo.com/productspace/country.htm
ADB Project Report: North East India PPTA Final Report; NEDFI Databank; West Bengal Industrial Development Corporation.

Bangladesh

Bangladesh shares its borders mainly with India and to a small extent with Myanmar. A vast area of its landmass is covered by Ganges–Brahmaputra delta, forming a network of inland water transport system. The country is home to two seaports at Chittagong and Mongla respectively. Dhaka and Chittagong are two important trade centers in the country, as well as major hubs of all modes of transportation—road, rail, air and waterways.

The economy of Bangladesh is primarily agrarian. The shrimp and frozen fish industries, located in Chittagong and Khulna, are dominant in exports. Other prominent export-oriented industries are garment and leather industry, situated in and around Dhaka, as well as the ceramics industry located in the northern districts of Dhaka and Rajshahi. Bangladesh is also known for its handicrafts. Despite being the largest producer, Bangladesh's jute industry has declined in prominence due to availability of substitutes (although there is a new trend towards environment-friendly jute goods). However, the country continues to export ropes and twines made from jute as well as other articles, particularly jute handicraft, carpets, etc.

Table 6.4 Products with Revealed and Potential Comparative Advantages in Bangladesh

Product	SITC Code	Districts
Ready Made Garments	84XX	Dhaka, Narayanganj, Chittagong
Textile Products	658X	Dhaka, Narsingdi
Shrimp, Frozen Fish	0342	Khulna, Chittagong, Barisal
French Green Beans	0542	Comilla
Fresh Vegetables	0545	Dhaka, Gazipur, Rajshahi (Division), Khulna (Division)
Footwear	8510	Dhaka, Gazipur, Chittagong
Ceramics	6664	Bogra, Gazipur, Dhaka, Mymensingh, Sylhet
Tea	0741	Sylhet, Maulvibazar
Twines, Ropes	6575	Dhaka, Narayanganj, Jessore, Khulna
Handicrafts		Rangpur, Chittagong, Jessore, Dhaka
Carpets, Rugs	6596	Chittagong, Rangpur, Jessore
Paper, Paper Products	641X	Dhaka, Chittagong, Narayanganj
Bicycles	7852	Dhaka, Chittagong
Chemical Fertilizer	5621	Chittagong
Lens, Prisms, Mirror	8841	Dhaka

SITC = Standard International Trade Classification.
Sources: Product Space Map for Bangladesh, 2000. http://www.chidalgo.com/productspace/country.htm Bangladesh Growth and Export Competitiveness, The World Bank, 2005.

With regard to human capital, the country has much to improve. With 50% of its large population being literate, it would be very difficult for Bangladesh to progress to producing higher value products and services. The poverty figures are stark, particularly in the rural divisions of Barisal and Rajshahi. The country, therefore, has to pay attention to social welfare, particularly education.

Table 6.5 Bangladesh Social Indicators

Division	Annual person wage (2005)	Literacy	Incidence of Poverty[a]
Barisal	23,737	53.6	52
Khulna	22,433	48.60	45.7
Dhaka	25,346	47.1	32
Rajshahi	15,564	41.8	51.2
Chittagong	28,259	47.9	34
Sylhet	22,259	44.3	33.8

[a] Head-count rate based on Cost of Basic Needs method, using upper poverty line.
Notes: Data from 2001 Census, Bangladesh Statistical Yearbook 2007, R. I. Rahman 2009.

Bhutan

The Himalayan country of Bhutan is sandwiched between India and PRC (Tibet) on the northern side. It is sparsely populated with few centers, such as the capital Thimphu, and the Paro valley where the country's airport is located. Some population concentration also occurs along the main road from Bhutan, at the border with India. Bhutan is endowed with rich alpine forests and has high biodiversity. The economy is dependent largely on export of hydropower to India, and on high-end international tourism. Small and medium scale manufacturing is very limited, and concentrated in the few key population centers. Of trade in goods, 80% passes through the Bhutan–India border at Phuentsholing, along the Paro to Jaigaon road corridor. Bhutan has revealed comparative advantage in fruits, and fresh vegetables (horticulture). After India, Bangladesh is the second most significant importer of such products. Rich forest resources enable the country to export a variety of herbal and aromatic, non-timber forest products.

Table 6.6 Locations with Highest Number of Manufacturing Establishments

District	Manufacturing establishments
Thimphu	224
Chhukha	133
Paro	99
Sarpang	51
Total	864

Source: Dept. of Industry, Ministry of Economics, 2009.

Bhutan still has a low level quality of human resources, as most people live in remote rural areas. The literacy rate stands at 60% overall. Due to its constrained labor supply, Bhutan has a relatively high cost of labor compared to the region.

Nepal

The Himalayan country of Nepal is bound by India on three sides and PRC (Tibet) on the northern side. The population is concentrated along the foothills of Himalayas (the Terai region) and the Kathmandu valley. Endowed with rich alpine forests and diverse vegetation, the country's economy is fairly dependent on forest resources. On the whole, the economy is driven by the agriculture and service sectors, and to a moderate extent by small– and medium -scale manufacturing, mainly located around the Kathmandu valley.

Table 6.7 Principal Industrial Characteristics: Nepal

Regions	No. of Establishments	Persons Engaged	Employees	Wages[a]
Eastern	825	57,150	54,885	1,606,012
Central	1,496	98,969	93,888	3,782,069
Western	583	23,764	22,094	741,413
Mid Western	153	6,250	5,821	134,149
Far Western	156	5,720	5,255	126,018

[a] Wages in Thousand NR.
Source: Census of Manufacturing Establishments 2001/02.

The primary exports of the country are ready-made garments and textile products. These are produced in the valley, including in Kathmandu, Lalitpur, and Bhaktapur. Garment industries are also found in and around Birgunj and Biratnagar. Nepal is also known for its hand-woven carpets and woolen wear, produced mainly in labor-intensive cottage industries. Another key export category is wood-based products such as handicrafts, furniture and paper stationery. Almost every district is home to a small number of such establishments. Forest resources also enable the country to export a variety of herbal and aromatic products, which are mainly produced in the eastern mountain districts. Among agro-based products, cooking oil, honey and lentils dominate. Most agriculture activities are concentrated in the Terai. Nepal also exports a small amount of tea, grown in the eastern districts surrounding the more famous Darjeeling area in India. Among higher value products, Nepal interestingly exports electrical transformers and organic chemicals.[11] The engineering industry is located in Kathmandu valley, Bhairahawa and Biratnagar.

Nearly half of Nepal's exports are directed to India, followed by the United States (US) and the PRC. India is not only an important trading partner but also forms the conduit for exporting to other countries. Most of the exports are routed through India's Kolkata port, although discussions are ongoing to make the ports of Mongla and Chittagong in Bangladesh, and Nhava Sheva near Mumbai, available as alternate routes.[12]

Nepal is in a better position with regard to its human resources. Literacy rates in Kathmandu valley and areas in the Terai are as high as 70%, with Kathmandu district recording a literacy rate of 77%.[13] The government has provided impetus in setting technical and engineering colleges in Kathmandu valley. However, the literary rates are not as strong in the mountainous districts in the northeast and west.

[11] Product Space: Nepal Country Map http://www.chidalgo.com/productspace/country.htm

[12] Asian Development Bank, *Identifying Nepal's Emerging Comparative Advantages*, TA 4133, 2004.

[13] ICIMOD, Mountain Environment and Natural Resources Information System (MENRIS) Division, from Nepal Population Census, 2001.

Table 6.8 Products with Revealed and Potential Comparative Advantages in Nepal

Product	SITC Code	Districts/Area
Ready Made Garments	84XX	Kathmandu, Lalitpur, Birgunj, Jhapa
Textile Products	658X	Kathmandu valley, Birgunj, Biratnagar, Bara, Rupandehi
Carpets	6592	Kathmandu, Pokhara
Woolen Garments	6543	Kathmandu valley
Furniture/Wood based Products	634X	Kathmandu valley, Nawalparasi, Terai
Herbal Aromatic Products	541X, 551X	Gorkha, Ilam, Panchthar, Rasuwa
Cooking Oil	4239	Bara
Notebooks, Paper, Stationery	6423	Kathmandu, Biratnagar, Birgunj, Makwanpur
Handicrafts	NA	Kathmandu valley
Jewelry	897X	Kathmandu
Honey	0616	Bara
Flowers	2927	Kathmandu valley
Travel Goods	8310	Kathmandu, Birgunj
Personal Care Products	5530,554X	Bara, Sunsari
Electrical Transformers	7711	Kathmandu, Biratnagar, Bhairahawa
Organic Chemicals	5983	Kathmandu valley, Bara Biratnagar,Birgunj, Banke
Lentils	0542	Terai
Leather, Hide	611X	Biratnagar, Bara, Birgunj, Sunsari, Makwanpur
Photographic films	8822	Kathmandu, Biratnagar
Tea	0741	Mechi hills

SITC = Standard International Trade Classification.
Sources: Product Space Map for Nepal,2000 , http://www.chidalgo.com/productspace/country.htm
Identifying Nepal's Emerging Comparative Advantages, The Asian Development Bank, 2004; Nepal Census Bureau.

Table 6.9 Nepal Social Indicators

Region	Literacy	Urban Population
Eastern	55.7	19.4
Central	52.90	49.7
Western	59.3	16.1
Mid Western	49.4	7.2
Far Western	48.7	7.6

Notes: Data from Population Monograph of Nepal 2003.

Existing Trade Support Infrastructure

India: North Eastern Region and West Bengal

Other than in West Bengal, the region does not enjoy a good transport network with the rest of India and the gateways of large-scale exports. The only transit link is through the roundabout across Siliguri in West Bengal. This has led to immense pressure on transport infrastructure in the narrow passage, and consequently high transport costs. Facilitating any shorter route would imply crossing international borders with neighboring Bangladesh, which due to political and administrative barriers has not been feasible thus far, although recent agreements are being forged. Further, the difficult terrain of the North Eastern Region also makes railways less conducive, thereby adding to the cost of road transportation. The only state with favorable railway network is Assam.

Due to long distances from main Indian markets and ports, coupled with high transportation costs, informal trade across the porous borders is substantial. This is exacerbated by the fact that of 35 land custom stations along the international border, only 22 are functional, and facilities for formal trade exist in only a few of them.[14] These factors further reduce the region's integration with rest of India and hampers formal external trade.

Key barriers to trade originating from the North Eastern Region are the sustainability of power and road networks.[15] The region lacks periodic maintenance of infrastructure. Power demand outstrips supply despite the immense potential for small hydropower projects. The region also lacks reliable logistics support for international trade, like cold storages, trade hubs, container facilities, and communication links with ports, etc. Such infrastructure facilities are crucial for the production and export of the region's agro-based perishable produce. Global Development Solutions' Integrated Value Chain Analysis estimates the loss due to a lack of logistics support at 26% of total packaging and transport costs, while attributing nearly 50% of the final price of the product to transport costs.[16]

A lack of financing and market information for SMEs is also responsible for the backwardness of the region. Further, despite higher literacy levels than rest of India, the region lacks quality higher education and technical institutions that could offer training and technical expertise to the entrepreneurs and develop human capital in the region.

Apart from barriers in the form of inadequate physical infrastructure and logistics support, the region also suffers from legal and policy issues that hinder optimal production and trade. These are primarily in the form of trade and non-trade barriers with neighboring countries. Also unclear is the efficacy of property rights applied in a predominantly tribal society. This would hinder optimal inflows of foreign direct investment (FDI) unless local solutions are developed to promote the commercial interests of investors.

In addition to a hostile trade climate, productivity in the region is abysmal. Key export industries in the North Eastern Region are labor intensive, particularly agriculture production and agro-based sericulture. Adequate training coupled with local knowledge of production is required to increase productivity.

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14 ADB, *Promoting Trade and Investment in India's North Eastern Region*, Rao, Govinda, M, 2009.

15 Northeastern States Trade & Investment Creation Initiative, 2006.

16 Pineapple Value Chain Analysis, Northeastern States Trade & Investment Creation Initiative, 2006.

West Bengal, on the other hand, has a good transport network between its production centers and trade gateways in comparison to the North Eastern Region. It has ports at Kolkata, Haldia, Diamond Harbor and a recently commissioned port at Kulpi in South 24 Paraganas district. International air cargo facilities are available at Kolkata International Airport. West Bengal Government has opened the economy to foreign as well as domestic investments in industries and service sectors. This signifies a marked shift in West Bengal's policy towards FDI in the state. West Bengal attracted more than $1 billion in FDI between 1996 and 2003.[17] However, when compared to other large industrial states in India such as Maharashtra, Gujarat, Tamil Nadu and Karnataka, West Bengal has a lot to do to catch up in infrastructure sector and investments.[18] Logistics support at the ports also need further improvement due to the volume of trade, not only from the neighboring regions in India but also from Nepal and Bhutan.

Areas requiring attention:

- Road maintenance
- Port maintenance and capacity upgrading
- Power reliability
- Information and Communication
- Logistics Hub for trade
- SME financing
- Trade policy barriers

Bangladesh

Bangladesh faces severe constraints with regard to physical infrastructure for production and trade. The country has to make substantial improvements to its road and rail networks. The railroads in many areas still use the meter gauge, which must be upgraded to a broad gauge to handle freight. Trade through land ports can be increased through the provision of logistical support and improvements to connectivity and communication links. Another critical infrastructure bottleneck is the container handling capacities at the seaports of Mongla and Chittagong. Bangladesh also has to enhance its capacity of air cargo service, particularly for the exports of perishable agro products. Power networks are unreliable, causing manufacturers to depend on fossil fuels for power from generators.[19] This not only adds to production costs but also creates significant negative externality in the form of pollution and CO_2 emissions.

As with Northeast India, adequate financing and reliable market information is lacking for budding entrepreneurs. A World Bank report on Bangladesh export competitiveness quotes financing cost to be 1/6th of the total production cost of t-shirts. Lack of adequate export finance is also plaguing the footwear and higher value agro industries.

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[17] Ministry of Finance, Public–Private Partnerships, http://www.pppinindia.com/states_wb_bo.asp

[18] Abhijit Banerjee, et al., "Strategy for Economic Reform in West Bengal," *Economic and Political Weekly*, 2002.

[19] Bangladesh Growth and Export Competitiveness, 2005.

In addition, many policy and governance hurdles hinder trade, such as high tariff and non-tariff barriers and rent-seeking. Bangladesh has the highest tariff structure in South Asia.[20] It has import bans on Indian yarns and packaging material that if lifted could significantly reduce costs in the textile sector and packaging of goods. The country also needs to improve quality assurance processes and to provide product-testing facilities in order to remain attractive to international markets, particularly those in Western Europe and the US. [21]

Areas requiring attention:

- Railroads infrastructure—gauge upgradation
- Road network maintenance
- Infrastructure at inland container depots (ICD)
- Port capacities and connectivity
- Air Cargo
- Power
- Information and Communication
- Quality control
- Rent seeking
- Trade policy barriers
- Long term export finance

Bhutan

With its rugged mountain geography, agriculture and services-based economy, Bhutan faces severe infrastructure constraints. Only the Thimphu, Paro to Phuentsholing corridor provides reasonably good connectivity by road to India, and by air to international destinations. Due to its landlocked status, all of Bhutan's trade passes through India. Bhutan is not connected to rail. Containerization facilities are not available. Border facilities are still basic and congested. Transportation costs are high in Bhutan, also due to small consignment sizes and insufficient economies of scale.

Overland trade needs to be increased by providing logistical support, improving connectivity and communication links. The capacity of Bhutan's air cargo services, particularly for the export of perishable agro products, needs to be enhanced. Lack of longer-term financing and market information—especially for SMEs—contributes significantly to low trade volumes. Power is fairly reliable, and most of the year Bhutan exports surplus power to India. Bhutan needs to improve the quality assurance process, and provide facilities for product testing in order to remain attractive in international markets.

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[20] World Trade Indicators 2008—Benchmarking Policy and Performance.

[21] Bangladesh Growth and Export Competitiveness, 2005.

Nepal

Being landlocked, Nepal has to rely on India's seaports for trade. The mountain terrain in the country also makes it difficult to have an extensive rail network. Only parts of Terai region have rail access. Under these circumstances, Nepal has to rely on more expensive road networks and land ports for transporting its goods to its markets. The porous border between Nepal and India facilitates much of the informal trade between the countries, but suffers from severe logistics constraints to encourage formal trade.

While Birgunj has undergone significant improvements for trade facilitation, particularly with the launch of a rail-based inland container depot (ICD) for goods handling, storage and customs clearance, other border posts at Biratnagar, and Bhairahawa require better infrastructure and capacity enhancements. These ICDs also need quick and reliable communication links with seaports in India in order to facilitate speedy custom clearance.[22] Air cargo facilities are not sufficient at Tribhuvan International Airport in Kathmandu for the export of fragile and perishable agriculture goods. Air cargo facilities are still primitive, with no exclusive cargo operators providing direct air-freight services from Nepal.

Political conflicts and policy issues continue to hinder production and trade. FDI flows into the country have not been substantial. In fact, the Maoist insurgency in the past decade, and the continuing threat of political instability, has not been auguring well for investment flows. Private financing for industries and for infrastructure is hard to come by. Most infrastructure projects are financed by international development agencies such as ADB and the World Bank, as well as international governments Trade policies such as cumbersome customs procedures have also added to the cost of trade in Nepal.

Areas requiring attention:

- Road network/maintenance
- Infrastructure at ICDs
- Air Cargo
- Information and Communications
- Private financing/SME export financing
- Trade Policy barriers
- Power
- Quality control
- Rent-seeking

[22] Identifying Nepal's Emerging Comparative Advantage, 2004.

7

Transit and Trade Initiatives and their Value-Chain Implications

As infrastructure is far from adequate to boost production and trade from the region, the respective country governments, with support from international development agencies, have undertaken many initiatives. A brief look at projects approved by ADB and the World Bank in the past decade shows 89 projects dedicated to infrastructure improvement, with the highest number in the transport sector. Many of these are being implemented and some are in the pipeline.

Realizing the nature of some of the key infrastructure requirements, particularly with regard to trade facilitation, special attention has been given to regional connectivity and trade facilitation projects. ADB plays a critical role in regional cooperation by providing

Table 7.1 Summary of Investments

Investment Profile	
Total number of projects	89
Regional projects	2
Bangladesh	30
Nepal	25
Eastern India	32

both funding and technical expertise. The West Bengal North-South Corridor Development Project and work to develop Nepal's East-West Highway are examples of two key projects implemented in the past decade with immense regional implications. Two more such projects on trade facilitation and information connectivity for the entire SASEC region are in the pipeline.

Table 7.2 Projects in Sectors

Project in Sectors	
Agriculture	21
Energy	16
Transport	39
ICT	1
Trade	7
Finance & Governance	7

Examining projects in individual countries, India has the largest number of projects, most of which are funded by the Government of India. 13 out of 32 projects have funding from either ADB or the World Bank. The Northeast region has been recognized as the thrust sector in the Twelfth Five-Year plan and Northeastern region vision 2020 in order to further the country's "Look East" policy.[23] Consequently, the Government of India, through the Ministry of Development of North Eastern Region has initiated several infrastructure projects in the region, focusing on road networks and energy. Government of West Bengal's special emphasis on attracting both domestic and foreign capital to the state is bearing fruit in the form increased industrial investments and infrastructure development. Sectors such as IT and automobile industries have shown rapid growth in the state. The state has also witnessed public–private partnerships in infrastructure development, such as in the aforementioned West Bengal Corridor development project and in Greenfield port development project in Kulpi in South 24 Paraganas district.[24]

In addition to physical infrastructure, the government has taken steps to improve human capital by making available technical training facilities in the region. Branches of India's premier institutes in technology and management—IIT and IIM—are already functioning in Guwahati and Shillong respectively.

Bangladesh finds itself in a strategic location with regard to facilitating trade from the region through its two seaports—Chittagong and Mongla. The regional projects under SASEC aim at connecting Nepal and Bhutan through Kakarvitta and Phuentsholling respectively to Mongla and Chittagong ports. It is expected that this new link will help reduce goods transit time by decongesting Kolkata port. Bangladesh is also critical in reducing the transit time from North East Region of India. Access to Chittagong port would provide a great fillip to the region's exports. Improved intra-regional connectivity is also expected to boost intra-regional trade.

Most of the projects in Bangladesh are funded by international agencies, and particularly focused at improving connectivity and trade facilitation through capacity expansions at ports, land custom stations, etc. A number of projects are also focused on the agriculture sector in order to promote agri-business. The energy sector too has been given priority in the past decade.

Nepal has received considerable development assistance in the form of grants to improve its road network and agriculture sector. The North-South and East-West highway corridor projects aim to link remote areas of the landlocked country to its trade route. Inland container depots (ICDs) at Birgunj and Kakarvitta have been taken up for capacity expansion and to improve customs clearing process.

SAARC Corridors

The South Asian Association for Regional Cooperation, with ADB support undertook the SAARC Regional Multimodal Transport Study (SRMTS). It was the objective of SRMTS to

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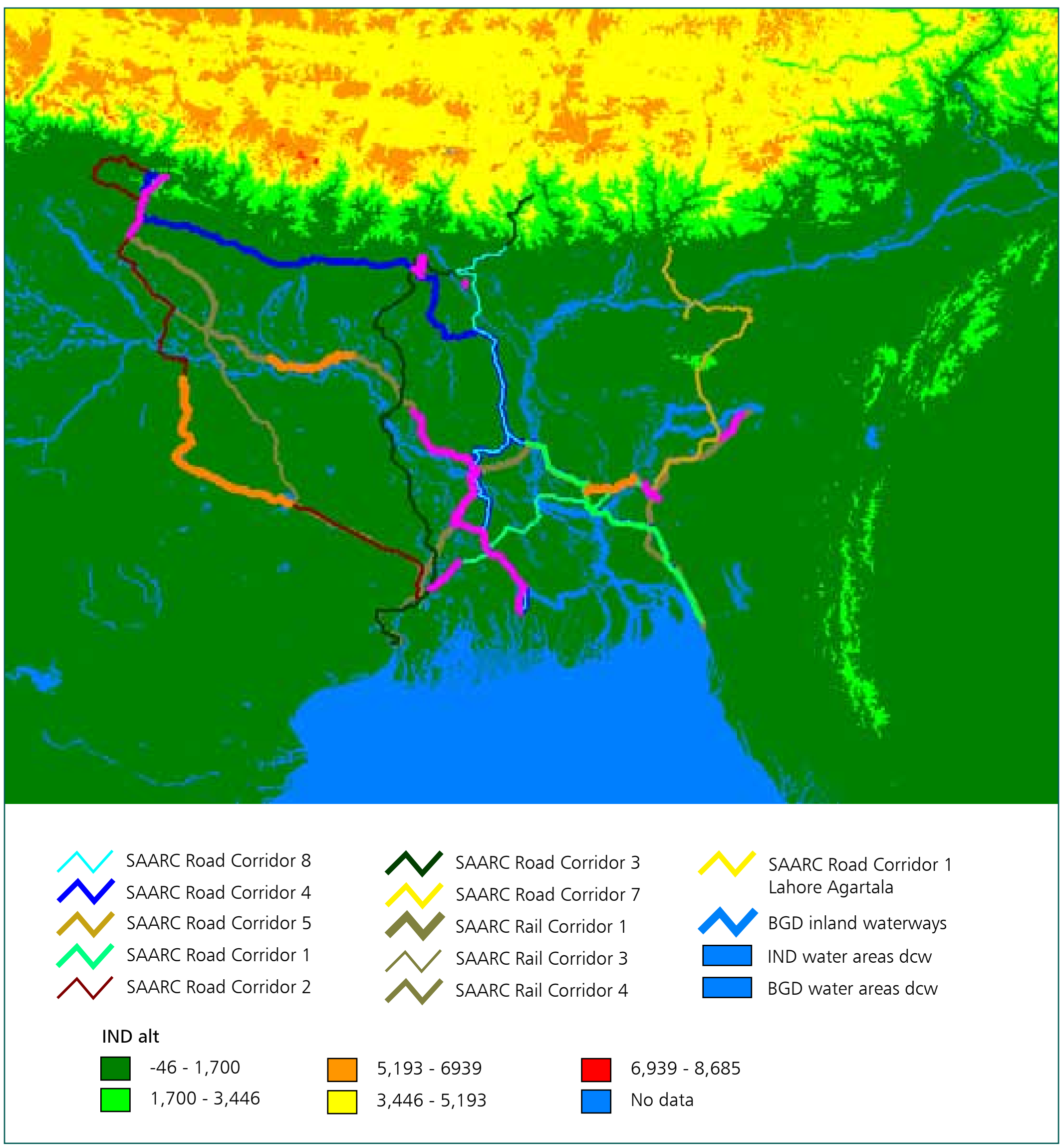
[23] North East Region Vision 2020, http://mdoner.gov.in/writereaddata/newsimages/vision%20statement%2020205117088053.pdf

[24] Kulpi port to get going by Jan '08, *Business Standard,* http://www.business-standard.com/india/news/kulpi-port-to-get-going-by-jan-%6008/304723/

enhance transport connectivity among SAARC member countries and thus to promote intra-regional trade. In the study, the main transport and trade corridors were identified on maps, along with some potential routes and detailed descriptions of their physical condition and functioning, in terms of the movement of goods and people. All key transport modes were considered—rail and road, waterways, and to a limited extent maritime and air gateways to the region. After careful application of selection criteria, 10 regional priority road corridors, five existing rail corridors, and two inland waterways were further examined. Along these corridors, investment needs for cross-border and regional projects were identified.

The following map shows the eastern South Asia geography with existing SAARC priority rail and road corridor lines.

