



MILLENNIUM CITIES INITIATIVE (MCI)
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY



VALE COLUMBIA CENTER
ON SUSTAINABLE INTERNATIONAL INVESTMENT
A JOINT CENTER OF COLUMBIA LAW SCHOOL AND
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

MCI AND VCC WORKING PAPER SERIES ON INVESTMENT IN THE MILLENNIUM CITIES

Nº 09/2009

BAMBOO BICYCLES IN KISUMU, KENYA

**Katherine Athanasiades
Michelle Eames
Riham Hussein
Young Rhee**

December 2009

432 Park Avenue South, 13th Floor, New York, NY10016, United States
Phone: +1-646-884-7422; Fax: +1-212-548-5720
Websites: www.earth.columbia.edu/mci; www.vcc.columbia.edu



MCI and VCC Working Paper Series

N. 09/2009

Editor-in-Chief: Dr. Karl P. Sauvant, Co-Director, Millennium Cities Initiative, and Executive Director, Vale Columbia Center on Sustainable International Investment: karl.sauvant@law.columbia.edu

Editor: Joerg Simon, Senior Investment Advisor, Millennium Cities Initiative: jks2149@columbia.edu

Managing Editor: Paulo Cunha, Coordinator, Millennium Cities Initiative