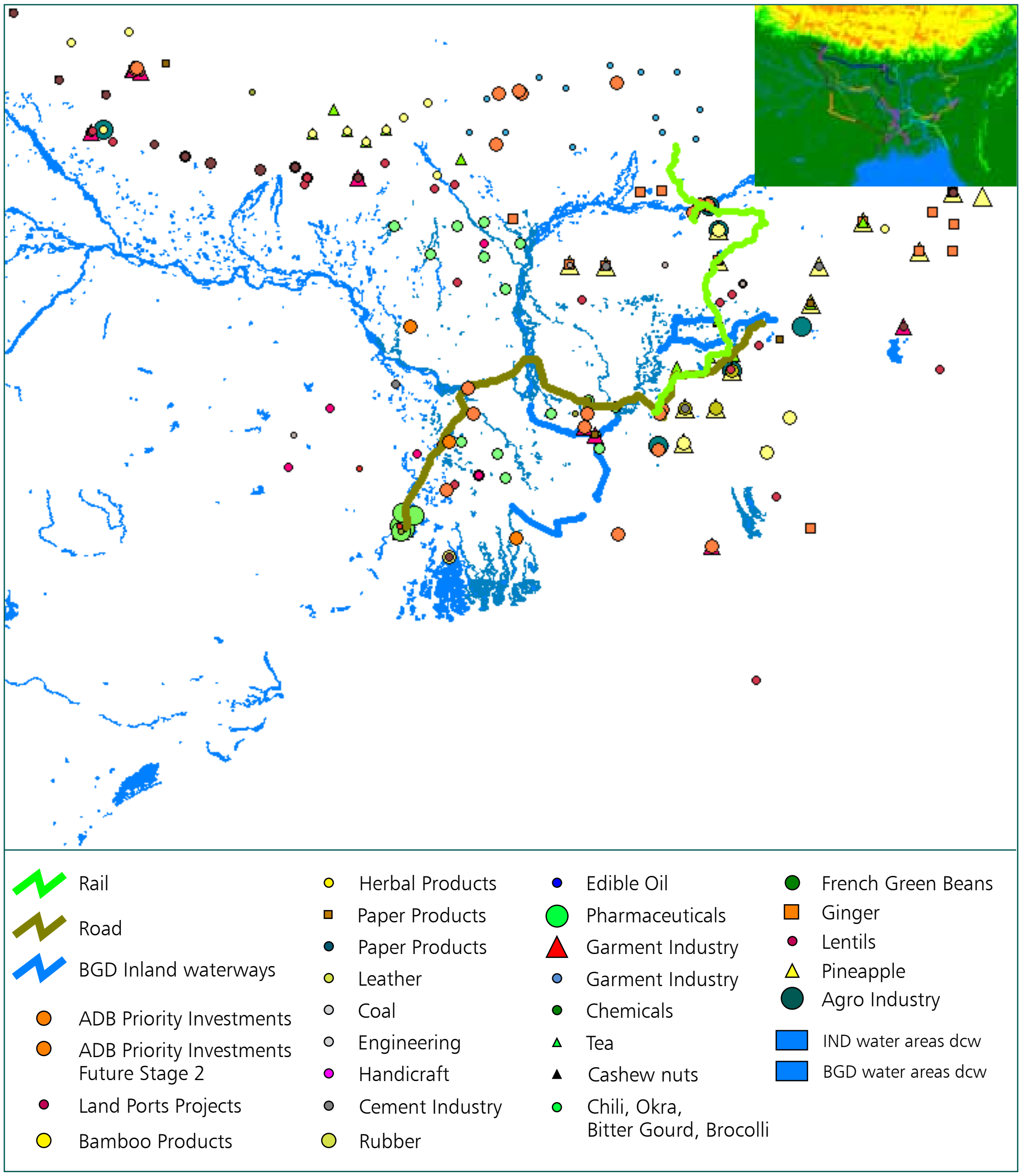
Figure 7.1 **GIS Map 11: SAARC Priority Rail and Road Corridor Lines**



Source: Author.

The following maps and tables show individual key corridors, and locate along them production of key actual traded volumes of goods (t), together with travel distances (km), times (h) and associated costs ($). The subsequent value chains will examine trade flows in depth.

Figure 7.2 **GIS Map 12: Major Products along Rail Corridor 1 and Road Corridor 5**



Note: Major products along rail corridor 1, and road corridor 5 (merging into road corridor 1)

Source: Author.

Table 7.3 Road 5 Merging into Corridor 1

City	Country	Distance	Travel Time (hrs)	Travel Cost ($ ton)	Freight Volume (tons/TEU)
Sandrup Jongkhar	BHU				
Guwahati	India	187	14	11.97	400,000 t
Shillong	India				Rs 4,000/t coal
Dawki	Bangladesh				2,700/t cement
Tamabil	Bangladesh				25,000/t fruits, rubber, and bamboo
Sylhet	Bangladesh				
Dhaka	Bangladesh				
Magura	Bangladesh				
Jessore	Bangladesh				
Benapole	India	92	4.5	5.97	1,000,000 t
Kolkata	India				

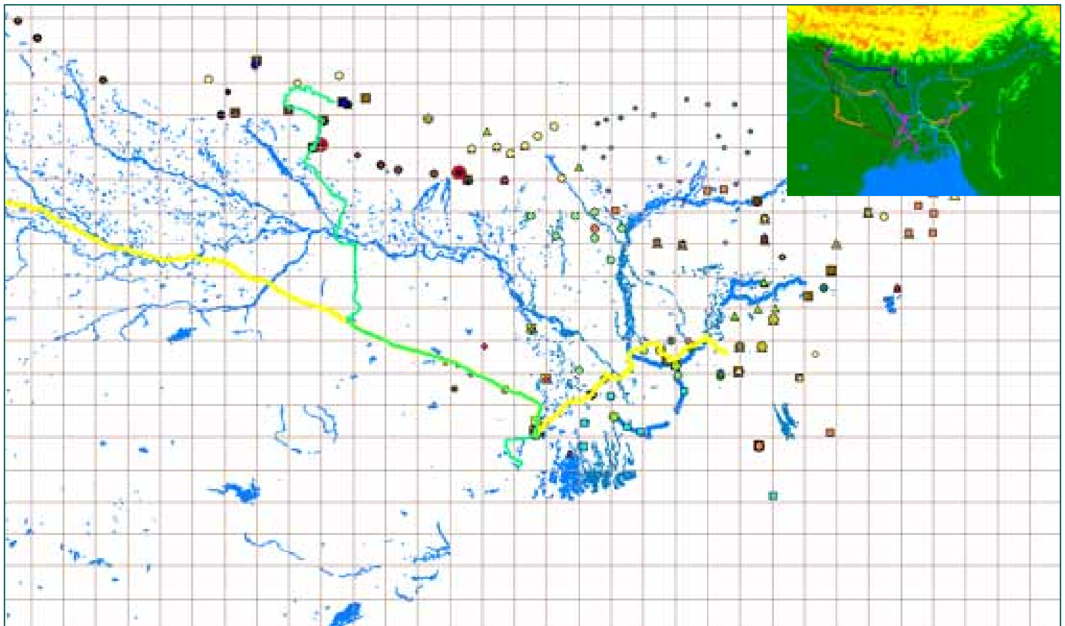
Sources: Estimate of Gains from Developing Functional Corridors, May 2010; TA4413-IND: Preparing the Northeastern States Trade and Investment Creation Initiative, Appendixes, 2006; North–South Corridor Development Project West Bengal, volume 4, 2000.

Table 7.4 Rail 1

City	Country	Distance	Travel Time (hrs)	Travel Cost ($ ton)	Freight Volume (tons/TEU)
Kolkata	India				
Darshana	Bangladesh	260	16	10	
Ishurdi Jn	Bangladesh				0
Joydebpur	Bangladesh				
Dhaka	Bangladesh				
Akhaura	Bangladesh				
Kulaura	Bangladesh	300	14	9.7	0
Karimganj (Shahbazpur)	India				
Jirimbam (Silchar)	India				

Sources: Estimate of Gains from Developing Functional Corridors, May 2010; TA4413-IND: Preparing the Northeastern States Trade and Investment Creation Initiative, Appendixes, 2006; North–South Corridor Development Project West Bengal, volume 4, 2000.

Figure 7.3 GIS Map 13: Major Products along Road Corridors 1 and 2



SAARC Road Corridor 2
SAARC Road Corridor 1 Lahore Agartala
BGD Inland waterways
Cosmetics/Personal cares
Herbal Products
Paper Products
Nu Agro Products
Photographic Plates
Infotech Services
Optical Lens
Footwear
Bicycles
Leather
Iron Steel
Coal
Engineering goods
Handicraft
Lime for cement
Cement Industry
Rubber
Edible Oil
Pharmaceuticals
Chemicals
Textile Industry
Garment Industry
Tea
Flowers
Fish/Shrimp
Agro Industry
Textile Industry
Garment Industry
Silk Industry
BGD water areas dcw
IND water areas dcw

Other Textile Products

Articles made of textiles
Carpets, Rugs of other material
Travel good, Handbags
Carpets
Textile Products
Twines, Ropes (Jute)

Agro Products

Cashew nuts
French Green Beans
Lentils
Chili, Okra, Bitter Gourd, Brocolli
Ginger
Pineapple

Wood Industry

Bamboo Products
Wood Based/Furniture
Wood Products/Furniture

Source: Author.

Table 7.5 Road 1

City	Country	Distance	Travel Time	Travel Cost ($/ton)	Freight Volume (tons)
Agartala	India				
Akhaura	Bangladesh				
Bhairab Bazar	Bangladesh	135.3	4.28	1.93	6,12,508
Dhaka	Bangladesh				
Manikganj	Bangladesh				
Jessore	Bangladesh	238	7.15	3.39	6,36,963.5
Benapole/ Petrapole	Bangladesh/India				Horticulture: 21,265.03 Textile: 4,456.57 Garments: 284 Jute: 23,660 Rubber: 980.2 Engineering: 327,803.5 Rice: 2,341,089
Kolkata	India	92	4.5	5.97	1,539,000[a]

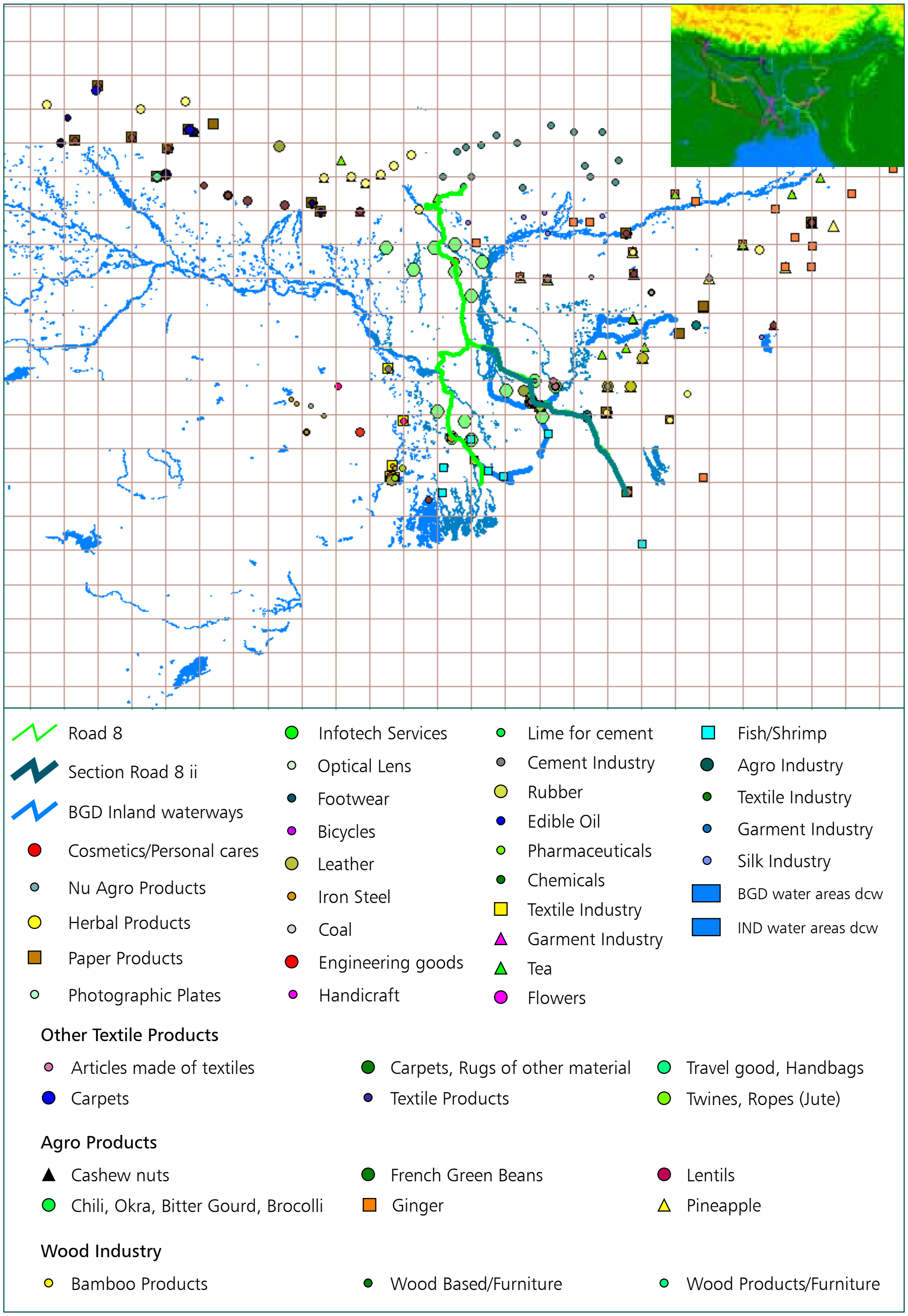
[a] Source: Padeco study, September 2009 for ADB's RETA 6435-REG: Preparing the South-Asia Subregional Economic Cooperation Transport Logistics and Trade Facilitation Project, and other data from ADB study on Estimate of Gains from Developing Functional corridors, May, 2010.

Table 7.6 Road 2

City	Country	Distance	Travel Time (hrs)	Travel Cost ($/ton)	Freight Volume (tons)
Haldia	India	RAX-HAL = 857 km.	26		
Kolaghat	India				
Bardhaman	India				
Asansol	India	1,156	35.1	0.613716 20’ CNT = $89 40’ CNT = $85	5,14,000[a] 1. Herbal products – 6.83 tons 2. Paper products – 1014.82 tons 3. Carpets – 168.32 tons 4. Footwear – 2,838.35 tons 5. Iron/steel – 39,334.32 tons 6. Fertilizer – 5,416.00 tons 7. Cosmetics – 2,183,803 pcs. NOTE: i 2008–09 data ii Source: TEPC/Nepal iii Only export fig. Except for fertilizer iv Volume for cosmetics is in pieces
Barhi	India				
Bihar sharif	India				
Hajipur	India				
Muzaffarpur	India				
Motihari	India				
Raxul/Birgunj	India	KTM-RX = 305 km	9.5	$9.7	
Hetauda	India				
Narayanghat	India				
Mugling	India				
Kathmandu	India				

[a] Source: Kolkata Port Trust.

Figure 7.4 GIS Map 14: Major Products along Road Corridor 8 (Puentsholing to Mongla) and 8 ii (Jamuna–Dhaka–Chittagong)



Source: Author.

Table 7.7 Road 8

City	Country	Distance	Travel Time (hrs)	Travel Cost ($/ton)	Freight Volume (tons)
Mongla	Bangladesh	579.63	17.3	8.13	11,56,674
Khulna	Bangladesh				
Jessore	Bangladesh				
Jhenaida	Bangladesh				
Ishurdi	Bangladesh				
Natore	Bangladesh				
Bogra	Bangladesh				
Palashbari	Bangladesh				
Rangpur	Bangladesh				
Lalmonirhat	Bangladesh				
Burimari/ Changrabandh	Bangladesh/India				
Jaigaon/ phuentsholing	India/Bhutan				
Thimphu	Bhutan				Horticulture: 2,6196.75 Rice: 5,3469.83 Jute:

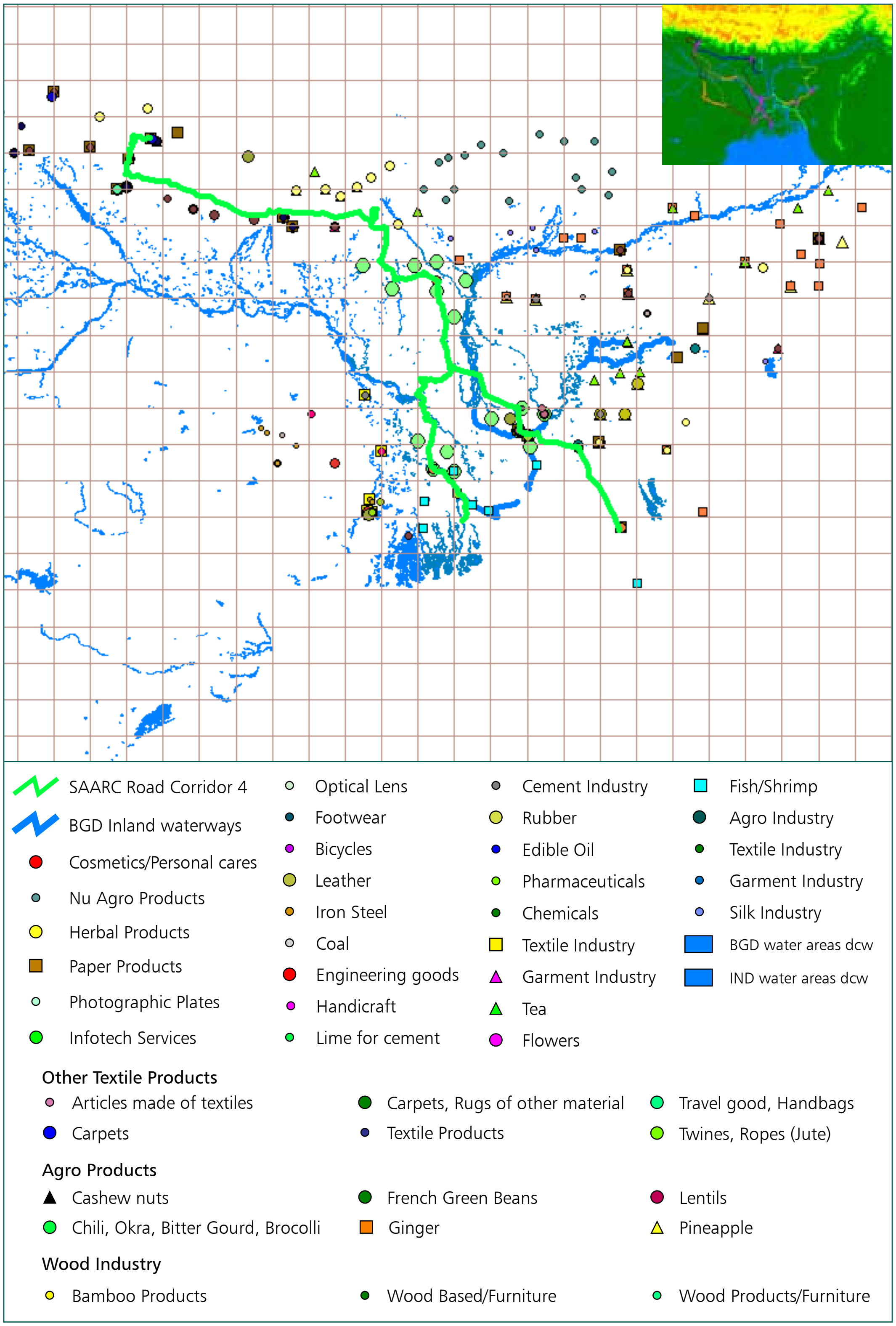
Source: ADB study on Estimate of Gains from Developing Functional Corridors, May, 2010.

Table 7.8 Road 8ii

City	Country	Distance	Travel Time (hrs)	Travel Cost ($/ton)	Freight Volume (tons)
Chittagong	Bangladesh				Shrimps/Seafood: 5,894.67 Leather goods: 3,988.29 Cotton/yarns: 31,395.41 Textiles: 5,078.45 Garments: 31,3514.94 Sports goods: Ceramics: Fertilizer: Machinery: 347.66
Feni	Bangladesh	234	8.37	3.33	27,39,331.5
Comilla	Bangladesh				
Dhaka	Bangladesh				
Joydebpur	Bangladesh	22	0.45	.31	3,64,655.5

Source: ADB Study on Estimate of Gains from Developing Functional Corridors, May, 2010.

Figure 7.5 GIS Map 15: Major Products on Road 4 (Partial—only Nepal)



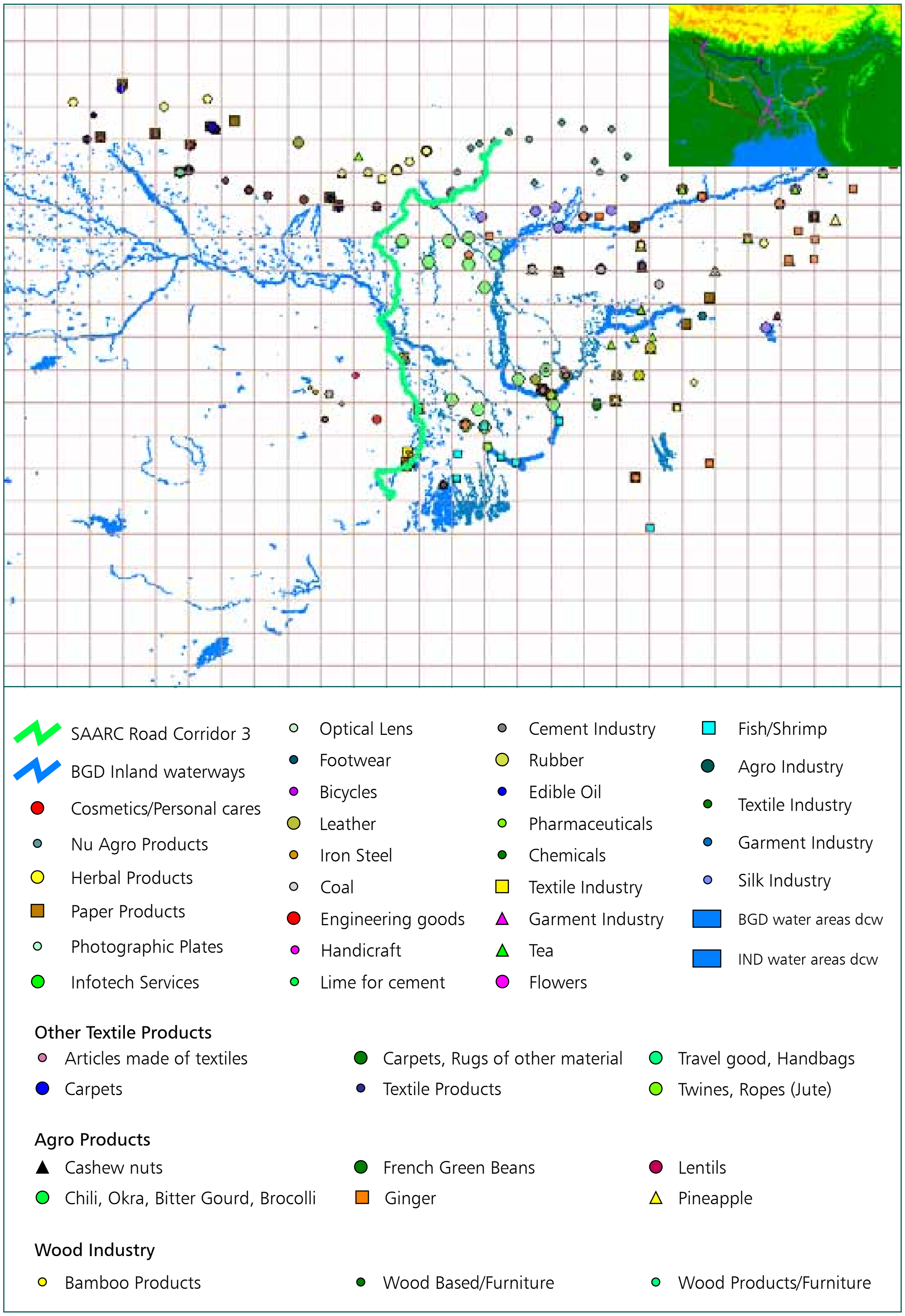
Source: Author.

Table 7.9 Road 4

City	Country	Distance	Travel Time (hrs)	Travel cost ($/ton)	Freight volume (tons)
Rangpur	Bangladesh	205.5	5.14	2.29	1,86,356 Rice – 1,472.83 tons Fruits – 15.3 tons Tea – 8,829.5 tons Leather – 41.3 tons Garments – 105 tons NOTE: i. 2008–09 fig. ii. Source: TEPC
Saidpur	Bangladesh				
Banglabandh/ Phulbari	Bangladesh/India				
Siliguri	India				
Kakarbhitta	Nepal				
Damal	Nepal				
Biratnagar	Nepal	BRJ-BANGLB = 436 km.	14	26.4	
Rajbiraj	Nepal				
Lahan	Nepal				
Janakpur	Nepal				
Birgunj	Nepal				

Source: ADB study on Estimate of Gains from Developing Functional Corridors, May, 2010.

Figure 7.6 GIS Map 16: Major Products on Road 3



Source: Author.

Table 7.10 Road 3

City	Country	Distance	Travel Time (hrs)	Travel cost ($/ton)	Freight volume (ton or TEU)
Haldia	India				Haldia: Tea – 7.12 tons Jute – 0.12 tons Iron/Steel – 556.61 tons Farakka: Tea – 17,168.53 ton Jute – 4,004.4 tons Rice – 732,696.16 tons Fresh Fruits/Vegetables – 1,686,411.17 tons Other Agricultural – 75,467.5 tons Manufactured Goods – 471,288.43 tons Building Materials – 2,215,075.46 tons Iron/Steel – 681,446.66 tons Miscellaneous – 1,415,045.94 tons Shiliguri: Rice: 3,876,121.44 tons Processed Foodstuff – 2,634,849.30 tons Manufactured Goods – 910,547.56 tons Iron/Steel – 935,139.31 tons Jute – 13,662.06 tons Fruits/Vegetables – 402,363.28 tons Building Materials/Minerals – 484,414.38 tons Miscellaneous Goods – 1,623,222.30 tons
Kolaghat	India				
Kolkata	India				
Ranaghat	India				
Bahrampore	India				
Farakka	India				
Malda	India	1,184	40.55	0.603642	
Raiganj	India				
Islampur	India				
Siliguri	India				
Jalpaiguri	India				
Cooch Bihar	India				

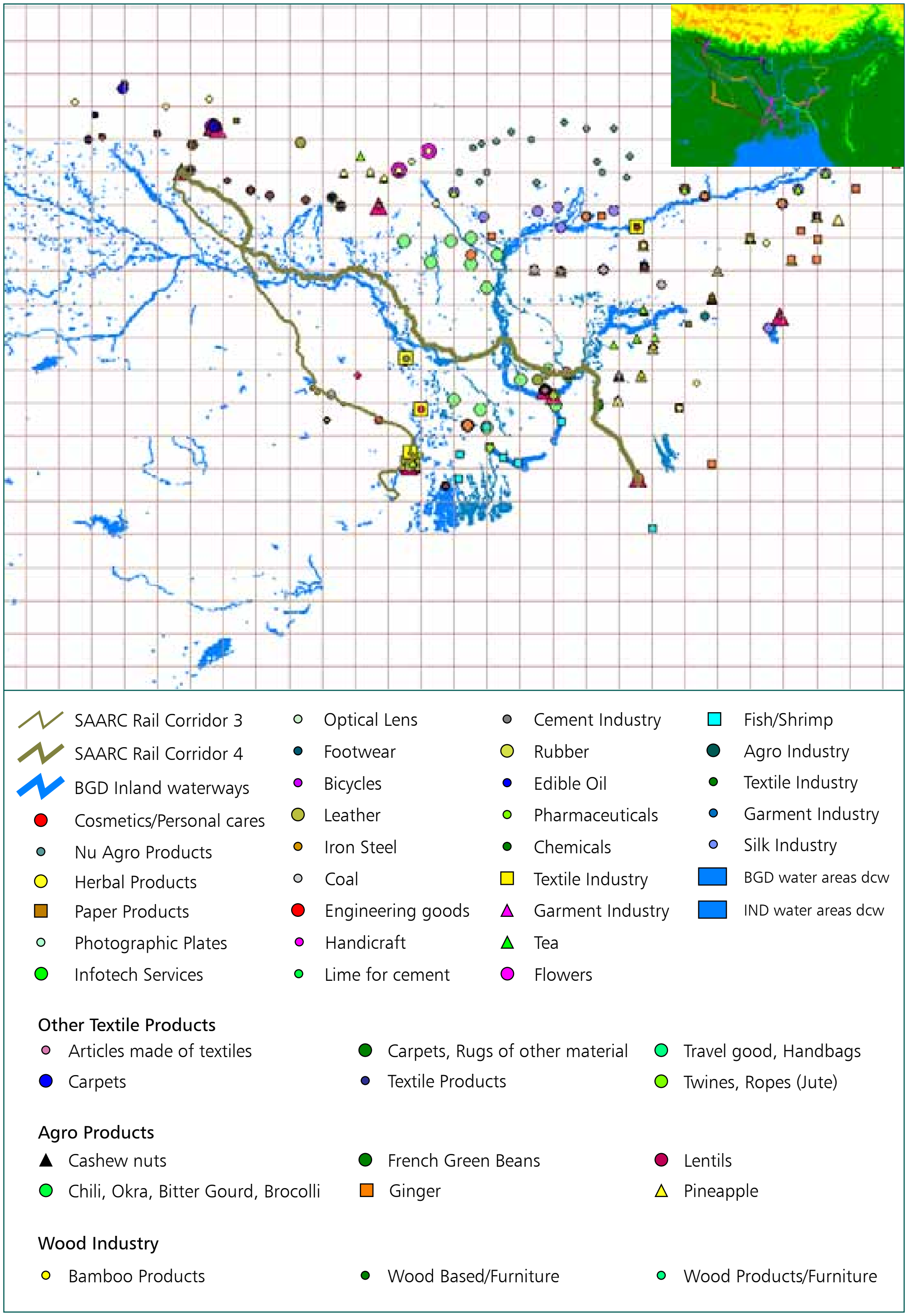
continued on next page

Table 7.10 *continued*

City	Country	Distance	Travel Time (hrs)	Travel cost ($/ton)	Freight volume (ton or TEU)
					Domestic Container Freight Traffic (Road): 27,311,446 tons International Cargo Freight Traffic (Road): 2,282,922 tons Estimated Value (in $) Per Ton Textile – 8,058.40 Garments – 1,334.21 Horticulture – 813.20 Jute – 573.64 Shrimp/Seafood – 5,716.37 Leather/Goods – 16,592.09 Cotton/Yarn – 3,115.52 Rice – 104.99 Metals (Zinc) – 584.29 Other Agricultural Products (Betel Nut) – 943.55 Textiles – 7,286.49 Machinery – 75,449.06

Source: Data provided by Dr. Pankaj Kundo of West Bengal.

Figure 7.7 GIS Map 17: Major Products on Rail Corridors 3 (to/from Nepal) and 4 (Partial from Dhaka to Chittagong)



Source: Author.

Table 7.11 Rail 3

City	Country	Distance	Travel Time (hrs)	Travel Cost ($/ton)	Freight Volume (ton or TEU)
Haldia	India	704 km.	48		
Kolaghat	India	(BRJ-HAL)			Export CNT
Baradhaman	India	Rates for 20’			(2008–09)
Kolkata	India	CNT export			TUES = 772
Asansol	India	up to 15 MT			FUES = 114
Lakhisarai	India	= $ 14.33\			Total = 1,000
Muzaffarpur	India	> 15–20 MT			
Motihari	India	= $ 11.85			Import CNT
Raxaul	Nepal	> 20–30 MT			(2008–09)
Birgunj		= $ 11.25			TUES = 10,382
					FUES = 2,160
		Rates for 20’			Total = 14,702
		CNT Import			
		up to 1 MT			
		= $10,382			
		> 15–20 MT			
		= $ 16.15			
		> 20–30 MT			
		= $ 13.83			

Table 7.12 Rail 4

City	Country	Distance	Travel Time (hrs)	Travel cost ($/ton)	Freight volume (ton or TEU)
Akhaura	Bangladesh	287	14.47	8.78[a]	
Joydebpur	Bangladesh				
Ishurdi	Bangladesh				
Malda	India				
Katihar	India				
Baruni	India				
Samastipur	India				
Muzaffarpur	India				

[a] Source: Estimate of Gains from Development of Functional Corridors, May 2010.

Channel Mapping Methodology for Value Chain Analysis

Global Development Solutions (GDS) employed its channel mapping methodology—a process of tracing a product flow through an entire "transmission" channel from the point of product conception to the point of consumption. This process highlighted the underlying patterns of inputs, constraints, and competitive advantage open to a producer. It also allowed the path to be traced for all activities associated with the production and physical transfer to markets of a good and approximates costs involved at each stage, regardless of whether or not they added value.

When applied correctly, the GDS methodology provides opportunities to benchmark one producer against another, as well as to benchmark production activities across regions and countries. Most of the data for the benchmarking stage is a result of Integrated Value Chain Analysis (IVCA) of over 120 specific product groups that has been undertaken by GDS in more than 20 countries in Africa, Asia and Europe.

Similarly, this methodology is an ideal tool for measuring and quantifying the cost of trade and administrative distortions that hinder the competitiveness of products and industries. Consequently, channel mapping can also be used as an effective tool to identify discrete areas for policy reform and investment.

IVCA provides a detailed breakdown of each stage of production, estimates the cost at each stage, and calculates the relative significance of these costs to the overall competitive market value of an end product. The value chains for specific products are explored in great detail over the coming three chapters, using the channel mapping approach.

8 Value Chain Reference—Indian Bamboo Floor Tiles

This and two subsequent chapters focus on a detailed examination of the value chains for three products—bamboo floor tiles in northeast India, ceramic tableware in Bangladesh, and seabuckthorn in Bhutan and Nepal—applying the channel mapping methodology through Integrated Value Chain Analysis (IVCA). For practical reasons, only a few product value chains could be mapped and analyzed in full across the region. We start in this chapter with the value chain for Indian bamboo tiles, included in summary form, taken from an earlier ADB-financed study, and by presenting the material from which a business development scenario was derived.

The IVCA for Bangladeshi ceramics is shown in exhaustive detail in the next chapter, while the potential for exporting the juice of seabuckthorn, a fruit that grows widely in Bhutan and Nepal, is examined in Chapter 10. Impediments to trade identified in the analyses are drawn together in Chapter 11 to present a way forward for project and policy interventions that maximize the potential of the three product types to access to export markets.

Background

Bamboo is a fast growing grass which occurs naturally on every major continent except Europe. Of the nearly 1,200 species of bamboo in the world, India is home to 130, belonging to 18 genera. Although most are indigenous, some have been brought into India from other countries. India is uniquely endowed, yielding firms a large and diverse resource of raw material.

Bamboo in India can draw upon a legacy of traditional skills and usage. The country's bamboo resources are the second-largest in the world. Most varieties grow naturally at elevations ranging from sea level to above 3,000 meters, and they do so in an extraordinary range of habitats across almost 10 million hectares of forested land, on small family farms, and in private and government plantations.

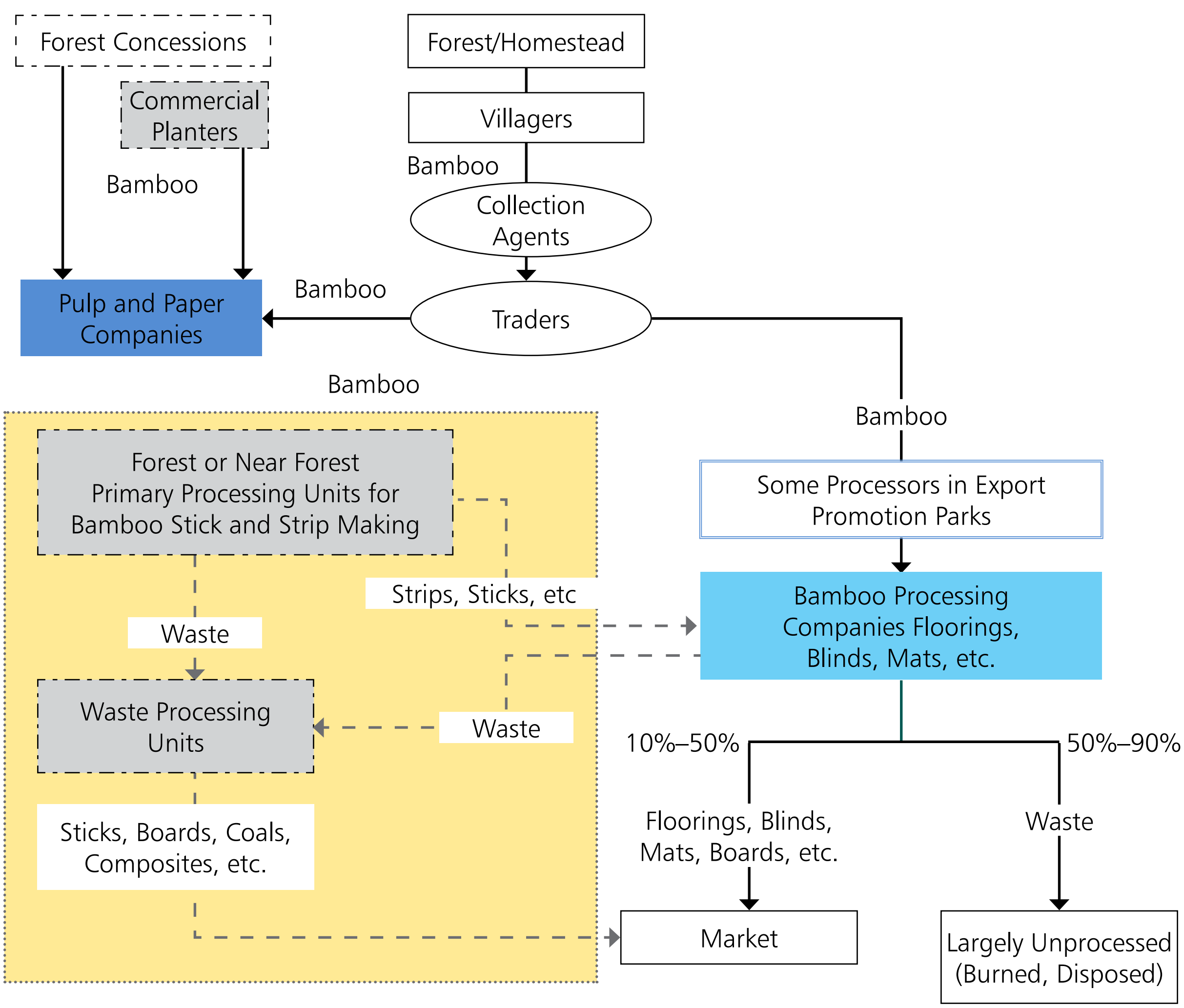
Value Chain Analysis

For the purpose of this analysis, a value chain for export-quality bamboo parquet floor tiles was prepared. Although the product analyzed was for "export quality," the producers also sold the product domestically to builders and home-owners.

The value chain for export-quality bamboo parquet floor tiles can be divided into at least seven levels of value-adding activities:

- Sourcing the raw material
- Crosscutting and treatment
- Drying
- Planning and sorting
- Cutting and sizing
- Finishing and packing

Figure 8.1 Bamboo Supply Chain in Northeast India



Note: Gray, broken lines and boxes denote a missing or very weak part of the supply chain.

Identified Value Chain Barriers

Lack of commercial plantation with scientific practices: Bamboo farming in northeast India is not well commercialized. There is a mismatch between commercially planted species and species demanded by processors of flooring and blinds. The market is dominated by the pulping industry and even the higher price offered by non-pulping processors is currently not bringing about the emergence of commercial plantations catering to their needs. Part of the reason is because the specific bamboo maturity and size requirements by these processors entail specific farming and management practices on the part of commercial planters—such as maturity marking and selective harvesting—which increase costs, as well as other factors such as the acquisition of specific species seedlings which may not be available in absence of any bamboo nursery in the region. Development of commercial plantations and seedling laboratories, and the adoption of appropriate management practices would immensely increase yields and the availability of raw materials. Due to current gaps in information, poor availability of finance to commercial farmers, and existing policy environment, that has yet to take place.

Weak supply chain: The manufacturers are currently constrained due to limited availability of strips needed for a fully functioning assembly and finishing line of tiles. Due to this, the existing units are burdened with an overcapacity and high overheads. A unit which is currently operating only at 20% due to this constraint can expect to reduce the production costs by 33% if it operates at full capacity. Support for the emergence of primary processing units that would supply bamboo strips and sticks would greatly improve the performance of the secondary processing facilities. The location of such strip-making units nearer to the source (forest/plantation) could also reduce the unnecessary transportation of bulk raw material, hence may lead to efficiency in transportation.

High wastage due to outdated technology: In the case of the traditional floor tile production process currently used in NE India, waste levels are as high as 90%. Use of efficient technologies could reduce such wastage substantially (about 40%–50%). Providing extension support to bamboo processors in their early stages of development to improve their operation's management in terms of quality control and technical skills could also reduce wastages.

Testing and certifications: Currently, firms do not export floor tiles .Hence certification and testing issues are not being looked into. However, some certificates relating to quality management, product standards and environmental management may be required in order to export. While these are buyers' requirements, they also enhance marketability of the product. For example, as long as flooring sellers have one standard (numbered din en 14354:2005) covered for wood-based panels and veneer flooring, then bamboo tiles can be exported to the European Union. The North American Laminate Flooring Association and ASTM International (formerly the American Society for Testing and Materials) provide well-accepted product standards, and certifications by the Forest Stewardship Council relate to environmental standards of the raw-material source (forest/plantation/homestead). The requirements and issues related to these need to be addressed by appropriately providing testing, certification infrastructure, and other assistance.

Informality and rent-seeking: Most of the bamboo comes from homesteads which are not commercially organized. Therefore, they are not aware of the appropriate regulations and procedures for transporting bamboo. This, among other things leads to rent-seeking behavior in transporting bamboo. As an illustrative example it was found that there were 24 "illegal" check-points on a 400 km stretch from the bamboo farm to the primary processing facility.

High import/export costs: There are high export logistics cost associated with TEU cost of accessing the Port of Kolkata via rail which costs $398/TEU, or 28.8% of the total logistics cost of a 20-foot container. Almost as costly, and much more time-consuming, is the expense of accessing an empty container. The inland container depot (ICD) in Guwahati by and large serves the tea-exporting businesses. Accessing an empty container there takes as long as 7 days and costs $390. It costs around $231/TEU just to reach the customs clearance and containerization point at the ICD. Further, there are significant costs associated with import-related charges. Accordingly, producers face difficulties in obtaining customs clearances at Guwahati. Thus, import-export transaction costs represent a high cost of doing business in the northeast and may serve as a disincentive for future investment in the region.

Capital shortage: A survey conducted by the National Sample Survey Organisation provides information for all the Northeastern states on the most critical problems that are currently being faced by the industries as perceived by the entrepreneurs. The most critical problem which emerges from the analysis as seen from Table 8.1 was capital shortage in six out of the eight Northeastern states. Any strategy for development of unorganized manufacturing industries in the region must, therefore, include the provision of export credit to entrepreneurs as a major component.

Inadequate market access: The second critical point identified from the analysis is the marketing of products. This is perceived as a more serious problem than availability of raw material. Availability has not yet become a serious problem as most of the units are obtaining it locally. Nonetheless, these are all dependent on outside market for disposal of their output. This highlights the importance of the role that can be played by the state agencies as also private trading corporations in strengthening the external linkages of the local entrepreneurs and creating demand for their products. Standardization of products, branding them, and publicizing their special qualities in national and international market would go a long way in creating the desired linkages.

Table 8.1 **Problems Faced by Entrepreneurs in the Manufacturing Sectors in some Northeast States, 2000/01**

States	Of the total					
	Electricity connection	Power cut	Capital shortage	Raw material unavailability	Marketing product	Total number of units
Assam	25.8	17.2	73.8	16.9	35.7	278,450
Manipur	12.2	11.8	59.7	12	14.1	53,911
Meghalaya	52.5	48.8	67.6	6.9	54.8	28,019
Mizoram	7.6	17	28.9	12.4	42.2	6,256
Nagaland	8.0	20.6	55.7	23.1	35.5	5,731
Tripura	10.9	23.1	67.6	31.4	41.1	35,507

Source: Author.

Business Plan Scenario

Based on the IVCA, which was conducted by the Global Development Solutions (GDS), and the interventions identified for the bamboo value chain, a preliminary business plan scenario was developed to identify the cost of interventions and their financial feasibility. Broad assumptions were made in this scenario and will require substantial refinement based on detailed investigations. It is important to note that no export of bamboo tiles currently taking place—nor are there good estimates for the share of the market the region can capture relating to global trade in bamboo tiles. The analysis has been carried out to assess broad feasibility rather than to help entrepreneurs make investment decisions.

The projects considered for analysis fall into two broad categories:

i. Bamboo value-chain-specific projects such as commercial plantations and strip-making units. These projects are specific to one value chain and would be funded as private investments under a trade finance facility component. We assume that many value chains such organic pineapples, other fruits and vegetables, etc. will develop parallel in the northeast and would require similar investments.

ii. Common infrastructure including ICD, trade facilitation centers, etc., which would be utilized by various value chains and developed under a sovereign loan component, suitably leveraging resources through public–private partnership formats.

Based on the analysis of the market size for bamboo flooring (estimated as close to $300 million in the next 10 years) and the potential of the North Eastern Region, it has been assumed that the region can capture around 10% of the global bamboo flooring market in next 10 years, which translates to around 2 million square meters (m^2) of floor tiles, costed at around $16–20 per square meter.

This would require establishing around 30–40 secondary manufacturing units with a capacity of around 60,000 m^2 per unit per year. These units would be established and operated by the private sector and could be located within the North Eastern Region, or in any other region well connected with it. The cost of establishing these units would vary to a great extent, based on technology employed and the variety of end products. As these are assumed to be purely private ventures with wide variations in costs and operations, the cash flows of these units have not been included in this analysis.

Pre-processing units/strip-making units would supply bamboo strips to secondary units, and are essential links in the value chain.[25] These units would be best placed near the source of raw material (plantations) since much of the bulk would be reduced during pre-processing, leading to cost reduction in transportation. These units have been considered as having a typical capacity equivalent to 11,000 m^2 of floor tiles per unit per year. About 130–140 such units would be needed for supplying the required quantity of strips to production units. The capital cost of establishing each unit has been taken as $121,613, based on estimates by GDS. It is assumed that around 5–6 such units would cater to one secondary manufacturing unit having a capacity of 60,000 m^2 tile equivalent, and thus around 23 clusters of the units need to be set up in the North Eastern Region. These could also function as common facility

[25] The absence of these strip making units has resulting in lack of input for the secondary manufacturing facilities. As a result, these units are operating well below their installed capacity resulting in higher unit cost of output.

centers (CFC) with training facilities/ commonly shared machineries where farmers could bring their produce and convert them to strips. These clusters would be linked to major roads and highways through feeder roads. As much of the region does not have adequate roads, it has been assumed that around 10 km of feeder road per cluster would be needed for adequate connectivity.

In order to source adequate raw material (*bambusa tulda* of 4 years maturity), commercial plantations would be developed in the North Eastern Region. As per GDS estimates, one culm of bamboo is used to produce 0.11 m^2 of floor tile and the establishment of 1 ha of bamboo plantation would cost around $158 excluding the cost of land and if seeds are used for planting. Based on these assumptions, around 2,800 ha of land would supply the required quantity of bamboo to the strip-making units, and would be developed at a cost of $441,700. Given the efficiency gains and cost reduction, the plantations and CFCs would develop in proximity to each other, functioning as closely integrated units. Seedling labs and nurseries would cater to the seedling requirements of the commercial plantations. These could be located anywhere in the region.

Based on GDS estimates of the power requirements for the CFCs and secondary processing units, around 9 MW of power would be required for the bamboo value chain. This would cost around $11 million based on benchmark costs from other power projects.

Currently the ICD at Amingaon is not operating at full capacity (10,000 TEU). It has been estimated by GDS that around 1,500 m^2 of tiles can be loaded in a TEU, which translates to around 1,300 TEUs for 2 million m^2 of tiles. In addition, producers of boards, blinds, mats and other bamboo related products may need around 1,000 TEUs to 2,000 TEUs per year in case they also capture market shares of 5%–10% globally. Thus, should the bamboo-related production pick up in the Northeastern states, the TEU load that the ICD would need to handle by 2015 is estimated at around 2,300 TEU per year. The ICD has capacity to handle the same if it is upgraded. However, as other value chains develop in the region, more load would have to be handled. It has therefore been assumed that in the initial years of growth in trade volumes, the ICD would be upgraded by providing adequate equipment (two each of cranes, reach stackers, trailers, and forklifts) and the extension of rail linkages of around 5 km. In the subsequent years, as the trade volume increased further, the ICD would require expansion and the addition of more equipment. It shall be noted that the ICD is currently catering mainly to tea exports and will continue to cater to tea and other commodities that will likely increase in trade volume due to value-chain and public infrastructure interventions.

In order to provide market access to SMEs, traders and farmers, it is suggested that a trade center be developed with facilities for e-auction and post-harvest activities such as packaging and processing, banking, cold storage, etc. The scenario assumes at least two such facilities with a network of collection centers spread across the Northeastern and pilot states. The cost of these centers has been considered based on benchmarks from similar (terminal market) projects being developed in other states of India. The throughput from these centers is considered to be 200 metric tons a day based on the expected volume due to development of various value chains like fruits and vegetables which would also utilize this facility.

In its IVCA analysis for organic pineapples, GDS has also estimated the requirement of cold storage warehouse at Agartala along with a pineapple processing center with capacity to handle 100 metric tons a day. The cost of the warehouse has been estimated to be around $500,000 and the same has been considered in the public infrastructure requirement.

While the common infrastructure has been considered as a public funding requirement, it is advisable to develop these projects in Public–Private Partnership formats wherever feasible to leverage the public resources. Based on the example of terminal markets being developed in various parts of the country, high potential is seen in developing trade facilitation centers in that format.

There would be substantial requirement for capacity development at various levels of value chain. This would include providing farmers with training in scientific plantation techniques, training for traders and entrepreneurs in international trade, testing & certification, etc., and technology transfer to SMEs. The estimated cost of training for around 7 years has been considered in this scenario. Policy and governance reforms, including those required to reduce corruption and the high transaction costs linked to it, would play essential roles the overall success of the project, but costs relating to these are outside the scope of this analysis.

The analysis indicates that revenues of over $200 million could be generated in the North Eastern Region over 15 years through the identified interventions in the bamboo value chain.

The interventions and business scenario discussed above have important implications. They serve as a reference point for interventions in Bangladesh, Bhutan and Nepal (see Chapter 11). In the cases of ceramics in Bangladesh, and for seabuckthorn product development in Bhutan and Nepal, the IVCA described in the next two chapters suggests that the same investment and policy considerations in the development of export markets for Indian bamboo floor tiles are appropriate for overcoming barriers to trade that the analysis identifies.

Table 8.2 Project Interventions Proposed for Value-Chain Specific Interventions (Non-Sovereign Component)

S.No.	Intervention	Gains	Capital Cost (benchmark per unit)	O&M Cost (per annum)	Units required	Capital Cost ($ million)	Mode of Implementation
1	Establishing Commercial Plantation of 200 ha each	Regular supply of required quantity and quality of raw material as per requirements of flooring/ window blinds industry	$157.75/ha to $228.06/ha excluding cost of land	Yr 1-3 $145.83/ha Yr 4- $73.34/ha, or 13.10/ton Yr 7 onwards- $104.38/ha, or 8.7/ton	12–15	0.4	Private sector/ PPP formats. Part of the capital cost could be funded through the non-sovereign component.
2	Seedling Lab/ Nurseries (expected to produce ~ 2 million seedlings annually)[a]	Cost reduction From Rs 15 for own nurseries to Rs10/ seedling ($0.25/ seedling	Rs15 million ($375,000)		1	0.4	Public sector/PPP formats
3	Pre-Processing facilities/ Common Facilities Center/ Strip manufacturing Unit (Capacity: 11,000 m^2 or 2 million strip)	Reduction by 33% in cost of a carbonized, horizontally configured, floor tile from $33.99/$m^2$ to $22.88/$m^2$	$121,613	$98,454	130–140	17.0	Private sector/PPP formats. The debt could be funded through the non-sovereign loan component
4	Secondary Processing units		Variable based on product and technology	–	30–40	n.a.	Private sector
						~$20 million	

[a] Each seedling lab can cater to the requirement of 2,000 ha of plantation. It has been assumed that the remaining plantations will have some form of captive seedling generation facility.

Note: These are tentative cost estimates based on the assumption that the global flooring market that would be captured by the North Eastern Region in 10 years is ~2 million m^2. Projects identified under non-sovereign loan component are specific for the bamboo value chain and are based on the integrated value chain analysis conducted under the TA. All investments in public and private infrastructure have been calculated assuming that the North Eastern Region will cater to approximately 10% of the global market in 10 years. The actual investment requirements would be different depending upon the market share they can capture and/or whether the region substantially serves the domestic market only.

Source: Author.

Table 8.3 Public Infrastructure (Sovereign Loan Component)

S.No.	Intervention	Gains	Capital Cost (benchmark per unit)	O&M Cost (per annum)	Units required	Capital Cost ($ million)	Mode of Implementation
5	Development/ improvement of feeder roads (two-lane)	Time and cost efficiency	~Rs 15 million/km ~ 0.38 million/km		~ 230 km	86.5	Public sector/ PPP formats
6	Improvement of ICD at Guwahati	To achieve time and cost efficiency[a]	–		–	9.5	Public sector
7	Trade facilitation centers[b] (~200 mt/day) and collection centers	Trade facilitation	~ $8.5 million		2	17.0	PPP formats
8	Power		~ $1.25 million per MW		~ 9 MW	11.1	Public sector/ PPP formats
9	Cold storage warehouse at Agartala		–			0.5	PPP formats
						~$160	

[a] This existing depot has processed less volume each year for the past 5 years. This cost includes cranes, forklift, reach stackers, and a rail link of approximately 5 km. The facilities, train frequency and access road need to be improved and better marketed to capture domestic traffic.

[b] Capacity of Trade facilitation centers (on lines of terminal markets in India) would be determined by the expected exports in other value chains.

Note: These components are not specific to a particular value chain (except for the feeder roads that may be required to connect to specific project facilities). The projects identified would also provide support for other value chains such as those for pineapple, rubber, flowers, etc. However, based on the analysis and infrastructure gaps identified in the study, these are essential infrastructure components that need to be developed, improved, upgraded or strengthened for overall support to trade activities in the North Eastern Region. The public investment loan component will have other items such as water, waste water treatment and disposal, Solid waste management, etc. which have not been identified at this stage. The total requirement provided here is tentative and needs to be verified by further investigations.

9

Ceramic Tableware Value Chain in Bangladesh

Findings from the following integrated value chain analysis suggest that the ceramics tableware industry has the potential to become a leading-light manufacturing sector in Bangladesh. The manufacturing base and know-how in the sector are modern, labor and energy prices are competitive, and the local craftsmanship is gaining a positive reputation internationally. However, there are many barriers to export growth and increased competitiveness for ceramics tableware manufacturing in Bangladesh.

Background

The ceramics manufacturing industry in Bangladesh started in the 1960s with the establishment of the first porcelain tableware production plant. By the mid-1970s, the country also had a sanitary ware production firm. By 1991, the country exported only approximately $1 million of ceramics wares as the bulk of production was destined for the local market. It was not until the late-1990s that the sector began to show significant export growth, and a contribution to employment. By 2008, some 40 years after its inception, ceramics manufacturing had emerged as a viable industry.

Notwithstanding the fact that it remains focused solely on household applications, and has not developed products for the increasingly important industrial ceramics market, the sector provides jobs for over 13,000 people and generates $35 million–$45 million in export revenues annually.

The Bangladeshi ceramics industry can generally be divided into two categories:

- The tableware industry, which focuses mostly on the export market; and
- The tiles and sanitary ware industry, which focuses almost exclusively on the local market.

Table 9.1 Bangladesh Ceramics Sector Profile, 2008

Ceramic Manufacturing Sector Total:	
A. Firms	19
B. Direct Employment	13,095
C. Indirect Employment[a]	100,000
D. Sales Revenues	$163 million
i Tableware (% share of total sector exports)	$52 million (90%)
ii Tiles and Sanitary Ware (% share of total sector exports)	$107 million (4%)
iii Bricks, blocks, etc (% share of total sector exports)	$2 million (3%)
iv Other (% share of total sector exports)	$2 million (3%)
Tableware	
Number of Firms	7
Direct Employment (number of people)	8,100
Installed Production Capacity (in million pieces/year)	98.20
Additional (new plants) Capacity 2010/2011	7.50
Actual Production (in million pieces/year)	73.75
Installed Production Capacity (in thousand tons/year)	39.28
Actual Production (in thousand tons/year)	29.50
Capacity Utilization	75%
Total Revenues in $ million	52
Export Market (% of total revenue)	$39 (75%)
Local Market (% of total revenue)	$13 (25%)
Tiles and Sanitary Ware	
Number of Firms	12
Direct Employment (number of people)	6,850
Installed Production Capacity, Tiles (in million square meters/year)	33.40
Actual Production, Tiles (in million square meters/year)	29.76
Capacity Utilization, Tiles	90%
Installed Production Capacity, Sanitary Ware (in thousand tons/year)	14.80
Actual Production, Sanitary Ware (in thousand tons/year)	13.10
Capacity Utilization, Sanitary Ware	90%
Total Revenues in $ million	107
Export Market (% of total revenue)	$1 (1%)
Local Market (% of total revenue)	$106 (99%)

[a] Estimate of the industry association—export figures as per end of fiscal year in June. Compiled by Global Development Solutions, LLC from industry association sources.

The ceramic tableware industry, which is the focus of this analysis, employs 8,100 people. Ceramic product exports almost doubled from $27 million in 2004 to $46 million in 2008. As can be seen from the table above, tableware exports ($41 million in 2008) contributed 90% of the overall ceramics manufacturing sector exports, yet porcelain/china for kitchenware and tableware is one of the slowest growing ceramic product segments in international trade.

In many respects, the pricing and positioning strategies of ceramics exporters from Bangladesh and other countries are influenced heavily by the market positioning of producers from the People's Republic of China (PRC), who tend to dominate low-to-medium-ending price segments where their capabilities in volume/scale, price and order consistency win buyers. Bangladeshi producers avoid that and compete instead "in the highest quality segment of decorated porcelain/bone china tableware." The problem is that while Bangladeshi porcelain/china may indeed be in the high end of the quality spectrum, export prices do not come close to the world average and the loosely-associated industry lacks any strategy to establish quality awareness and reputation internationally.

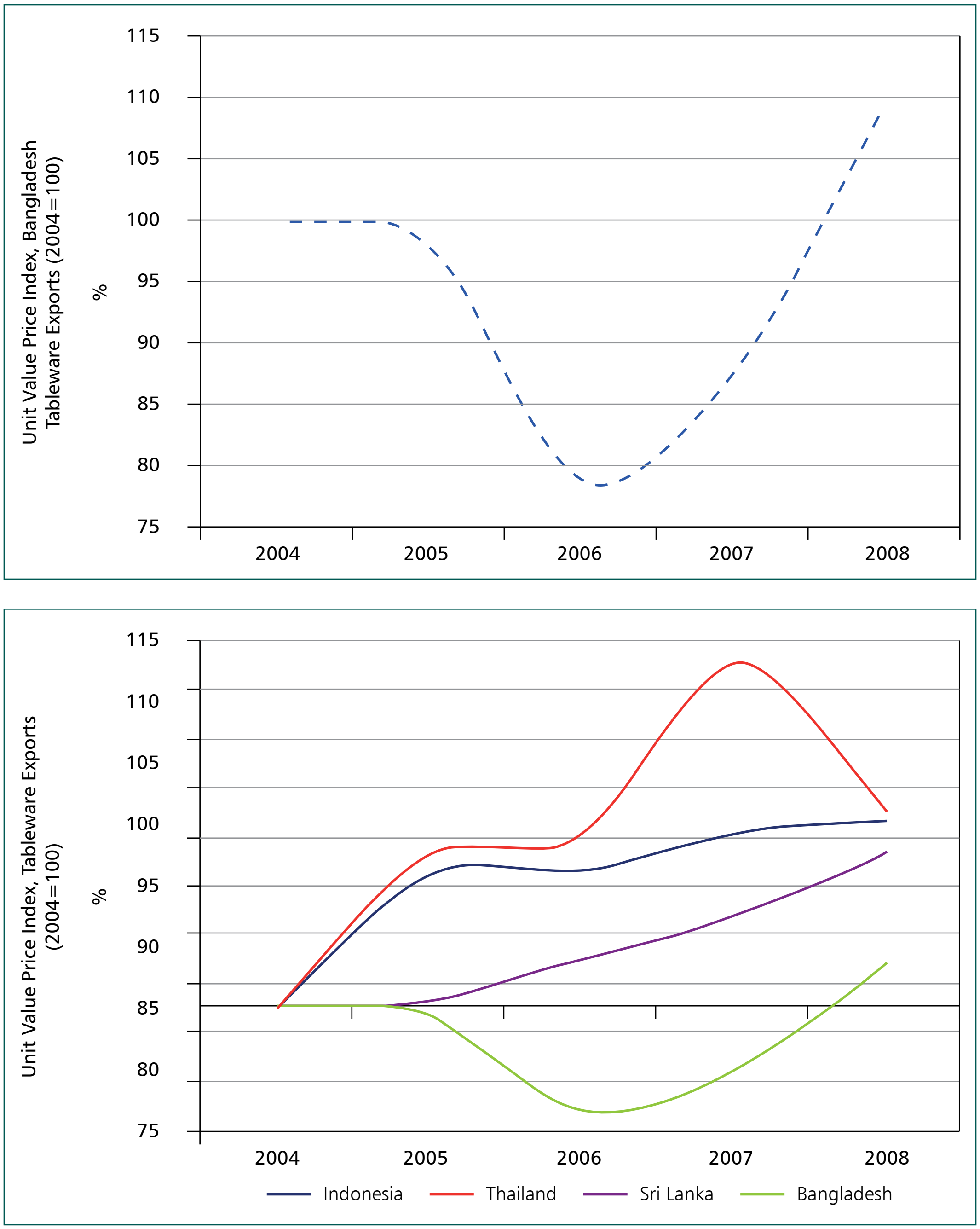
Moreover, industry executives admit that Bangladeshi exporters, due to their failure to protect their collective interests, engage in a "race-to-the bottom pricing" (see Figure 9.1), which has a debilitating effect on profitability and market image.

Also, opportunistic buyers for brand-named wholesale and retail outlets in countries such as Italy, Spain, and the US encourage price wars among Bangladeshi exporters, and take credit for quality characteristics through their own branding strategy. With the exception of few white-ware orders for IKEA, all high-end porcelain/china, such as those plated with precious metals, do not bare a "Made in Bangladesh" mark nor any other reference to Bangladesh.

Market Structure and the Supply Chain

The first notable feature of the ceramics tableware supply chain in Bangladesh illustrated below is the high concentration of exports in one market segment (the porcelain/china market segment). In addition, 70% of ceramics tableware exports from Bangladesh go to Europe. The bulk of the rest go to North America. In 2007, the Indian, East Asian, South American and Middle Eastern markets took less than 5% of the value of ceramic tableware exports.

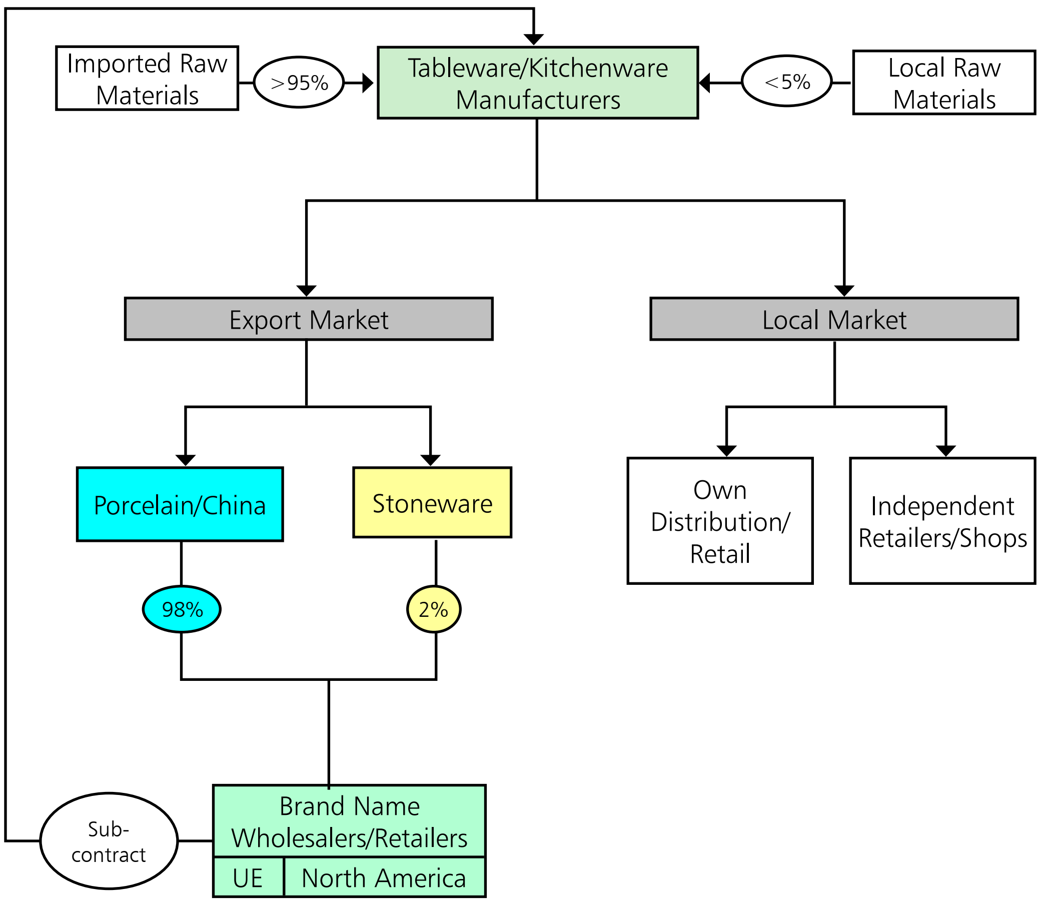
Figure 9.1 Comparative Unit Value Price Index, Ceramic Tableware



Note: Index calculated based on unit sales price of 2004 (2004 price equals 100).

Source: Compiled by Global Development Solutions LLC from Intracen.

Figure 9.2 Ceramic Tableware Supply Chain, Bangladesh



Source: Global Development Solutions, LLC.

Other features of the ceramic tableware supply chain are its heavy dependence on imported raw materials—more than 95% of all raw materials (in volume and value) are imported—and fast growth in local demand, which according to one estimate exceeds supply by over 160%. Interviews suggest that local porcelain tableware producers are unable to close the demand gap because under concessionary duties paid for capital machinery imports they are obliged to export at least 70% of production.

There appears to be a lack of interest from industry players to work together to strengthen their collective position in the global supply chain. Also, no specific public sector policies in support of the ceramics industry exist, and as in most other industries in Bangladesh (with the exception of the garments industry) ceramics exporters rely on the general export-promotion policies of the government.

The export prospects and the competitiveness of the ceramic tableware industry are challenged by a range of public sector failures, which are examined in detail in the IVCA that now follows.

Value Chain Analysis

For the purpose of this analysis, a value chain for export-quality Bangladesh ceramics, especially tableware, was prepared. Broadly, ceramics denote the manufacture of any product made from a non-metallic mineral hardened at high temperatures, including glass, earthenware, porcelain, and white-ware (non-decorated tableware). Ceramics also denote porcelain enamels, brick tiles and terracotta, refractories, cement, lime and gypsum and certain abrasives.

Household ceramic applications generally fall within a definition of pottery, with applications in tableware and kitchenware, sanitary ware—sinks and toilets—and tiles. The focus of this value chain is tableware made of porcelain.

The value chain for decorated porcelain tableware can be divided into eight key value adding activities:

- Raw material intake, inspection, and mixture preparation;
- Molding or casting, depending on tableware product;
- Biscuit drying and firing;
- Glazing and gloss firing;
- Decorating and firing (decorating may not be performed, depending on tableware, in which case ceramics is moved from gloss kiln to finishing and packing);
- Finishing and packing;
- Transport to market; and
- Administration and overheads.

Typically, the process starts with the intake of imported raw materials which are inspected at the stone yard and moved to mixture preparation stages of production.[26] The primary materials for ceramic products are white clay and sand. The largest deposit of white clay in

[26] Mixture preparation is considered to be one the key elements of a pottery maker that is generally guarded with the highest degree of secrecy among producers.

Clay Forming Process

Bangladesh was discovered in 1957 at Bijoypur of Mymensingh. The total reserve of white clay from this region is estimated to be 2.57 million tons. Clay was also found in Jaflong (of Sylhet) but there is no clay or sand treatment plant at these locations. This is why about 95% of raw materials for making quality and exportable ceramic products in Bangladesh are imported from abroad, mainly from India, Japan, Germany, New Zealand, Republic of Korea, Thailand, and the PRC.

The inspected raw material mixtures are put in molds or casts, depending on specifications provided by the customer. After quality control inspections, ceramics pieces are placed on a conveyor belt which directs the ceramic pieces into a dryer. Following the drying period, ceramic pieces are placed on yet another conveyor belt to a finishing machine where edges and surface are smoothed out. The ceramic pieces are then ready for "biscuit" firing in a kiln.

Once the pieces, which are referred to as "biscuit ware" have been glazed, they must be fired again—commonly referred to as gloss firing. Depending on specifications provided by the customer, the fired glazed biscuit ware may end up directly in the finishing department

Box 9.1 Quality Finish

Most of the costs at the decoration stage (73%) are associated with the cost of imported decoration materials which are beyond the control of producers. The rest of the cost structure (27%) is associated with labor, energy, and maintenance costs. Labor is relatively inexpensive ($35–$65 per month for line workers), machinery is modern in most plants (state-of-the art in some), and waste levels are comparable with leading producers in locations such as the UK.

	UK %	Bangladesh %
Green bodies - recyclable	5	5
Green bodies - scrap	2	5
Biscuit	10	12
Glaze	10	12
Average manufacturing waste	22	29

Source: Global Development Solutions, LLC from Industry sources.

Depending on the amount and type of decorations, production costs range from $1,500 per ton (for simple styles with limited amount of decoration or shape complexity) to over $3,000 per ton for complex pieces with high content of precious metal decorations and enamels (gold, platinum, etc.).[a]

[a] Porcelain tableware is typically quoted on a per-piece basis based on standard sets such 52-piece sets. Depending on type, prices range from $1 (IKEA-type white porcelain) to over $10 per piece (brand-name catalogue pieces with precious metal rim decorations).

Biscuit Drying and Finishing

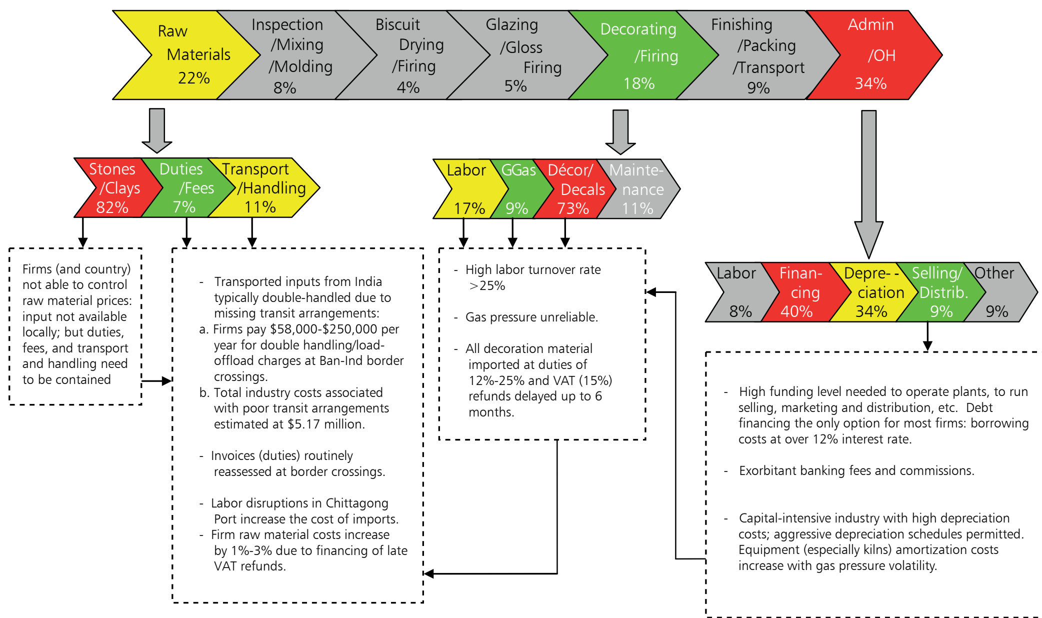
Finished Decorated Porcelain

or channeled to a decorating unit where decorations and/or artwork such as painting and decals are introduced—after which they are fired again.[27]

Once cleaning, polish and inspections are completed, the finished porcelain/china is sent to the packing department where export products are packaged and loaded onto trucks for shipments via Chittagong Port.

An integrated value chain analysis for exportable porcelain tableware shows that for an average production mix,[28] administration and overhead costs dominate the value chain with 34% of total costs, followed by raw materials (22%) and decoration and decoration firing (18%).

Figure 9.3 Value Chain for Porcelain Tableware, Bangladesh



Source: Global Development Solutions LLC.

Value Chain Challenges for Ceramic Tableware Exporters

According to the IVCA, political instability as well as unreliable gas pressures from public utilities are major bottlenecks.

Political instability has a detrimental effect on the industry's expansion prospects. Unlike labor-intensive industries, setting up and running a modest ceramics plant (8–10 tons daily production) requires significant fixed investments (at least $6 million) that require a

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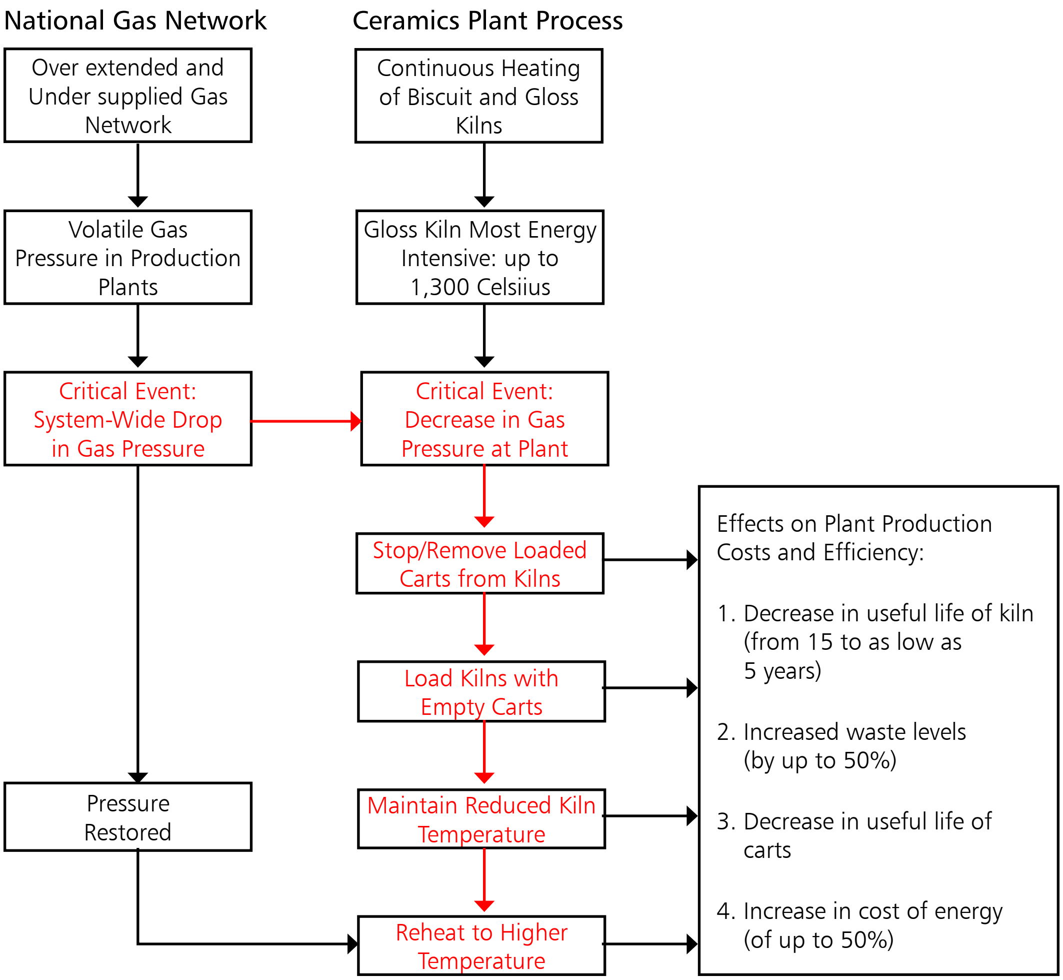
[27] Depending on type of technology used, firing parameters such as temperature and especially duration may vary significantly (up to 48 hours for Japanese kilns and as little as 22 hours for Italian kilns)

[28] The mix includes a range of products (decorated, non-decorated, hollow-ware, flatware, etc).

stable political environment.[29] Even though most of the existing producers have significant expansion plans, they report that political instability is crippling their expansion prospects.

Notwithstanding its low price, the quality of the gas supply is reported by some observers of the industry as a significant bottleneck. Due to high demand and poor infrastructure, gas pressure in the pipeline is extremely volatile. According to interviews, most tableware exporters are lucky enough to have plants in areas around Dhaka, where gas pressure is steady most of the time, but gas pressure remains volatile and all factories retain costly industrial back-up generators.

Figure 9.4 Gas Pressure Impact on Ceramic Production Process



Source: Global Development Solutions LLC.

29 According to BCWMA, an estimated $350 million is invested in the ceramics industry as of 2010 (upgrades and expansions of original plants included).

At any given time on the factory floor, multiple kilns run simultaneously firing biscuit, gloss, and decoration. Unlike decoration/printing presses that are powered by generators and can be turned on/off at any time, decoration as well as biscuit and gloss firing kilns need to run constantly during production cycles. They also cannot be shut down at will and need to cool off gradually (by loading empty carts) until pressure returns to normal. As a result, major losses are incurred in the short term (increased waste levels) and long term (faster kiln and cart amortization)—see figure 9.4. Improvements in the gas distribution network are therefore anticipated to improve the competitiveness of the industry.

Some other major bottlenecks identified by the IVCA are:

Delayed VAT refunds and high import duties: Due to a combination of factors such as corruption and poor administrative capacity, ceramics exporters in Bangladesh report delays of up to 6 months in receiving their VAT refunds, which costs around 1 to 3% of raw materials. Newly established firms typically will have to hire two or three people at the beginning of operations to constantly manage the VAT account with government officials and pay unofficial fees of up to 20% of the refund value to expedite the refunds.

In addition, the cost of raw materials is increased by duties, and imports inspections. Even though duties on most raw materials are relatively low (7%), ceramics producers question the rational of having duties on materials that are not available locally. Data suggests too that invoice values are routinely reassessed by customs officers to prevent under-invoicing. As a result, the actual burden of duties and taxes paid by ceramics producers for raw material imports is estimated to be 15% higher than the nominal rate of such taxes (see table below). In this context, modernization of the customs infrastructure that would enable customs officers to access up-to-date information on customs valuation of goods is anticipated to increase the transparency and fairness in invoice reassessments.

Table 9.2 Nominal vs. Actual Duties, Minerals Import, Bangladesh

Duties and other Charges[a]	Nominal %	Actual %
Customs Duty	7	7.66
Value added tax (VAT)	15	17.57
Pre Shipment Inspection (PSI)	1	1.30
Total Charges[a]	**26**	**29.81**
% Increase (Actual/Nominal)		15

[a] On Invoice Value.

Source: Global Development Solutions, LLC.

Dependency on imported raw materials: Producers recognize that in the short term they, as well as policy makers in Bangladesh, can do very little if anything to control how minerals are priced internationally. At the same time, according to producers, major cost-containment measures can be implemented in areas related to how minerals are moved and taxed.

Complete dependency on imports generates typical problems with price and supply volatility related to fluctuations in international mineral prices as well as in exchange rates. According to findings from the IVCA, 18% of the total raw material costs are associated with the transport, handling and duty charges of minerals. This suggests that there could indeed be room for intervention to reduce these costs, which is anticipated to reduce the contribution of raw material prices (22% of the value chain) on the overall production costs.

A closer look at transportation costs suggests that importing raw materials through land (from India) or sea (other Asian countries) is hindered by significant transaction/handling costs. When raw materials are imported from neighboring India overland, transportation and handling charges increase their prices by an average of 17%. Since India and Bangladesh do not have transit arrangements, Indian shipments must be offloaded then reloaded onto Bangladeshi trucks at crossing points such as Benapol. This inefficiency increases the raw material prices by an average of 7%, which is nearly the same as the cost of overland transport from the border to Dhaka, a distance of about 300 km (see table below).

Table 9.3 Raw Material Imports from India, Transaction Costs, 2009

Item	$/ton	% of Raw Material Price	% of Total Price
Raw Material Price (Weight Average), FOB Benapol	200.46	100	79
Duties/Fees		9	7
Customs Duty	15.36		6
Value Added Tax (VAT)[a]	1.80		1
Advanced Income Tax (AIT)[b]	–		0
PSI	2.61	1	1
Handling/Transport Benapol-Factory		17	13
Offloading/Loading Charges, Benapol/Bumra	13.60	7	5
Overland Transport	14.00	7	6
Offloading, Factory	6.52	7	3
Total Charges[a]	254.35	29.81	100

[a] This VAT figure represents carrying cost 6 months (delayed) refund at 12% APR. Actual VAT at 15% paid upon import of raw materials.

[b] AIT counts towards tax payment - not included in VCA hence left out. Actual AIT at 3% paid upon import of raw materials.

Source: Global Development Solutions, LLC.

When raw materials are imported from Southeast Asian and other countries via sea freight, supply chain inefficiencies still exist but revolve around under-handling rather than over-handling. The table below illustrates a cost and freight (C&F) bill for a shipment of plaster of Paris from Thailand coming via Chittagong Port. It can be seen that this particular shipment was stuck at the port for 39 days. At the time of shipment, a 5-day holiday was in effect which resulted in backlogs and clearance/processing delays. The port charges associated with these delays cost firms an estimated $38 per ton; a full quarter of all costs associated with moving a TEU from Chittagong to Dhaka. Importers admit that delays of this magnitude occur less frequently than in the past (a few times every year), but shorter delays (of few days) are still pervasive and Chittagong Port operations continues to disrupt firm supply chains.

Inadequate foreign commercial/trade office support in new markets: Bangladesh has 10 trade/commercial offices abroad. Interviews with ceramics exporters suggest that not only do these official trade support missions provide very little to no actual support to exporters,

Table 9.4 Plaster of Paris Import from Thailand, Transaction Costs, 2009

Plaster of paris Jan-09 $ Forex 70.8				
Nweight 21,488				
Gweight 21,000				
Pkgs 840				
Containe 1x20”				
C&F Bill (CTG)	**Taka**	**$**	**$/ton**	**% of Total**
Bank verify	100	1	0.07	0
Customs duty, DF VAT, charges as per B/E and assessment notice	123,368	1,742	82.98	58
Customs Development Charge	70	1	0.05	0
River dues and port charges (shed bill) 39 days demurrage	56,265	795	37.84	26
NOC Charges	23,964	338	16.12	11
Shipping charges	5,000	71	3.36	2
Noting, assessment, examination, delivery etc., customs	–	–	–	
Port expenses for delivery	2,000	28	1.35	1
Merchant labor	3,000	42	2.02	1
Agency commission at 0.25% on assessable value (minimum)	213,767	3,019	144	100

Source: Interviews, Global Development Solutions, LLC.

they are mostly concentrated in Europe where Bangladeshi commercial ties are already established. No official trade missions exist in growing markets such as Latin America, Africa, and the Middle East where Bangladeshi exporters have little presence and need the most support to open new markets.

Inadequate testing/accreditation regime: Most importers of Bangladeshi ceramics products require some tests/certificates, such as the typical test for lead/cadmium leaching. Two laboratories in Bangladesh can perform these tests: Bangladesh Standards and Testing Institution (BSTI) and Institute of Glass and Ceramic Research and Testing (IGCRT).

Interviews suggest that it may take BSTI as much as 22 days to deliver a leaching test certificate to exporters, which is why exporters generally use either IGCRT (which typically delivers such a certificate within 72 hours) or laboratories located abroad (e.g., Singapore, Hong Kong, China etc.) in cases when importers require accredited testers. IGCRT, however, is not accredited. The accreditation board is within BSTI, and interviews suggest that BSTI and IGCRT do not have any working relationship to address accreditation or other research-related issues. IGCRT is part of the Bangladesh Council of Scientific and Industrial Research and is an institution that has the potential to perform valuable research to the ceramics industry since it has testing facilities appropriate for the industry.

High overheads, dominated by financing charges: The highest and dominant cost component of the value chain in terms of administration and overheads is the cost of financing (40%), followed by depreciation (34%), and selling/marketing and distribution (9%).

Interviews with private sector enterprises in Bangladesh suggest that there is a great deal of frustration stemming from lending rates, banking charges and fees. Bangladesh has multiple layers of banks, among which the entrenched nationalized commercial banks (referred to below as NCBs) and government-owned specialized banks (SBs) have a stable customer base among public enterprises. Foreign commercial banks (FCBs) and private commercial banks (PCBs), including Islamic banks, also play an important role, and exercise a great degree of market power.

The interest-rate spread (6%–8% depending on lending type) is considered by many observers of the sector to be hurting industrial and export development in the country. High administrative cost, market power, and inefficiency in the management of banks are considered the main reasons behind the wide interest-rate spreads in the country.

The value chain analysis shows that fees such as bank charges and commissions constitute 13% of total financing charges, or 5% of total overhead costs (see the table below). To put this into context, for a typical ceramics tableware producer with 600–800 workers on the production line, bank charges and commissions paid during a year are equal to its wage bill for all its manufacturing labor.

Table 9.5 Overhead Charges, Ceramics Tableware Production

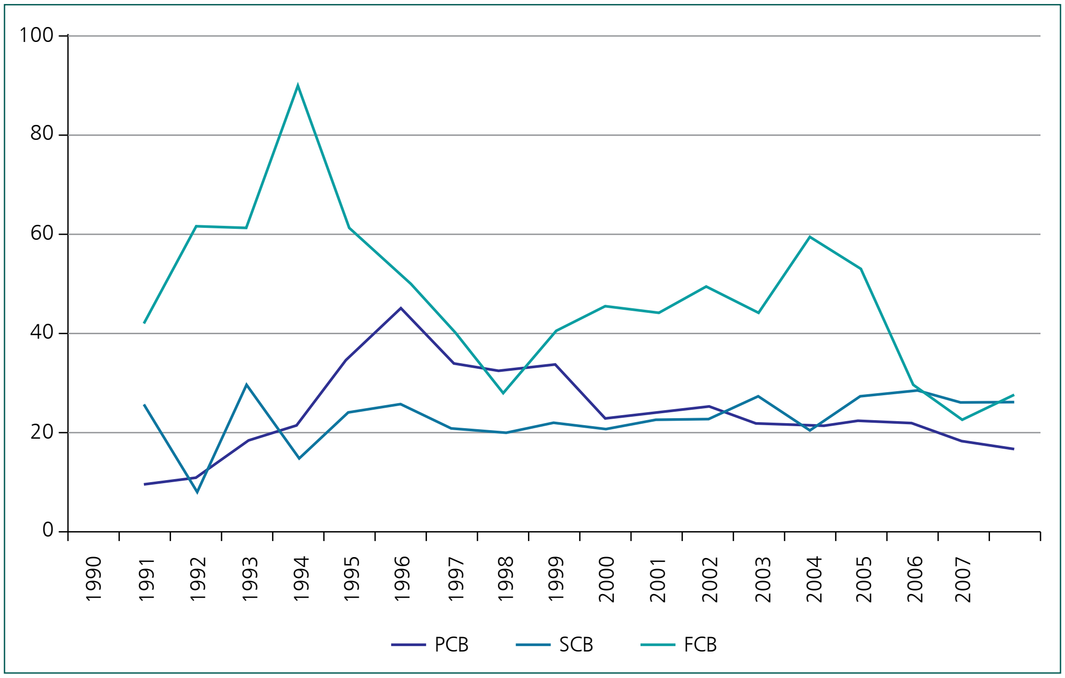
	% Share of Admin/OH	% Share of Finance Charges
Financing Charges	40	87
Interest	35	13
Bank Charges, Commissions	5	
Depreciation	34	
Export Processing/Selling/Advertising	9	
Salaries	8	
Vehicles, Fuel/Maintenance	1	
Rent, Insurance, Other	8	
Total	100	100

Source: Global Development Solutions, LLC.

Producers find these charges exorbitant and call for tighter oversight on commissions and fees charged by banks. The figure below shows that these fees have decreased over the years but are still high (18%–26% of interest income of all banks).

The key private and public sector barriers in the country's ceramics sector are summarized in the table below.

Figure 9.5 Commissions and Fees as % of Interest Income, Bangladesh



Source: Bangladesh Institute of Development Studies.

Table 9.6 Summary of Barriers to Competitiveness—Bangladesh

Issues	Public Sector	Private Sector
Political instability	X	
Delayed VAT refunds	X	
Unreliable gas pressure from utilities	X	
Inadequate testing/accreditation regime	X	
Missing transit arrangements with India: high cross-border transaction/handling costs of raw materials	X	
Exorbitant commissions and fees on finance	X	X
Inadequate foreign commercial/trade office support; limited to no presence in growing markets of South America, India, and East Asia	X	X
Extremely weak cooperation and coordination within industry—industry association only in name. Race-to-the-bottom pricing between producers		X
Porcelain/china tableware market positioning potentially weak		X

Source: Global Development Solutions, LLC.

10

Medicinal Plants Value Chain in Bhutan and Nepal

Using seabuckthorn juice as a proxy, value chain analysis highlights the key barriers to competitiveness in the medicinal plants sector for both Bhutan and Nepal. Seabuckthorn in those countries and India is neither researched nor developed and is generally unknown in the marketplace. In contrast, PRC and Russia are at the forefront of rapidly growing research and development in wide-ranging applications for the pervasive Eurasian plant.

Bhutan is recognized as "Men-Jong," or "The Land of Medicinal Plants" for its wealth of medicinal species and long history of use. In the context of developing this market potential at home, the Bhutan government's Institute of Traditional Medicinal Services (ITMS) undertook a field visit to Ladakh in India in 1999. After a few unsuccessful trials to make seabuckthorn juice, ITMS discontinued its attempts to assess the plant's juice commercialization potential. While only a few hundred kilograms of seabuckthorn are used annually—as an ingredient in a post-trauma recovery medicine—other plants, such as lemongrass, pipla, ginger, and turmeric, are commercially used, albeit in limited volumes.

Box 10.1 Seabuckthorn

Seabuckthorn is native to Eurasia and has been known and used by humans for centuries. The natural distribution of seabuckthorn reaches in Eurasia from PRC, the Altai region (in Russia and Kazakhstan), the Hindukush-Himalaya region (India, Nepal, Pakistan), the Carpathians until the Alps and Pyrenees. A second band reaches the riparian states of the North and Baltic Seas from northwest France and southeast England until Lithuania, Estonia, Finland and Norway.

Plants typically grow 2–4 meters tall, although some in PRC have reached 18 meters, and others grow no higher than 50 centimeters. There are both male and female plants; the latter develop berries that are round to almost egg-shaped, and up to 1 centimeter long. The fruit is usually orange, but fruits are also found in yellow and red. Unlike the majority of fruits that fall away from the maternal plant at maturity, the seabuckthorn berries remain on the bushes all winter until eaten by birds or other animals. The fruits have a distinctive sour taste and a unique aroma reminiscent of pineapple.

In Nepal, the seabuckthorn plant grows abundantly in its natural high altitude habitat. Only few attempts have been made to commercially exploit this natural resource, and these have been in the area of juice production.

Seabuckthorn, however, is considered internationally as having great potential. Rarely is there a plant similar to seabuckthorn in its range of applications, and almost full root-to-leaf possible commercial use.

Background

During the last several decades, seabuckthorn has attracted special attention and domestication efforts in many countries as it has diverse commercial applications with multiple benefits. With nitrogen fixing properties, seabuckthorn is a pioneer plant which readily grows in poor sandy soils. It can tolerate high pH levels, extreme temperatures and salinity. In PRC, more than 90% of the cultivated seabuckthorn is used for protection against water and wind erosion, and to recover degraded soils.

Seabuckthorn berries are among the most vitamin-rich fruits, with studies confirming numerous benefits and more than 190 bioactive compounds. The berries appear to be an unsurpassed natural source of essential oils, vitamin C, pro-vitamin A (carotene), tocopherols (e.g. vitamin E) and flavonoids (e.g. vitamin P-active bio flavonoids). They are rich in several other vitamins, including B1, B2, B3, B9, F and K as well as fruit acids and minerals.

The berries also contain numerous microelements and have a remarkably high content of essential fatty acids (e.g. unsaturated fatty acids like Omega 3), phytosterols and vegetable oils which make seabuckthorn increasingly interesting for the pharmaceutical, cosmetics, and functional foods industries.

Table 10.1 summarizes broadly the possible uses of the seabuckthorn plant.

Commercial cultivation and exploitation has not been developed to any significant scale in most European and Asian countries due to a lack of know-how in harvesting and processing technologies, and market-oriented product development.

Over 95% of all seabuckthorn in the world is found in PRC, where the area under seabuckthorn is vast, at more than 1.5 million hectares. The seabuckthorn industry there is a fully integrated and developed supply chain of growers, semi-finished and finished goods producers. The number of patent applications related to seabuckthorn tripled from approximately 100 (from 1995 to 1999) to over 300 in the first 6 years of the century—almost 90% of these patent applications come from Russia and PRC.

As can be seen from the figure above, PRC and Germany have the widest range of semi-finished products while Russia and neighboring countries concentrate mainly on pulp oil. Seabuckthorn juice has the highest market value in total but on a per unit basis, it is one of the cheapest semi-finished products. The global average selling price in 2006 was less than $1 per kilogram, compared to seabuckthorn oils that sold for as much as $130 per kilogram.

Semi-finished products are turned into finished products dedicated to three main market segments: food, cosmetics and pharmaceuticals. Information on finished seabuckthorn

Table 10.1 Seabuckthorn Plant Parts and Their Uses

Plant Part	Possible Uses		
Bark	Pharmaceuticals Cosmetics		
Leaves	Pharmaceuticals Cosmetics Tea Animal Feeds		
Fruits	Volatile Oil	→ Pharmaceuticals → Drinks → Food	
	Juice	→ Sports Drinks → Health Drinks → Ternary Juice	→ Food → Beverages → Brewery
	Pulp	→ Oil	→ Pharmaceuticals → Cosmetics
		→ Residues	→ Pigment → Animal Feeds
Seeds	Oil	→ Pharmaceuticals → Cosmetics	→
	Residues	→ Animal Feeds	→
Roots	Soil conservation, soil erosion, land reclamation		

Source: Li and Beveridge, National Research Council Canada.

Table 10.2 Average Annual Production of Seabuckthorn Semi-Finished Products in Eurasia, 2006

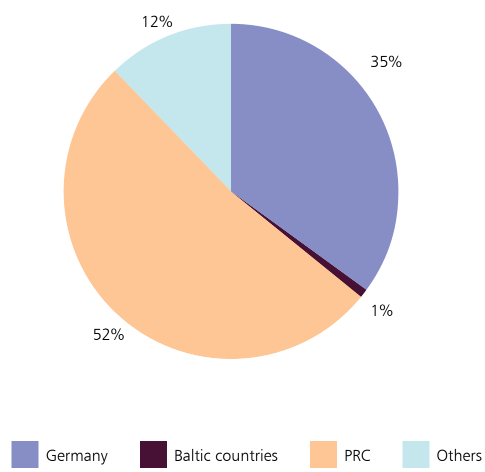
Production in Tons	Germany	Baltic	PRC	Russian Federation (including NIS)	Others	Total Eurasia (tons)	$ million	Average Price $kg
Seabuckthorn juice	120	420	12,000	162	115	12,817	10.88	1
Seabuckthorn puree (pulp)	480	300	3,000		35	3,815	4.43	1
Seabuckthorn juice concentrate	13	10	300	50	8	381	1.54	4
Seabuckthorn juice powder	6		300			306	6.47	21
Seabuckthorn seeds	35	20	350	33	13	451	1.04	2
Seabuckthorn dried skins	11	10		5	2	28	0.11	4
Seabuckthorn pulp oil								
CO_2-extracted	1		20		5	26	1.97	76
centrifuged	4	10	34	70	3	120	8.42	70
solvent extraction				3		3	0.15	59
Seabuckthorn seed oil								
CO_2-extracted	1		30		5	36	3.28	91
cold pressed	1		25		2	28	2.14	78
solvent extraction			50			50	3.18	64
Seabuckthorn dried leaves	1	3	600			604	1.94	3
Flavone powder			5			5	7.42	1,483
Seabuckthorn pomace dried	60	10	600		15	685	0.21	0.5
Total							53.14	

Source: Compiled from EAN-SEABUCK.

products market (all three segments) is scarce, especially in relation to cosmetics and pharmaceuticals. The general features of the market, however, are fairly well known. The market size is estimated at $300 million–$350 million in annual sales. Roughly half is represented by raw juice sales, largely dominated by Chinese producers for the Asian market. The other half of the market is in cosmetics, dominated by German producers for the European market.

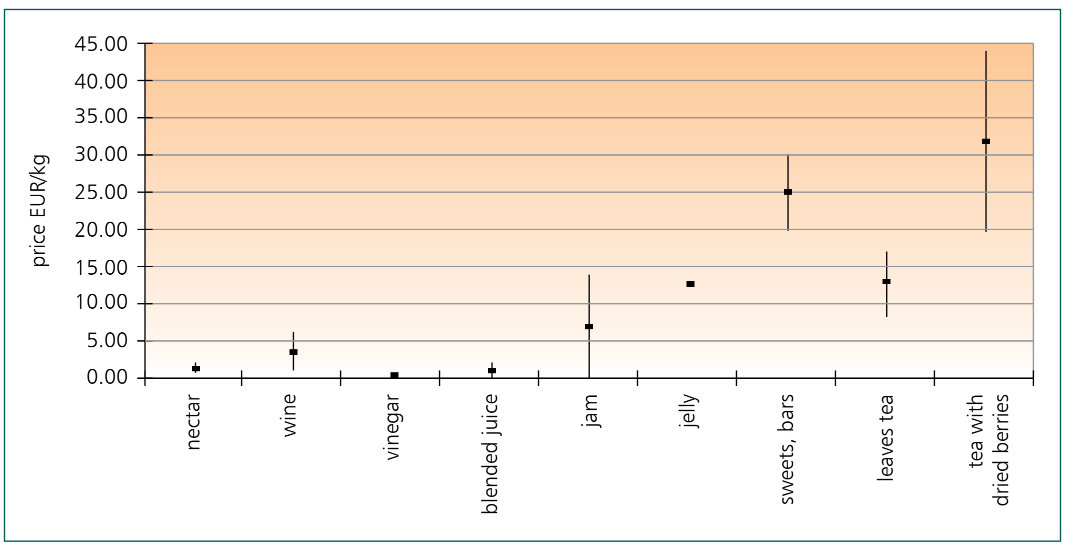
Table 10.3 Seabuckthorn Final Products' Market Value and Market Share by Country, 2006

Seabuckthorn Product	Annual Turnover ($ million)
Raw Juice (100%)	**125.56**
Nectar	4.11
Wine	0.48
Vinegar	0.34
Blended Juice	3.87
Jam	3.57
Jelly	0.15
Sweets, Bars	0.40
Tea	1.11
Cosmetics	**119.95**
Cremes	52.07
Lotions	26.92
Other	40.95
Nutraceuticals	**23.95**
Flavone powder capsules	4.24
Pulp Oil Capsules	5.08
Seed Oil Capsules	14.60
Fruit Powder Capsules	0.04
Syrup	3.03
Total	**286.50**



Compiled by Global Development Solutions from EAN-SEABUCK.

Figure 10.1 Price Range of Seabuckthorn Finished Products, 2006



Source: EAN-SEABUCK.

Chinese producers have been so successful in promoting seabuckthorn juice that some Asian markets fetch prices as high as $130 for one kilogram in specialty stores, where seabuckthorn juice is sold in 30 ml bottles as a health drink. The price range of juice reported in 2006 was extremely wide (at $1.50/kg to $120kg) which could be the result, among other things, of different marketing strategies utilized by producers in various markets/countries. With appropriate technologies, cost structures, and proper marketing, producers of seabuckthorn juice have significant price ranges with which to work and position themselves in markets.

Nepal: Seabuckthorn Supply Chain and Market Profile

Two seabuckthorn species, *H. salicifolia* and *H. tibetana*, can be found in the Nepalese Himalayas. Seabuckthorn is one of the least known plants in the country. The only attempts to reverse the underutilization of the plant in Nepal have generally come from the nongovernment organizations (NGOs) and donor communities. Through such organizations' interventions in promoting cultivation, proper harvesting, as well as market and other linkages, the first steps of seabuckthorn utilization in Nepal began in few regions—mainly in the mid-western parts of the country in 2004–2006.

In Humla, Mugu, Jumla, Dolpa, Mustang and the easternmost Taplejung region, projects were set up to collect wild berries and extract juice with the idea of promoting sales in Kathmandu, and among trekking tourists. As an example, an initiative to arrange for forest-to-market linkages was started in 2008 through a combination of donor and private sector support for collection and sales of seabuckthorn berries from the wild. At least 1,000 collectors and juice-pressers from five regions were encouraged to make forward contract arrangements with a Nepalese juice maker for about 4,000 liters of raw juice. Unfortunately, only 400 liters from one region were delivered in 2009 and the juice company exited the seabuckthorn market.

These types of market linkages and other related failures appear to have stunted the emergence of a proper seabuckthorn sector in Nepal. Only one small company still bottles seabuckthorn juice on a commercial basis. Bottling of seabuckthorn juice also takes place in Mustang through farmers' cooperatives set up by a local NGO. With the exception of these two limited operations, however, no other commercial, research, or any other activity related to seabuckthorn exists in Nepal.

No market structure and/or supply chain of seabuckthorn can be discerned in Nepal. There is no market for berries, raw juice, or other seabuckthorn intermediary inputs in the supply chain. Consequently, price and other signals such as quality and reliability for such products are not readily formed in the marketplace. Also, the quantities of seabuckthorn collected in the wild are limited and unpredictable Therefore, the supply chain schematic presented below is a stylized presentation of a discrete supply channel of seabuckthorn from Mustang to supermarkets in Kathmandu rather than an established countrywide supply chain.

The predominant features of this supply channel are:

- Generally poor hygienic environment during berry harvesting, transportation and processing in juicing facilities.
- Raw juice is typically extracted manually in household backyards with very rudimentary facilities. Manual presses are also used but their berry-to-juice yield is typically low (40%–50%) compared to modern electronic presses (over 70% berry-to-juice yields).
- Pulp, seed, leaves, and other juicing byproducts are typically discarded.

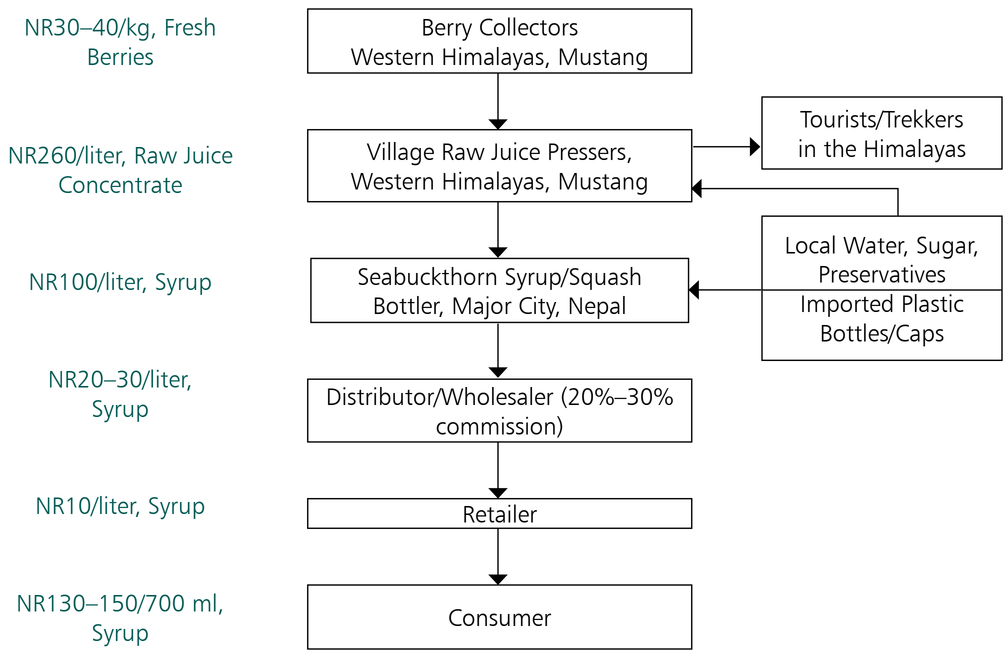
Table 10.4 Nepal Seabuckthorn Profile, 2010

A. Commercial Firms or Local Cooperatives Involved in:	
Growing/Cultivation	0
Juice Making/Bottling	2
Oil extraction	1
Functional Foods, Pharmaceuticals, Cosmetics	0
B. Direct Employment	<100
C. Indirect Employment	<1,000
D. Sales Revenues	Not Available
E. Exports ($/year)	
Berries	0
Juice	0
Oils[a]	<$10,000
Functional Foods, Pharmaceuticals, Cosmetics	0

[a] Estimate from formal and informal operations in Mustang area. Work involves mainly seasonal (one to two months) picking labor and some involvement in juice making. Exports values of oils are rough estimates and should not be used for investment decisions.

Source: Compiled by Global Development Solutions, LLC from industry association sources.

Figure 10.2 Seabuckthorn from Mustang Forest to Kathmandu Supermarket



Source: Global Development Solutions, LLC.

- Packaging materials are typically imported from India. Packaging is generally of poor quality, especially in relation to plastic bottles, caps as well as labels.
- The juice/syrup making process is rudimentary and sedimentation of pulp in the finished product is typical—such sedimentation does not generally affect taste but is visually unpleasant and requires shaking before consumption.

Value Chain Analysis

For the purpose of this analysis, a value chain for export-quality seabuckthorn fruit juice in a concentrated syrup form was prepared. This is the type of juice that is currently produced for a local market in Nepal, but it is also typically produced in the world market.

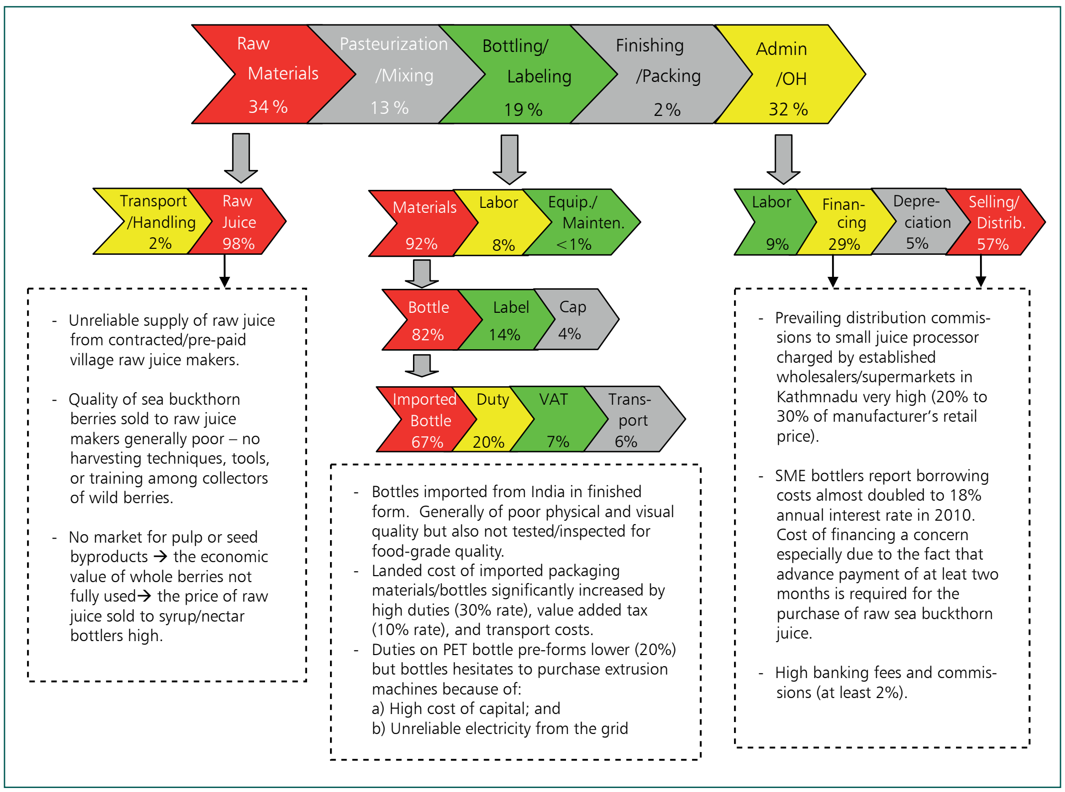
The value chain for seabuckthorn juice in Nepal can be divided into five value-adding activities:

- Raw material intake;
- Pasteurization/filtering and mixture preparation;
- Bottling, including labeling;
- Packing and branding;
- Administration and overheads.

Typically, the production process starts with the intake of seabuckthorn raw materials. In the illustrated case, which is typical for small scale seabuckthorn syrup makers in Nepal, the raw material is the raw seabuckthorn juice.[30] The raw juice is made by farmers in rural communities who source wild berries from local collectors and then either press them manually without any machinery or use mechanical presses to extract it. In most cases, the pulp and seed byproducts are discarded since there is no market for them in the country.[31]

The raw juice is then transported from the highlands to bottling plant where it is mixed with boiled water, sugar, and preservatives and is ready for bottling. Bottles, which are typically imported from India, are washed and manually filled after which labels and caps are attached. The filled and labeled bottles are then packed in carton boxes and sold to distributors in Kathmandu. An integrated value chain analysis for locally sold seabuckthorn syrup juice was undertaken in Nepal (see figure below).

Figure 10.3 Value Chain for Local Seabuckthorn Juice (Syrup), Nepal



Source: Global Development Solutions, LLC.

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30 A small-scale seabuckthorn juice bottler in Nepal is typically a household backyard operation processing 10kg–50kg of berries per day for approximately 3–4 months when fresh berries are available in the market (September to December)—the annual juice output of not more than 3,000 liters. A medium size bottler in Nepal can bottle up to 100,000 liters per year.

31 Only one NGO-run farmers' cooperative association in Mustang uses pulp and seeds for exports to Germany.

The IVCA shows that at an estimated production cost of NR (Nepalese Rupees) 102 per 700 ml, the cost of sourcing raw juice dominates the value chain at 34%, followed by administration and overhead costs (32%), and bottling costs (19%).

Value Chain Challenges for Seabuckthorn in Nepal

Findings from the IVCA for seabuckthorn in Nepal suggest challenges for developing the export potential include unreliable and costly raw supplies, high overheads dominated by distribution and financing charges, and the duties and taxes levied on imported packaging materials. Other operating impediments exist, and hanging over the market is the issue of competiveness due to the cost of transportation from the high Himalayas and export-processing transactions. Each of these barriers is now explored in turn.

Unreliable and costly raw juice supplies: Typically, the producer of seabuckthorn juices/nectars orders and pays in advance for a quantity of raw juice from village-based cooperatives or agents. With cash advances in hand, village cooperative sellers and/or agents contract collectors to harvest seabuckthorn berries in the wild. Interviews suggest that there are multiple problems associated with seabuckthorn berry and raw juice supplies. First, final processors, such as the seabuckthorn syrup producer illustrated in the value chain above, cannot rely on village communities for consistent supply of raw juice. Even though paid in advance, raw juice producers in the villages are typically unable to deliver sufficient quantities. For example, a seabuckthorn syrup/squash juice producer ordered 4,000 liters of raw juice from five different regions of Nepal in 2009, but only 15% of quantities ordered were delivered (see table below).

Interviews suggest volatility of raw juice supplies is related to issues such as size of operations, the economics of collection and manual pressing of wild berries, etc. Raw seabuckthorn juice producers are typically small, backyard operations whose only tools are their hands, a few meshes and buckets. These producers are typically local farmers whose primary agricultural activities are related to production of staple and/or cash crops—seabuckthorn, which grows in the wild and is not cultivated, is neither a staple nor a cash crop for them.

In 2009, the price of seabuckthorn berries delivered to buyer's gate ranged from NR30–NR40 ($0.40–$0.55) per kilogram in Dolpa, Humla, and Mugu. In Mustang, where seabuckthorn juice has recently gained popularity and is consumed by tourists along

Table 10.5 **Raw Seabuckthorn Juice Demand vs. Supply, Sample Producer Intake 2009**

Location	Quantities Ordered (liters, raw juice)	Quantities Delivered (liters, raw juice)	Undersupply (liters, raw juice) %
Humla	500	0	100
Mugu	1,000	100	90
Jumla	500	0	100
Dolpa	1,000	100	90
Taplejung	1,000	400	60
Total	4,000	600	85

Source: Interviews, Global Development Solutions, LLC.

Box 10.2 Average Annual Production of Seabuckthorn Semi-Finished Products in Eurasia, 2006

The seabuckthorn berry is difficult to harvest because it does not readily form an abscission layer and the fruit is tightly clustered on two- or three-year old, thorn-covered branches. Harvesting is done manually or with simple, hand-held tools. Manual harvesting, however, is labor intensive: approximately 1,000–1,500 hours of human labor are needed for every hectare of orchard, while for wild berries, 5-10 kilograms of berries can typically be picked per 8-hour day depending on bush/tree size and density. Mechanical fruit harvesters have also been tried in Europe and North America, with varying success. Direct harvesters can be very effective, but they usually damage the fruit or other parts of the plant. Robotic harvesters can reduce fruit damage but tend to be slow. Indirect harvesting means shaking a portion of the plant. Forces applied the trunk, branch, or foliage cause the fruit to be detached from the stem. Attempts at harvesting seabuckthorn berries have typically experienced problems of fruit damage, bark damage, and low efficiency. The concepts that have been tried include tree shakers, vacuum suction units, quick freezing units, and "whole branch harvesters."

trekking paths, berries fetched a price of up to NR70 ($1) per kilogram.[32] A liter of raw seabuckthorn juice fetched NR170–NR260 ($2.4–$3.6) in 2009. Considering the poor road infrastructure as well as the fact that harvesting of seabuckthorn berries is inherently difficult (see text box below), collection of seabuckthorn berries in the highlands of Nepal represents a relatively difficult non-forest timber product to access, harvest and transport and generates incomes that do not necessarily compensate the effort sufficiently. Interviews suggest that a seabuckthorn berry collector in the Nepali Himalayas may earn NR250–NR350 ($3.5–$4.8) for 10–12 hours work of accessing, collecting, and delivering seabuckthorn berries to buyers in urban areas.[33] By contrast, unskilled farm labor wages in Nepal are NR350–500 per day ($4.8–$7).

For some farmers/collectors, $3–$5 per day may represent a sufficient incentive to engage in berry collection. According to interviews with juice bottlers, however, sourcing sufficient quantities of seabuckthorn berries and/or of raw juice even for the smallest bottling plants is impossible. This suggests that the current economics of wild seabuckthorn in Nepal is not enticing for many collectors.

One of the critical aspects working against the economics of seabuckthorn berry collection in the wild is the fact that residues from the juice-making process have no value at all in the local market. In most cases pulp/cream and seeds are thrown away when in fact they are of equal if not higher value than the raw juice if used in pharmaceutical and/or cosmetic applications. As a result, collecting seabuckthorn only for the purpose of raw juice extraction is a suboptimal exploitation of the plant which limits its market value. In this context, wild seabuckthorn in Nepal is not likely to provide significant economic benefit to parties involved in its collection and raw juice extraction unless investments take place in businesses producing the entire range of products that can be made from the seabuckthorn plant.

[32] With the berry-to-juice extraction ratio of as low as 20% but not more than 50%, it may take as much as 3 kilograms of berries to produce a kilogram of raw juice manually. With manual mechanical presses, it typically takes 2 kilograms of berries to produce one kilogram of raw juice—but farmers in highlands typically do not have any mechanical presses.

[33] Current Nepali royalty for wild seabuckthorn berry is NR3/kg but no one is reported to collect or pay this royalty in the country.

Such investments are also a prerequisite for the emergence of commercial seabuckthorn plantations.

According to interviews, in addition to quantity, the quality of berries and juice supplied is also unreliable. Most farmers in Nepal are not trained in proper harvesting techniques, and the quality of berries is of generally poor hygienic quality. Berries often burst during collection, and storage is done in plastic containers that may not be well sanitized. The cold chain (storage, transportation) is also not available.

Costly overheads dominated by distribution and financing charges: According to the integrated value chain analysis, the second highest cost component of the chain—administration and overheads—is dominated by the cost of selling/marketing and distribution (57%), followed by the cost of financing (29%), and labor (9%).

Interviews with private sector enterprises in Nepal suggest that small scale producers pay between 20% to 30% commissions to wholesale distributors to get shelf space in major retail supermarkets in Kathmandu. Seabuckthorn producers are not an exception. In the case illustrated in the value chain diagram, the wholesalers and retailers get paid at least NR20 per bottle to distribute and stock seabuckthorn syrup juice. Interviews suggest that these commissions are at least double and in many cases three to five times higher compared with commissions paid by soft drinks and other concentrated juice producers. Since the quantities of seabuckthorn syrup/squash bottled are extremely limited compared to other drinks, wholesalers and retailers generally hesitate to carry stocks of seabuckthorn syrup in their shelves. When they do carry it, they charge high commissions to distribute and sell it.

Until and unless seabuckthorn drinks are produced in a large scale, it is difficult to anticipate any decrease in distribution and selling commissions that small scale producers have to pay to reach customers in urban areas via retail stores. One avenue to cope with the existing level of distribution/selling commissions is through marketing capacity building. Value chain interviews suggest that seabuckthorn syrup juice is priced at the same level as other fruit juices that are made from concentrates. Its health and other specialty drink benefits do not appear to be reflected in its retail price. For example, Dabur of India, which has its own bottling plants in Nepal, markets its "Real" brand of juices at prices similar to seabuckthorn syrup (NR140–NR150 per liter compared to NR130–NR150 per 700 ml for seabuckthorn syrup juice).

Although Dabur does not claim its drinks are made of fresh fruit juice, by using marketing/labeling techniques, it has been able to sell what is basically imported concentrate-based juice as "nature fresh" and "original goodness" product. By contrast, bottlers of seabuckthorn juices and syrups are typically small firms that have very limited marketing skills and/or budgets that result in potentially weak product presentation and positioning in the juice market.

This suggests that technical assistance in marketing to such firms is anticipated to increase their marketing capabilities and enable them to fully exploit any upward price potential.

Figure 10.4 **Concentrated Juice "Competing" Product to Seabuckthorn Juice, Nepal**

Dabur Nepal.

Figure 10.5 **Seabuckthorn Syrup Label, Nepal**

Global Development Solutions, LLC.

In addition to high distribution/selling commissions, the value chain suggests that a third of administrative overheads are associated with financing charges. Interviews suggest that for SMEs the situation is alarming. Many of them report being unable to borrow at annual interest rates below 15%, while some report rates of as high as 18%. When the reported banking charges and fees of 2% are added, the effective rates of 20% become an insurmountable barrier. Therefore, it is anticipated that an SME affordable finance fund in the juice processing sector is needed for the seabuckthorn and other SME processors to be able to grow and improve operations.

Imported packaging material costs: According to the value chain, bottling costs represent the third-highest portion of the value dominated by bottling material costs (92%), followed by the cost of bottling labor (8%). Since small-scale bottling is typically done manually with minimal equipment and machinery, the cost of maintenance is insignificant. The cost of the plastic bottle dominates the bottling costs with 82% share. This suggests that the ability to contain plastic bottle costs is crucial for small and medium size juice producers.

The value chain analysis suggests that one-third of the plastic bottle costs are duties, taxes, and transport charges. Producers find these charges exorbitant, especially the 30% duties on imported plastic bottles. When the 10% value-added tax and the cost of transportation are added, the cost of plastic bottles imported from India is increased by about 50%—the bulk associated with duties and taxes (see table below).

Bottlers find these duties and taxes extremely burdensome because no bottles of similar, albeit not high, quality can be found locally. Bottlers have an option to source PET pre-form bottles which have a lower (20%) intermediate raw material tariff, but none of the companies interviewed had blowing machines—according to producers, the political situation and increasing interest rates are not conducive for such investments. The same holds for companies bottling aloe vera and other herbal drinks, or those involved in packaging herbal teas and Ayurveda medicinal capsules.

Table 10.6 **Prices and Origin of Imported Minerals, Bangladesh, 2009**

Imported Plastic Bottle	NR/bottle	$/bottle	% of Import Price
Import Price, Plastic Bottle, India[a]	8.5	0.12	100
Customs Duty[b]	2.55	0.04	30
VAT[c]	0.85	0.01	10
Transport	0.75	0.01	9
TOTAL (FOB Kathmandu)	12.65	0.18	149

[a] Adjusted for on1 liter equivalent— prices vary depending on source in India.
[b] Nominal tariff for both SAARC and the rest of the world.
[c] Value Added Tax.

Source: Interviews, Global Development Solutions, LLC.

Increasing the availability of locally produced packaging materials of a price and quality required by Nepalese producers and exporters would greatly reduce the cost of doing business in the food processing industry. A detailed value chain analysis of the packaging industry in Nepal may be needed to identify the reasons behind the industry's inability to supply a range of packaging materials, including basic items such as plastic bottles and aluminum foil.

Interviews suggest producers in Nepal are unaware of duty reductions currently available to importers. Nepal provides a 7% rebate on import duties from India for items with duty rates of 25%, and a 5% rebate for items with duties above 25%; but none of the small-scale bottlers or food packing companies interviewed knew this. A campaign to raise awareness would help the food industry.

Other more general barriers on the supply-side include:

Political instability: Due to prolonged political instability in the country, export promotion policies for the food processing industry, including seabuckthorn industrial applications, are not at the top of government's agendas and interventions in Nepal. According to interviews, producers face regular labor, racketeering and other disruptions in operations which they directly link to the political instability.

Poor electricity and transport infrastructure: Power outages are a daily occurrence throughout the country. Unreliable electricity supply together with the poor transport infrastructure, especially in rural highland areas, has become a critical reason why producers shy away from making much-needed basic equipment investments. Operating a relatively modestly equipped plant is impossible without owning or having access to diesel electricity generators, while interviews suggest that this option is very costly. Substantial improvement in the reliability and affordability of electricity in Nepal is needed in order to sustain investments in basic machinery by SMEs.

Inadequate research, testing and quality control facilities: The Food Act of 1967 and the Food Regulation of 1970 govern the production, trade and marketing of food and food-related products in Nepal. A critical component in the regulatory oversight and control is the quality control and testing of the food produced and sold in the country. The Department of Food Technology and Quality Control (DFTQC) carries out this function. DFTQC performs both regulatory/oversight and research and development functions, but it is underfunded and its laboratories and equipment are in a poor state.

As illustrated by the value chain analysis, a range of issues stand in the way of seabuckthorn being fully realized for domestic market applications and products. In 2009, only three firms in a single seabuckthorn application (syrup juice) were involved in commercial production in Nepal. By 2010, only one was reported active because most firms find it hard to cope with a range of impediments that trouble SME production—not only in area of seabuckthorn processing, but also food and medicinal plant processing in general. Increasing costs of financing, costly packaging material and electricity, as well as generally poor marketing are some of the key bottlenecks that make competing in the domestic, let alone international, markets very difficult.

Table 10.7 Summary of Barriers to Competitiveness, Nepal Seabuckthorn Juice

Issues	Public Sector	Private Sector
Political instability	X	
High duties on packaging materials which are not available locally	X	
Unreliable electricity supplies	X	
Inadequate transportation infrastructure	X	
Pervasive rent seeking at customs points	X	
Inadequate testing, quality control, and research facilities	X	
High interest rates	X	X
Potentially underdeveloped packaging industry		X
Weak marketing network		X
Weak food industry association structures in general and non-existent drink bottling association in particular		X

Source: Global Development Solutions, LLC.

Box 10.3 Competiveness: The Critical Export Barrier

In addition to the issues mentioned in this chapter, the potential for exporting products originating in the Nepalese Himalayas, such as seabuckthorn and other products, is critically challenged by the cost of transportation and export processing transactions. In terms of transportation, for example, it costs an estimated $3,800 to transport a TEU (16-ton load) of seabuckthorn raw juice from Mustang to main European ports. This raw juice requires minimal packaging in the form of plastic drums and has no sanitary quality certification or organic certification. It has to go via road and rail to get to Kolkata where it is shipped first to Singapore via feeder vessel then from Singapore to Europe via main vessel. If one adds export duties, certificate of origin fees, and unofficial fees at Nepali and Indian customs, the raw juice is estimated to reach European ports at a price of $2,930 per ton. When this price is benchmarked against a Chinese quote it is evident that Nepali seabuckthorn raw juice reaches the same market at more than twice (125%) the price of the Chinese product (see table below).[a]

Table 10.8 Benchmarking Seabuckthorn Raw Juice, Nepal vs People's Republic of China

Item	$/ton		% Variance (Nepal/PRC)
	Nepal	PRC	
Raw Seabuckthorn Juice	2,400	1,100	118
Plastic Drums (200 kg)	75	–	
Transport[b]	588	205	187
Customs Charges			
Export Duty (2%)	48	–	
Certificate of Origin Fee (0.2%)	5	–	
Unofficial Fees	22	–	
Delivered Price, FOB Europe	**3,138**	**1,305**	**140**
Days, Origin to Destination	55	25	120

[b] Includes handling, freight forwarder fees, etc.
Route: Mustang to Pokhara by Road, Pokhara to Birgunj by Road, Birgunj to Kolkata Port by Rail, Kolkata Port to Singapore by Feeder Vessel, Singapore Port to European Base Port by Main Line Vessel.
Source: Global Development Solutions, LLC.

[a] The quote was valid until August 2010. It can be obtained from the author upon request by interested parties.

continued on next page

Box 10.3 *continued*

To make things worse for Nepali competitiveness, the Chinese juice comes with organic and sanitary quality certification. As the value chain analysis showed, it is evident that Nepali producers do not make full utilization of the seabuckthorn plant, which makes competition in a product like raw juice virtually impossible. Nevertheless, as the table above shows, transportation costs and associated duties, taxes, and official fees all contribute significantly to bring down the competitiveness of Nepali products. Transport-based barriers to competitiveness become even starker for exporters of specialty goods. For example, no reefer containers are available anywhere in Nepal or in the immediate neighborhood. A specialty coffee exporter, who needs such reefer TEUs, will have to spend, in addition to the charges highlighted in the table above, $2,500 per TEU bringing the container all the way from Singapore to Kolkata ($990/TEU) and then from Kolkata to Kathmandu ($1,600/TEU). In this context, it is evident that without major improvements in the reduction of transport and related charges within Nepal and across regional borders, Nepali agricultural exports are likely to struggle to compete.

Bhutan: Proxies for Seabuckthorn Production

Seabuckthorn is a relatively unknown plant in Bhutan. With the exception of specialists in the Institute of Traditional Medicinal Services (ITMS) in Thimphu, few people have ever heard about the plant.[34] The National Biodiversity Center, which is in charge of biodiversity policy and maintaining the nation's herbarium and gene bank, is also unaware of the plant and its prevalence in Bhutan. Further, neither is the plant known nor used by the private sector. Seabuckthorn berries are not collected in the wild or grown on plantations and there are no commercial applications.

As a result, an Integrated Value Chain Analysis (IVCA) of seabuckthorn juice, oils or any of its related products in Bhutan is not possible. This study will provide a general market and institutional overview of a medicinal plants value chain in Bhutan. The value chain bottlenecks of some existing food processing products will also be discussed, with the aim of informing policy makers and potential investors about the prospects of seabuckthorn in Bhutan.

One government organization, the Institute of Traditional Medicine Services (ITMS) under the Ministry of Health dominates the medicinal plants sector, sourcing more than 200 species collected or grown by farmers and setting the price of each plant annually in a list distributed to local communities.

ITMS buys an estimated Bhutanese Ngultrum (Nu) 9 million ($200,000) of medicinal raw materials each year. The money for raw materials is indirectly government-subsidized as ITMS is legally in charge of production and sale of traditional medicines at subsidized rates.[35] With the exception of a few small, private firms involved mainly in lemongrass and tea packaging, there are no other major buyers. The twin effect of ITMS being the country's biggest buyer and seller of traditional medicine at subsidized rates is the key feature of the medicinal plant supply chain in Bhutan. Interviews suggest that listed purchase prices have very little, if any, relation to market prices.

34 ITMS had researched seabuckthorn juice production in Bhutan over a decade ago. Extremely limited amounts are used in a medicinal remedy, hence there are very few people within ITMS with knowledge of the plant.

35 ITMS has also a spin-off corporation, formerly known as Pharmaceutical and Research Unit, which sells commercial products in the market.

The second feature of the supply chain is that Bhutan has relatively high labor costs compared to the region. The daily wage for unskilled labor in Bhutan is $3–$5. Even though one cannot afford much with this in Bhutan, it is double the rates charged in Nepal and India, so private firms consider this as high. Coupled with the cost of moving goods through rugged, mountainous terrains, and other logistical issues, costs along the supply chain for collecting (or growing), processing, and marketing medicinal plants are generally considered to put Bhutan at a disadvantage to other countries.

In terms of the institutional support structure, few of the many forest policies and regulations in Bhutan address issues related to Non-Timber Forest Products (NTFP). Rural people (75% of the population) use a wide range of medicinal plants and other NTFP for medicine, food, etc. Bamboo is used extensively for implements and handicrafts and many other non-wood forest products are used in the country. The Forest and Nature Conservation Act 1995 and the Forest and Nature Conservation Rules 2007 provide the legal basis for the use and management of forest resources, including NTFP.

In practice, local trade in NTFPs is informal, with only limited monitoring; a general lack of quantitative data on potential areas and volumes of NTFPs is a major obstacle to promoting sustainable trade and export. It is anticipated that the recent drafting of the National Strategy for NTFP Development in Bhutan will change this. Meanwhile, one useful source is the *Guidelines for Identification and Collection of Medicinal Plants in Bhutan*, published in 2008 by the Department of Agriculture.

The guidelines can help interested communities determine what species to grow, but supporting services such as extension support related to NTFPs in Bhutan does not exist. In 2009, the MoA created the *Biodiversity Action Plan* (BAP), which touches upon the need for sustainable NTPF management, but does not outline specific actions related to the sector.

In terms of promotion of NTFP-based exports, the primary concern of the government is in the area of conservation; there are no specific export promotion policies for the medicinal plants sector. Every economic development policy in the country is subordinate to the concept of Gross National Happiness (GNH). One of its tenets is that economic development goals are considered only after conservation and sustainable development objectives are met. As stated in the BAP, "*the Action Plan takes into account the potential to use our biodiversity as an asset for socio-economic development but in a manner that is within limits of sustainability and without impairing the ecological and spiritual values of the natural environment*."

In terms of food regulatory agencies, the Bhutan Agriculture and Food Regulatory Authority (BAFRA) is the institution in charge of overseeing the implementation of the Food Act of Bhutan 2005 and the Food Rules and Regulations of Bhutan 2007. Established in 2000, the agency is responsible for food quality and safety in Bhutan. It also coordinates and liaises with other national, regional and international agencies that are related to regulation of quality and safety of agricultural products including foods. BAFRA also carries out inspection and certification of agricultural goods and products, and foods.

For any import or export of agricultural goods and foods, the necessary permit must be obtained from BAFRA prior to undertaking any import or export transactions. Similarly, for the transport of plants and their products within the country, an in-country movement permit (locally referred to as *chalan*) must be obtained. Bhutan also has one National Quality Control Laboratory with a food, seed and veterinary laboratory.

Maximizing the Seabuckthorn Value Chain in Bhutan

Unlike Nepal, Bhutan has no major infrastructural bottlenecks such as unreliable electricity and road transportation access. Moreover, the country is politically stable. The prospects for the development of a seabuckthorn industry in Bhutan depend in large part on whether such an industry would be set up to capture the entire spectrum of the value addition that is possible from the seabuckthorn plant (juice, creams, teas, feed, etc.) or just a narrow range of products.

Interviews suggest that in order to create an enabling environment that maximizes the chance of attracting potential seabuckthorn investments in Bhutan, the following issues should be considered:

- Addressing prevailing packaging and transportation cost bottlenecks.
- Accelerating existing efforts to establish a national eco-certification program.
- Provision of technical assistance for growing, harvesting and processing.
- Encouraging investments that focus on the economies of scale required for exports.

Non-existent local packaging industry: Interviews suggest that one of the most critical bottlenecks to food and medicinal plant processing industries in Bhutan is the lack of packaging materials availability locally. Interviews with juice bottlers in Bhutan suggest that the expenditures for packaging material represent almost half total unit production costs. In the case of apple juice bottling, for example, depending on the type of juice container chosen, the packaging material constitutes 45%–48% of the production cost. Due to the lack of locally available packaging materials, producers are forced to import from PRC, India, etc. In the case of plastic bottles, PET pre-form capsules may be imported from as far as Chennai, India: 1,800 kilometers away from Thimphu. The resulting costs are such that most of the added value in the end-product value is actually captured by foreign packaging companies and the transporters of such materials.

Private firms involved in medicinal plant and food processing face challenges similar to the ones faced by juice bottlers. For example, one of a handful of private companies in Bhutan involved in the export of herbal teas pays to local medicinal plants collectors not more than 6% of its total packed herbal tea expenditures. For the particular tea that was exported, the company purchased three medicinal plants from local collectors and then processed them at a local tea house facility. In order to obtain the desired export-quality packaging, the company transported its tea to Kolkata and imports it back to Bhutan packed and ready-to-sell—this cost the company 42% of its total production costs. Considering the fact that Nepalese producers face similar problems with packaging, encouraging the emergence of a packaging industry in a location situated somewhere in the triangle Nepal-Bhutan-Northeast India could fundamentally change the economics of processing medicinal plants in the region. Increasing access to affordable packaging for Bhutan and Nepal, and potentially the northern states of India would greatly improve the competitiveness of producers and exporters.

Box 10.4 Juice Bottling

In the case of apple juice bottling, depending on the type of juice container chosen, the packaging material constitutes 45%–48% of the juice production cost (see table below).

In the case of plastic bottles, PET pre-form capsules may be imported from as far as Chennai, India: 1,800 kilometers from Thimphu. The resulting costs are such that most of the value-added component of the end product is actually captured by foreign packaging companies and the transporters of such materials. As can be seen from the table below, the local value addition in a bottle or carton of apple juice is minimal.

Farmers, for example, get for their apples no more than 4%–5% of total expenditures in making 1 liter of apple juice by a Bhutanese company (depending on the ratio of apples and water content in the juice). By contrast, Chinese and Indian packaging material producers capture almost 50% of the expenditure by local firms for producing a liter of bottled apple juice in Bhutan; inevitably, this limits the ability of producers in Bhutan to pass on a greater share of value of their products to farmers and local small businesses concerns.

Table 10.9 Bottled Juice Production Costs, Bhutan

Product: Apple Juice Packaging: 1 liter Tetrapack	Nu/1,000 liters	$/1,000 liters	% of Total
Raw Materials	1,222	27.16	5
Additives	2,366	52.58	10
Packaging	10,157	225.71	45
Tetrapack (PRC)	7,350	163.33	32
Cap (PRC)	1,277	28.38	6
Carton Box (Bhutan)	1,530	34.00	7
Labor, Energy and Other Variables			
Costs	1,810	40.22	8
Fixed Costs	7,200	160.00	32
Delivered Price (FBO Thimphu)	22,755	505.67	100
Product: Apple Juice Packaging: 1 liter Plastic Bottle			
Raw Materials	766	12.02	4
Additives	2,366	52.58	11
Packaging	10,026	222.80	48
Bottle (India)	6,006	133.47	29
Cap (India)	600	13.33	3
Label (India)	2,300	51.11	11
Carton Box (Bhutan)	1,120	24.89	5
Labor, Energy and Other Variable			
Costs	1,810	40.22	9
Fixed Costs	5,770	128.22	28
Delivered Price (FBO Thimphu)	**20,738**	**460.84**	**100**

Source: Interviews, Global Development Solutions, LLC.

Eco-certification: Bhutan has a strong policy commitment to the protection of its biodiversity, and has taken significant steps for promoting environment-friendly exports. Utilization of most pesticides and chemical fertilizers in the country is not allowed. Its natural products would in most cases qualify as "organic."

Unfortunately, the national certification agency is yet to function in Bhutan. Interviews suggest that in absence of a national eco-certification, market-based organic certification schemes adopted by a medicinal plants processing firm in Bhutan have had a direct positive impact on income generation of participating households in both lemongrass and honey processing. Moreover, field interviews suggest that eco-certification has potential not only to generate significant value to Bhutanese products but also to cushion negative cost effects caused by the imported packaging and related transportation costs to and from Bhutan.

While market-based certification is working well for firms that can afford to pay for such services, interviews suggest that other smaller concerns may not necessarily be able to afford individual certification schemes, not least because of a lack of managerial and technical expertise. In this context, it is very likely that a publicly financed and supported national certification scheme in Bhutan would be needed.

Seabuckthorn value chain training: Field interviews suggest that no local capacity exists in Bhutan along the entire seabuckthorn value chain. The plant's characteristics, its propagation, and cultivation are not known in the country. Proper harvesting, handling, and storage techniques are also not known. At the end of the value chain, even the official medicinal institute has been unable to properly separate seabuckthorn juice. Investments in seabuckthorn cultivation and processing must be accompanied by technical assistance along the entire value chain if a seabuckthorn industry is to emerge.

As a concluding note on the value chain analysis of the prospects for seabuckthorn in Bhutan, the nature of the international competition is such that a place in the trade profile of Bhutan can be ensured only through full utilization of the plant across multiple applications. Some seabuckthorn applications of relatively low value, such as juices, may not be able to tolerate uncompetitive costs of packaging and overland transportation. Other application such as oils, which can sometimes sell for prices hundreds of times higher than juices, will most probably be able to circumvent the current packaging and transportation cost limitations.

11

The Way Forward to Overcome Barriers to Trade

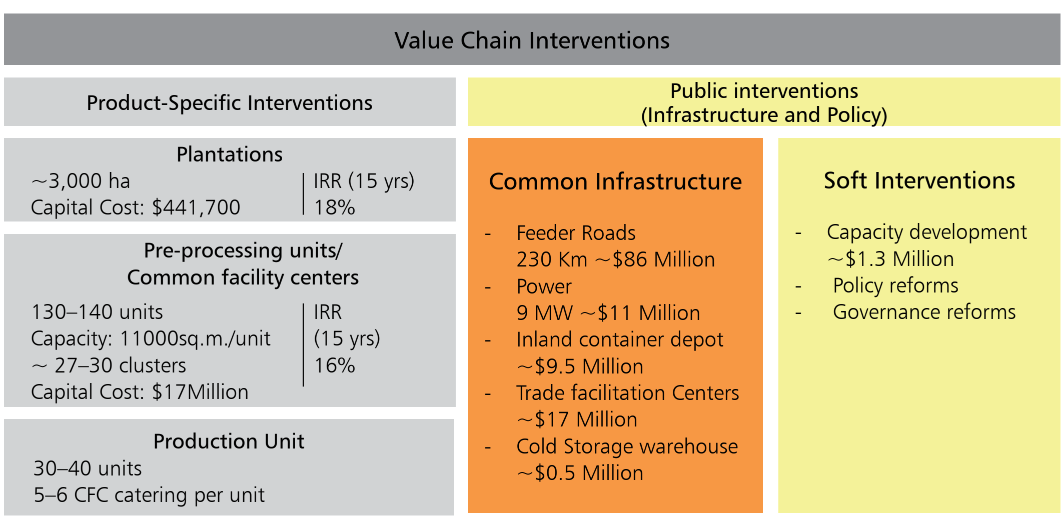
The value chain analysis in the preceding chapters highlighted production stages and key problem areas that impede greater trade and competitiveness for export products. In examining the problems, the analysis has the advantage of drawing out possible project and policy interventions for solving them. It is these interventions that constitute the scenarios for testing in the agent-based model introduced in this publication.

Whether for ceramics in Bangladesh, or for seabuckthorn product development in Bhutan and Nepal, the same investment and policy considerations are appropriate for overcoming barriers to trade identified in the analysis. In order to present the information in a coherent and usable fashion, we now show the project and policy interventions possible for enhancing the value chains.

Value Chain Interventions: Bamboo Floor Tiles in Northeast India

The IVCA for bamboo farming, intermediate processing and for the production of floor tiles highlights a need for multiple project as well policy level interventions so that production and export of tiles and other value-added products such as blinds, mats etc., can be a driver for sustainable growth in northeast India.

Figure 11.1 **Preliminary Business Plan Scenario: Value Chain Interventions in Northeast India**



Source: Author.

Project Interventions

There are three important project level interventions that emerge from the above analysis. These include:

i. Common facilities centers for bamboo strips in rural areas: Based on standard location theory, it can be argued that manufacturing of bamboo strips involving significant levels of bulk should be located near the source of raw material. Therefore, there is a case for setting-up such common facilities centers in rural areas in the northeast.

ii. Commercial bamboo plantations: Commercial plantation of bamboo requires a long-term investment horizon. Intensively managed bamboo plantations with appropriate practices such as crop rotation, maturity marking, etc. could deliver suitable quality of raw material at much lower cost to the processing units. Access to long-term finance will be crucial for such plantation to succeed.

If both the above project interventions are simultaneously implemented, it could help solve the coordination failure that currently afflicts the bamboo plantation and processing industry.

iii. Seedling laboratories/nurseries: The current capacity to provide seedlings for large-scale commercial plantation of bamboos is a critical bottleneck. The cost per seedling from such a lab could be half of that available from the market. This could substantially lower the input cost of bamboo for processing facilities.

Policy Interventions

Some of the areas where policy interventions are expected to provide impetus to industries and promote trade in bamboo products from the North Eastern Region have been identified as follows:

i. Make raw materials more available: Help to simplify the procurement and transportation of bamboo, and enabling private plantations/farmers to get access to good quality seedlings of the required species, allows a regular supply of bamboo to factories and a reduction in wastage. Plantations can be encouraged to grow species required for the development of value-added products such as floor tiles and window blinds.

ii. Provide impetus to research and development activities in the sector such as for bamboo species, techniques of planting and processing application.

iii. Encourage common facilities centers/pre-processing units to be located closer to the plantations/forests by providing assistance in form of land (on nominal or commercial lease depending upon project viability).

iv. Technology development and transfer: Develop and transfer improved tools and techniques at various stages of the value chain, such as growing the raw material, preprocessing and processing; access to information technology for networking and identifying buyers for products.

v. Entrepreneurial Development: Provide access to finance and market information and create a level playing field for SMEs to compete in the market.

vi. Incentives: Technical and financial assistance should be provided to entrepreneurs to establish a new unit or improve the management of the existing units.

vii. Product promotion: Generate consumer awareness and provide assistance for image-building and the marketing of bamboo products.

viii. Infrastructure improvement: Develop support infrastructure such as critical missing links in roads, upgrading of inland container depots (ICDs) and facilities for sea freight; streamlining container charges and availability to reduce the delays and other costs associated with exporting from India.

Apart from above, the authorities need to take policy and institutional actions to solve issues related to procurement, capacity building and transaction costs to traders/ transporters due to informal levies that are generated from rent-seeking behavior of police and forest officers. They also need to address constraints to the procurement of bamboo that arise from its classification as a tree under the Forest Act.

Value Chain Interventions: Bangladesh, Bhutan, and Nepal

The IVCA both for ceramics in Bangladesh, and for seabuckthorn product development in Bhutan and Nepal, highlights the need for multiple project and policy interventions so that production and export of tableware, juices, jams and healing creams etc., can be a sustainable growth driver for regional trade.

i. Common facilities centers in rural areas: As a time-sensitive and high-value food item derived from bulky raw materials, it can be argued that processes for juicing and pulping seabuckthorn should be located near the source. Therefore, there is a case for setting up common facilities in rural areas in Bhutan and Nepal closer to the plantations/forests by providing assistance in form of land on nominal or commercial lease, depending upon project viability.

ii. Common testing facilities and arrangements for semi-finished and finished products: A physical testing structure on a product-by-product basis for high-standard high-value export markets needs to be put in place for tableware, seabuckthorn, and other products. In Bhutan, this could mean investment in an expanded laboratory for medicinal herbs and products at the Institute for Traditional Medicine. In Bangladesh, investment in facilities at the Institute of Glass and Ceramics Research and Testing would provide technical assistance to marketing cooperatives under the control of producer societies and associations.

iii. Establish or strengthen producer and marketing societies and cooperatives: This component provides impetus to research and development activities, such as planting techniques and processing applications for seabuckthorn species, at various stages of the value chain. Access to information technology for networking and identifying buyers could be included, alongside assistance for image-building and marketing to generate awareness among consumers.

iv. Develop entrepreneurial skills: Product standards in the northeast region of South Asia are too stringent for exporters to become competitive given their cost of compliance. Product standards keep changing and require a high degree of information on requirements related to inputs, packaging, pre-cooling and cold storage facilities, refrigerated logistics and transport across borders, product traceability, and accredited certification agencies. The component needs to set up and invest in such information requirements, and follow up with investments in soft logistics and information infrastructure. Entrepreneurial development provides access to finance and market information and creates a level playing field for SMEs to compete in export markets.

v. Improve infrastructure: Develop support infrastructure such as critical missing links in roads, inspection and testing facilities; upgrade ICDs and facilities for sea freight; and streamline container systems and charges, and their availability, to reduce delays as well as costs associated with exporting.

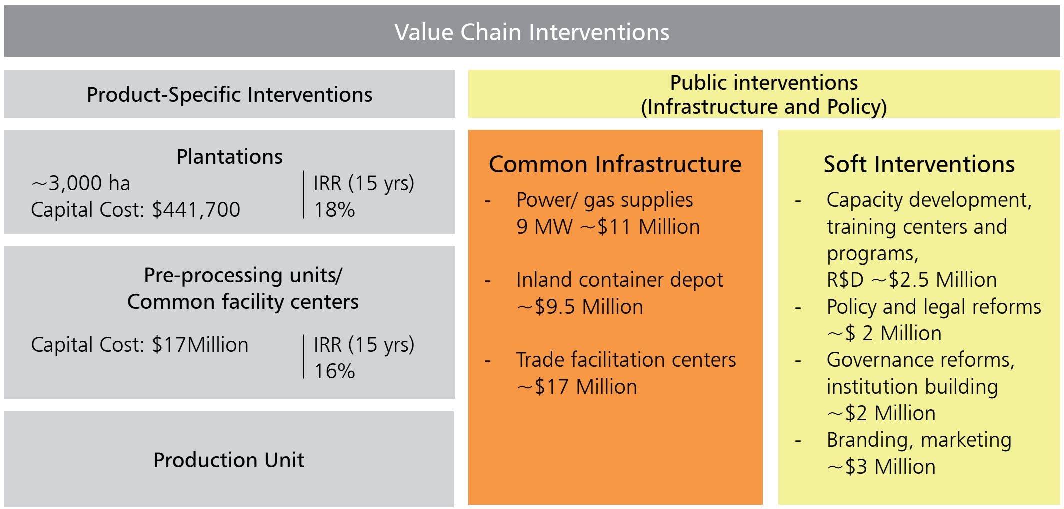
vi. Devise country-specific responses to international standards and technical barriers: This requires legal review of acts (for instance food acts, pesticide rules, standards acts, national accreditation board acts, intellectual property acts, geographic indication laws), and the establishment of agencies to control internationally acceptable traceability systems and process certification bodies. Also needed are the consolidation of focal points for Sanitary and Phytosanitary Standards, preferably in a Bio Safety Agency, and the launch and consolidation of technical barriers to trade enquiry points in accordance with World Trade Organization requirements. Such agencies could include a regional interaction component.

vii. Invest for commercial cultivation: In the region, seabuckthorn grows largely in the wild, and is harvested as such, with the exception of about 4–5 trial hectares in Nepal. Commercial cultivation requires a longer-term investment horizon. Intensively managed seabuckthorn with appropriate practices such as crop rotation, maturity marking, etc. could deliver suitable quality of raw material at much lower costs to the pre-processing units. Access to long-term finance will be crucial for the success of such plantations.

viii. Increase the availability of raw materials: Simplification of the procurement and transportation of packaging materials, enabling access to good quality seedlings of the required species to private plantations/farmers, would ensure a regular supply of required species to factories, and reduce wastage.

Based on the IVCA conducted by the Global Development Solutions (GDS) and the interventions identified for the Bangladesh ceramics sector, a preliminary business plan scenario was developed to identify the cost of interventions. It is presented in Figure 11.2.

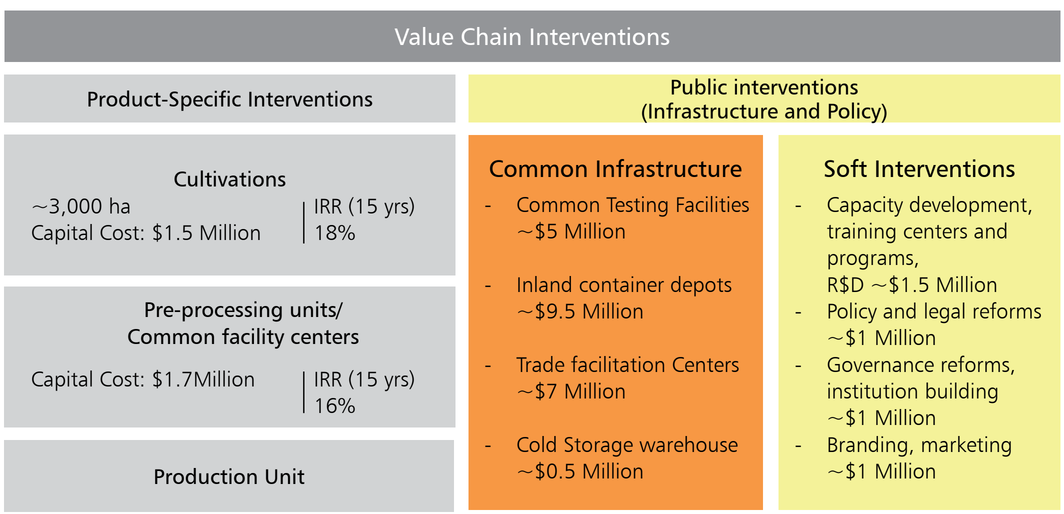
Figure 11.2 Value Chain Interventions, Bangladesh



Source: Author.

The same matrix of interventions in the seabuckthorn value chain in Bhutan and Nepal looks like this:

Figure 11.3 Value Chain Interventions, Bhutan and Nepal



Source: Author.

Strategic Investment Initiatives for Prioritization

Identified interventions enable access to markets from remote and economically backward areas through urban trade and airport hubs. Developing the urban trade hubs with backward linkage requires strengthening of two trade capacity training centers (Dhaka and Thimphu), the upgrade of three product standards facilities (Dhaka, Kathmandu and Thimphu), and increasing the effectiveness of two technical barriers to trade (TBT) centers in Dhaka and Kathmandu.

These interventions would lead to competitive products in the world market. In ceramics and in bamboo floor tiles, in comparison to Chinese producers, Bangladesh and India would increase price competitiveness by one-third by upgrading the value chains for those products to internationally competitive levels. Institutional capacity building can integrate over 1,000 productive SMEs in remote areas, where capacity creation centers can be established (identified potential areas for such centers are: the Bhumtang, Thimphu–Paro areas in Bhutan; the Pokhara–Dhaulagiri area in Nepal; the Comilla area in Bangladesh; and areas in Tripura and Assam in northeastern India). Trade facilitation reform measures are focused on the intellectual property right regime in Nepal in line with the country's World Trade Organization commitment, and on reforms of existing acts and regulations on product standards. Agreements regarding transit cargoes along northeast India trade routes to Dhaka and Chittagong (including measures regarding sealed containerized through-transport on rail and road) considerably lower transport times and costs. Investment in key inland trade hubs, inland container depots, warehousing and transshipment centers is needed at the Bhutan/India border (Phuentsholing), and at the Bangladesh/India borders at Akhaura, Dawki, and Phulbari, as well as near Guwahati and at Agartala airport in the North Eastern Region . Agartala, Dhaka, and Kathmandu airports require cool-chain facility investments with high priority. Three key transit routes, the one linking Nepal to the Kolkata ports, and the two linking Guwahati, Silchar and Agartala to Dhaka and Chittagong in Bangladesh, need traceability investment on a priority basis. Several of the latter type of trade facilitation investments can be financed and implemented under PPP arrangements.

All this is combined with the investment in rail and road infrastructure along the SAARC corridors. Those corridor improvements lower the cost of transport in some cases, as is detailed in the table on time and cost reductions from investments along corridors. In some cases, cost per ton per kilometer can increase, when a new corridor link allows traffic across borders, with respective cost increase due to border and transit delays and cost inefficiencies. However, new traffic across border would benefit from the substantial shorter distances of travel when compared to the existing situation.

Table 11.1 Time/Cost Reductions from Investments along Corridors

	Travel Time per km (ratio)	Travel Cost per km (ratio)	Future Distance (km)	Existing Distance (km)		Travel Cost Change in %
Road 1	2.01	2.56	468	1,680		0.714286
Road 2	0.65	0.81	1,323	1,314		0.812956
Road 3		880	1,039	1,039		
Road 4	0.64	0.80	1,314	n.a.		
Road 5	0.99	2.26	400	1,081		0.836983
Road 8	0.77	1.12	880	n. a.		
Road 8 ii	3.72	4.74	253	n. a.		
Rail 1	1.40	1.03	500	1,600	(600 road)	0.321461
Rail 3			704	704		
Rail 4	0.43	0.83	905	n. a.		
Rail 4 i	3.15	2.40	213	(Akhaura Chittagong)		

Source: Author.

12

Strategic Road Map for the Development of Selected Export Trades

In the previous sections, this report has mapped the economic space in the modeling area. It then has used the channel mapping methodology in tracing product flows and transfer through entire value chains from the points of product conception to the point of consumption. The methodology has thus measured and quantified costs of trade and the respective distortions that hinder competitiveness of products and industries in the area.

Two sets of investments, one containing a set of supports for non-perishable trade mostly through investment in hard infrastructure, the other one adding investments that support trade in perishable goods, have been lifted from the layers of the regional economic maps. Then these maps have been "run through" an agent-based model on the background of poverty and impact maps. This has identified a priority investment set (exclusive of hard transport infrastructure) which constitutes the South Asia Strategic Framework for AfT road map as a possible guide in the selection of future priority project investments in the subregion. In this last section, a high impact AfT investment set is summarized.

Priority trades within national export product spaces have been identified by governments as areas for development (Table 25). Added to this list are some promising trades from the national export product space that were evaluated during the value chain studies. For all three countries, most of the trades involve processing of natural resources. Therefore, improvements must focus on the collection of these inputs as well as their processing and distribution to the market ("transmission channel mapping.")

Most of these trades already receive attention from bilateral and multilateral agencies as well as NGOs. The current project will focus on coordination improvements in the value chains used to collect the outputs and to deliver the processed goods to their final markets as a means to improve the competitiveness of these trades.

Table 12.1 List of Selected Trades

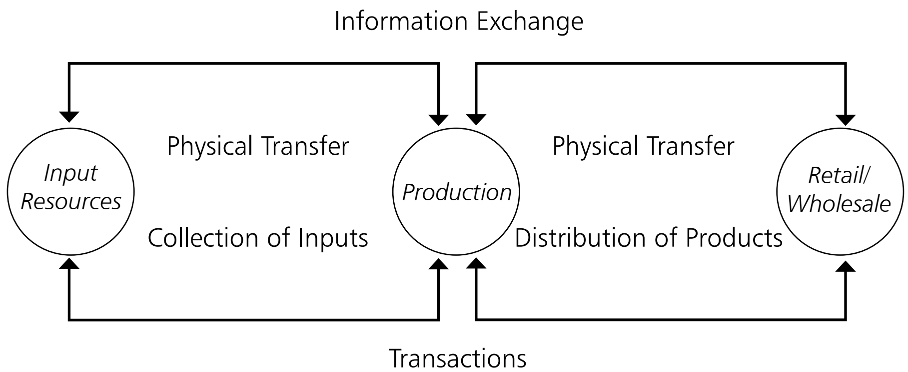
Bangladesh	Nepal	Bhutan
Leather Seafood Pharmaceuticals Shipbuilding	Pashmina Cardamom, Ginger Medicinal Herbs Tea Labor	Oranges, apples Cardamom Onions Asparagus Mushroom
Added		
Ceramics		Medicinal Plants

Source: Bangladesh Export Promotion Board, Nepal Trade Integration Study.

Value Chain Improvements

The value chains have three basic dimensions, as shown in Figure 12.1. The first is the physical transfer of raw materials and products—beginning with the suppliers and ending with the final markets. The second is the transactions between the parties that are required in order for the transfer to take place. The third is the information exchanged between these parties to complete the transactions, coordinate the transfers, and to monitor supply and demand for the raw materials, intermediate goods and final products.

Figure 12.1 **Schematic of Value Chain Components**



Information Exchange	Transactions	Physical Transfer
Demand and Supply	Financial arrangements	Transport
Order processing	Payment for services	Consolidation, Storage
Monitoring flows	Regulatory procedures	Intermediate processing

Physical Transfers

Inefficiencies in the transport of inputs to production and the goods produced are major constraints to the growth of exports from Nepal and Bhutan, and to a lesser extent those of Bangladesh. These limitations are associated with both the physical characteristics of the routes and the quality of services using these routes. The transit times limit trade in perishables but have less of an impact on other cargoes. However, the costs are relatively high because of distance, and low utilization.[36] For overseas exports from Bhutan and Nepal, land transport costs often exceed those for ocean freight, thus reducing the competitiveness of these trades.

Efforts to improve freight transport usually involve a substantial investment in infrastructure and/or restructuring of the roles of the public and private sectors in the operation of the gateways. Given the ongoing efforts of the donor community and relatively small size of the current project, these types of initiatives have been be examined but not included as part of the project. What are included are new modal arrangements, especially for exports of higher value trades from Nepal and Bhutan.

[36] A combination of both empty backhauls and average distance travelled per year.

Increasingly, the logistics services associated with the physical transfer of export products include value-added processing of the goods in transit. One of the major challenges is to increase the proportion of this processing that is performed within the country rather than in neighboring countries. This is especially important for Nepal and Bhutan, where most of the natural resource-based exports receive minimal post-harvest processing before being shipped. In order to capture more of the downstream processing, it is necessary to restructure not only the supply chains but also the transactions which connect the producers to the final markets.

Transactions

Export trade transactions have both financial and regulatory dimensions. The former concerns changes in ownership of goods being transferred between suppliers, producers and foreign buyers, and payments for logistics services used in the physical transfer.

Regulatory transactions cover the procedures for enforcement of product standards, the safety of logistics services and control of trade in specific goods, as well as collection of trade-related taxes. Efforts to reduce or eliminate the bottlenecks associated with these procedures are generally part of a broader trade facilitation strategy. In the past, emphasis has been given to reforming customs procedures at the borders and international gateways. This has significantly reduced the time required to clear cargoes. Equally important, it rewards shippers who are willing to collaborate in enforcement of the regulations. Since exporters have less of a regulatory burden than importers, the principal beneficiaries are exporters who use a significant amount of imported inputs.

The transactions for certifying the quality of goods for export have become increasingly important, not only because more rigorous standards have been introduced by the major importing countries but also because countries have taken a greater role in promoting their exports. Efforts to introduce national branding as a complement to the brands of individual firms raise the reputational risk associated with one firm exporting substandard goods. As a result, national certification procedures need to be strengthened to complement quality control efforts of the individual firms.

Another area in which there has been significant improvement in transactions is the reduction in the amount of documentation required for exporting goods and importing inputs for their production. This has been complemented by efforts to harmonize the format of the remaining documents in order to simplify processing and provide compatibility with trading partners. These initiatives are likely to strongly benefit from the introduction of special customs regimes such as bonded warehouses, free-trade zones, and inland container depots, where imported inputs, as well as high-value exports, are given special status.

Efforts to reduce financial transactions generally fall within the category of supply-chain management. Improvements are usually initiated by producers and/or foreign buyers in order to enhance their competitive position. Logistics service providers respond by offering more integrated services. While opportunities exist for providing technical assistance related to modern supply-chain management systems, third-party logistics providers increasingly offer such services.

Information

The flow of information related to export trades includes the exchanges between the suppliers, producers, and foreign buyers and between private enterprises participating in the trade and public agencies regulating that trade. The information is used not only to process orders for inputs and goods produced but also to monitor production and to trace their movements through the supply chain. There is also increasing demand for up-to-date information on the market for different types and quality of products. The improvement in information technology and communications systems has allowed for an increase in accessibility and the exchange of this information. Particularly interesting is the provision of market-related data to SMEs and small producers.

The larger firms are able to monitor markets and obtain market research. They are also increasingly involved in electronic transactions. This is especially important for producers located in Nepal and Bhutan, who traditionally rely on contacts with buyers and occasional trade fairs to establish new markets. Larger processors are able to monitor commodity prices and engage in electronic trades, whereas smaller firms remain dependent on local buyers to provide information on demand.

The exchange of information is also important for implementing new requirements concerning the traceability of imported goods. Exporters of products based on natural resources are being required to provide increasingly detailed information on the source of resources going back to the locations where they originate.

Efforts to develop information platforms remain at an embryonic state. As part of the road map, the requirements for additional market information and exchange of this information will be examined along with the potential to introduce simple systems for the specific trades.

Potential Initiatives

The growth of natural resource-based and manufacturing exports depends on the efficiency of production and the logistics for the collection of inputs and distribution of products. For natural resource-based exports, gains in efficiency involve raising the yields for cultivation and processing in a manner that reduces unit costs for the harvested and processed products. This can be accomplished by improving the technology and increasing the scale. For cultivation, this implies clustering of small farms to permit common procurement of inputs and sale of outputs. For processing, this implies investment in larger facilities complemented by improved systems for collection of inputs from an expanded hinterland. It may also imply clustering of processing activities in order to obtain economies of scale for supply of energy and logistics services.

Governments can support these efforts by encouraging the use of new organizational structures at the producer level, e.g. cooperatives and supplier contracts, and at the processing level by encouraging collaboration between large and small enterprises—with the former providing additional processing and the distribution of exports from intermediate inputs produced by the latter.

Efforts to diversify both the products and markets are an on-going concern for the private sector and for governments. However, the accessibility of market information varies with the size of the enterprises. The larger manufacturers of leather and medicinal products in Bangladesh have well-developed strategies for diversification in overseas markets. In contrast, the Pashmina producers in Nepal are small and lack the collaboration necessary to enter new markets. Similar problems with fragmentation limit efforts to promote Nepalese tea and Bhutanese spices. Governments can encourage collaborative efforts among producers through funding for technical assistance and marketing studies.

Government and larger enterprises can assist small enterprises in improving the quality of their outputs. At the same time, the larger enterprises can introduce processes to increase the value of their products. Efforts to improve exports need to address quality controls at all levels, including government procedures for testing and certification.

Improvements in collection and distribution include the restructuring of networks by adding intermediate storage and consolidation/deconsolidation points, and by revising the configuration of supply chains. For collection, this can occur in response to an increase in sources of supply or changes in the size of shipments. For distribution, this can take place due to trade facilitation initiatives as well as through efforts to diversify markets or products.

The larger enterprises have the scale to establish brand identities and make the transition from contract manufacturing to producing their own products. The product identity can be based on uniqueness of materials, design, or quality of processing. Governments can assist this effort through promotion of national brands and the enforcement of product standards and certification.

The various initiatives for improving specific export trades have a value chain component, as indicated in Table 12.2.

- Increase scale—collaborative arrangements for SMEs and small farms. Institutional strengthening, technical assistance for organizational or administrative systems, and financial support for processors.

- Diversify product mix and move up the value chain—technical assistance for design, market surveys, and financial support for pilot project to add value to products.

- Improve quality control—technical assistance and investment for testing and certification.

- Diversify markets—market surveys, alternative shipping strategies, new storage and consolidation facilities.

- Establish country-level brand—technical assistance for establishing trademark and standards, and financing for certification equipment.

- Complement trade facilitation—modified supply chains to reduce delivery times and inventory, the introduction of more time-sensitive products, more information and communications technology (ICT) systems, and the establishment of secure supply chains.

- Market access—technical assistance for promotion of business-to-business and supply-chain management, and financial assistance to establish market data collection systems and platforms for distribution.

Table 12.2 **Potential Roles for Government**

Objective: Improve	Value Chain	Possible Components
Scale and clusters	Physical transfer Transactions	Institutional strengthening Supply chain analysis Financial support for collection network
Product diversification	Physical Transfer	Market analysis, Technical assistance for design Supply chain analysis Financing for pilot projects
Value addition	Physical transfer	Technical assistance Market analysis Supply chain analysis Financing for pilot processing
Quality control	Transactions	Technical assistance Investment in laboratories and testing equipment
Product Identity	Information	Technical assistance for trademark and certification
Trade facilitation	Transactions	Regulatory reform, Harmonization of documents ICT processing systems
Market access and diversification	Information Physical Transfer	Market survey Pilot information platforms Supply chain analysis New distribution networks

Source: Author.

Specific Initiatives

Efforts to increase the selected trades would be directed at increasing their competitive advantage as well as overcoming disadvantages. For natural resource-based products from Nepal and Bhutan, the principal competitive advantage is associated with the unique plants available at higher elevations and the opportunities for supply supplying out-of-season fruits and vegetables. For manufactured goods from Bangladesh, the principal competitive advantage is low-cost labor.

The principal disadvantages are associated with limited availability and accessibility of large plots of land for cultivation. For Nepal and Bhutan there is also the distance from the major trade routes, the high cost of transport due to the topology and the fragmented pattern of ownership of agricultural land. Bangladesh's lowland, riverine geography renders it vulnerable to severe weather and makes land transport difficult. Added to these are problems with the supply of energy in Bangladesh and Nepal despite natural endowments of gas and hydropower.

The challenges for specific exports from Bangladesh include:

Seafood—small farms with low yields that are also vulnerable to storms, losses in distribution of fries, and variable quality control for products

Leather—quality and availability of skins during the year, size and condition of the tanneries, and a limited number of large size manufacturers of quality products

Medicinal plants—a focus on simple herbal recipes rather than extract-based medicines, uneven quality control and limited product identity, lack of overseas distribution network, and limited interest in expanding into foreign markets

Ceramic flatware—access to imported clay, unreliable supply of energy, and limited interest in expanding into foreign markets beyond existing trade.

For Nepal, the challenges for exports of:

Pashmina—need to import wool, limited quality control for imported wool, lack of collaboration to achieve scale for exports

Spices—limited cultivation and primarily small scale, minimal processing, no organized market for exports, costly packaging

Table 12.3 Competitive Advantage and Disadvantages for Selected Trades

Comparative	Advantage	Disadvantage	Value Chain Problems	
			Upstream	Downstream
Bangladesh				
Seafood	Environment Labor	Small farms Fragmented supply chain, Uneven quality control	√	
Leather	Labor	Supply of skins over the year Variable quality of skins	√	
Meds Plants	Traditional processing Labor	Limited high value products Product identity	√	√
Ceramic flatware	Traditional processing Labor	Imported inputs, Product identity		√
Nepal				
Pashmina	Traditional skills	Imported wool Lack of national certification	√	√
Spices Meds plants	Local plants Climate Local plants	Minimal value added Product identity Packaging	√	√
Tea	Climate	Smallholdings Variable quality	√	√
Bhutan				
Spices	Local plants	Minimal value added	√	
Meds Plants	Climate Local plants	Limited cultivation Packaging, Product identity	√	√

Source: Author.

Medicinal plants—limited, small scale cultivation, simple processing no product development, no testing capability

Tea—primarily low-value crush-tear-curl tea, limited scale of production from small farms and estates, competition from Darjeeling brand.

For Bhutan, the challenges are greater because the trades are less developed than in the other two countries and trade is limited to the region. They include minimum cultivation, lack of capacity for processing, testing or certification, no organized marketing.

The advantages and disadvantages for each of the trades are summarized in Table 12.3, together with an indication if the major constraints on logistics are associated with the collection of material for the production activities or the distribution of the products to final markets.

Project Road Map

Projects related to the individual trades that might result from the examination of value chain interventions are listed in a priority project road map in Table 12.4. At a country level the potential investment is anticipated to be in the range of \$20–\$60 million for Bangladesh, \$9–\$20 million for Nepal and \$6–\$10 million for Bhutan. The market access programs would be developed together with stakeholders and would identify target markets, value-addition opportunities, packaging and branding options, and supply-chain configurations. A subregional export finance and guarantee scheme would require an additional investment of \$150 million.

Table 12.4 Priority Project Road Map

Activity areas Per Country:	Project components		Purpose			
	Value Chain Section/ Sector	Component	Improved Coordination and Processes	Capital Investment for Agglomeration	Institution and Capacity Building	Short-Medium Term Timeframe [S or M]
Bangladesh	Seafood	Contract farming, coops	√		√	M
		Supply chain management	√		√	M
		Quality control strategy/ traceability system		√	√	M
	Leather	Tannery relocation financing		√		S
		Contracting for skins with quality control	√		√	M
	Ceramic Flatware	Marketing study / market access program (value addition, certification, market positioning)		√	√	S
	Medicinal Plants	Product value enhancement	√	√		S
		Testing and certification		√	√	S
		Traceability system		√	√	M
	General	Logistics/Energy hub for Export production	√	√	√	M
		AEO program	√		√	S
		New airfreight facility		√		M
		Export finance and guarantee institution			√	S
		Border ICDs/trade infrastructure		√		S

continued on next page

Table 12.4 *continued*

Activity areas Per Country:	Project components		Purpose			
	Value Chain Section/ Sector	Component	Improved Coordination and Processes	Capital Investment for Agglomeration	Institution and Capacity Building	Short-Medium Term Timeframe [S or M]
Nepal	Pashmina	Contracting for domestic wool	√		√	S
		Integration of producers	√		√	S
	Tea	Contract cultivation/ collection program	√		√	S
		Orthodox tea planting pilot	√	√		S
		Market access strategy			√	M
	Medicinal Plants	Pilot project for cultivation and processing	√	√		S
	Spices	Contract cultivation / collection program	√		√	S
		Processing and packaging facilities		√		S
	General	Logistics/Energy hub for export production	√	√	√	M
		AEO program	√		√	S
		New airfreight facility		√		M
		Testing and certification		√	√	S
		Export finance and guarantee institution			√	S
Bhutan	Medicinal Plants	Pilot project for commercial cultivation of seabuckthorn	√	√		S
	Spices	Integrate outbound supply chain w/processing	√	√		M
	Perishables	Develop transit corridor and distribution center	√	√		M
	General	Phuentsholing ICD		√		M
		Air cargo enhancement		√	√	M
		Testing and certification		√	√	S
		Traceability system		√	√	M
		Market access strategy		√	√	S

Source: Author.

Conclusions

The model presented in this report provides a novel methodology and accompanying software platform, giving policy makers a framework in which to evaluate the potential of real projects to bring investment gains to people in the economic periphery. It is embedded in real value chains and geographies and able to capture sophisticated spatial economic dynamics, explicitly representing both space and time the complexity of change in product value chains.

By allying the identification of gaps in the value chain with a predictive model that shows the likely effects across an economy of possible interventions, the approach is innovative and a powerful practical tool. In contrast to many modeling approaches, this visualization allows for results-based explorations in a newly expanded visual space of solutions to development and regional integration issues, as development results are directly linked to a specific set of geographic interventions. This allows the decision maker to follow a "bundled" set of investments based on a clear understanding of the synergism, from the concept design to the result. For policy makers and stakeholders to be able to better envisage outcomes, the proposed approach compares favorably with other more established approaches, and will with greater probability lead to successful program and project outcomes which contribute to inclusive growth.

This report has mapped the economic space in the modeling area, then used the channel mapping methodology in tracing product flows and transfers through entire value chains from the points of product conception to the point of consumption. The methodology has thus measured and quantified costs of trade and the respective distortions that hinder the competitiveness of products and industries in the area.

The analytical approach had to contend with a particular issue. To do the mathematics in geographic space, the calculation space had to be contiguous. However, the three countries on which the report focuses are separated geographically by the eastern states of India. Eastern India had to be modeled as well, and for this previous ADB regional studies and related or publically available data basis had to be tapped by the report team, and had to be incorporated into the report. Thus the regional strategic approach to AfT was projected onto the eastern part of India as well. Moreover, through choice and particular luck, the consultant team has been selected such that at least one of the team members had been in involved in one or the other key reports on South Asia regional transport and trade integration that were funded and undertaken by ADB over the past decade. Hence the report was able to draw on a long collective memory of all interactions with key government, civil society, and private sector players in South Asian regional integration.

The road map which has been prepared is work in progress. It needs to be detailed with improved baseline investment data and with further suitable target indicators and project implementation plans. The investment scenarios require updating, and more scenarios than the three specifically developed will need to respond to policy makers' evolving priorities in the subregion. Furthermore, the tile-based model is also a work in progress, as further layers of interaction can and should be added. For instance, the model as is had not included capital as factor of production , and hence the impact of trade and export finance would add to the cost-benefit calculation of the scenarios to be run. At the moment, the model is not yet accessible in user-friendly ways for additional scenario constructions, and it will be necessary to significantly improve the user interaction surface.

Recommendations Based on Gap Analysis

The value chain analysis employed and detailed in this study identifies missing capabilities in serving specific product and market segments. On the basis of maximizing gains from investments, it allows a set of recommendations that form the foundation of the identified framework for priority interventions. Thus the study has pinpointed the following:

Input concentration: For policy makers, this study points to the rationale of concentrating inputs on production centers with the highest potential (comparative advantage) for product diversification and access to lucrative markets.

The governments of Bangladesh, Bhutan and Nepal, often with the help of donor studies, have identified their product space in relation to global markets. This study has focused its analytics on a sub-set of selected trades for which value and logistics chains are worth developing. It revealed that future trade-related priority investments need to focus on bundling of inputs for small-scale producers, in production centers for select export trades.

This is to achieve required economies of scale in higher value-added products in order to allow competitive sourcing by international buyers within time, quality, and cost constraints, including:

- Production monitoring and traceability systems from input source to buyer should ideally be consolidated in production centers
- Support for small producers should be clustered. This implies investment in larger processing facilities, institutional and technical support systems, to allow producer cooperation and coordination
- Support for a pilot program in an exceptionally promising export trade
- This may also imply clustering of processing activities to obtain economies of scale for supply of reliable, quality energy, long-term export finance and guarantee, and logistics services.

Market access programs in selected exports from the economic periphery: Efforts to diversify products in adjacent product spaces, and their markets, vary with the size of enterprises. The larger manufacturers of select exports have well-developed strategies for diversification in overseas markets, whereas smaller producers lack this capability. This means:

- Governments can support collaborative efforts among producers and producer organization through funding for technical assistance, quality assurance and certification infrastructure for select trades

- Governments can support efforts to develop market information platforms, and related infrastructure. Simple systems can be introduced for specific trades, and those systems can be integrated with border and customs information systems

- National branding, or trademarks, and monitoring efforts will reduce for overseas contract buyers the reputation risk associated with small firms exporting substandard goods. This effort needs to be integrated with "traceability systems" for specific trades

- Governments need to have in place a complete standards, testing, conformity assessment, and (public and private) laboratory certification systems, with international recognition in key export markets

Improvements to product flows are important: The safety of logistics services and the smooth control of trade across transport modes and through international borders and gateways needs to be increased through better agent coordination arrangements. This is to reduce spoilage of time and quality sensitive shipments of natural resource based exports, and to reduce delivery times and inventory. Considerations for overcoming such effects include actions to:

- Add investments that raise the number of intermediate storage and consolidation/deconsolidation points, bonded warehouses, inland (ICDs) or at international gateways (ports, borders), and revise the configuration of supply chains

- Introduce arrangements and facilities for scaling up time and quality sensitive product exports, with special emphasis on development of air cargo

- Develop and finance a best practice customs authorized economic operator (AEO) program, with strong institutional capacity building both in the public and private sectors.

While South Asian countries have some of the highest trade barriers in the world, which still bedevil trade within the region, collective action led by India, the region's largest trading economy by far, can substantially reduce these barriers, spurring trade and cutting input costs for exporters. These actions have to be spearheaded by collective regional institutions so that the entire region uses the same international standards for trade.

At the moment, South Asia does not adhere to most international conventions and understandings for harmonizing trade and transport systems, and the future adoption of such standards will require substantial investments in the physical set-up of trade routes. That is the long-term view. This report takes the short view, and as such presents a unique strategic approach for a priority road map to investments that can be put to use immediately to build export markets and incomes for people in the economic periphery.

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Aid for Trade
An Investment-Benefit Road Map from South Asia

Aid for Trade (AfT) came to prominence just over a decade ago at the launch of the World Trade Organization's Doha Round. With its focus on helping least developed countries and economies escape the poverty trap, it aims to strengthen their capabilities to meet market demand and to reduce supply-side constraints such as a lack of trade infrastructure.

In accordance with that objective, this report lays out an applied framework for prioritizing potential trade-related interventions and investments according to the expected strength of their combined economic impacts. Along the way, and for the first time, the economic geography of northeastern South Asia has been comprehensively mapped. Computer-driven modeling provides a dynamic portrayal of the economic geography that is a resource for decision makers (and investors).

By bringing to light new avenues yielding very high economic benefits for investment and reforms, the framework can give guidance for undertaking trade improvements under AfT on pilot projects within a national setting, between neighbors or spread to partners further afield. In all cases, the endeavor is the same: expressed in the metaphor of hard investment, it is to build bridges to export markets so that people in the economic periphery have a better opportunity to take poverty off their own maps.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people who live on less than $2 a day, with 828 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

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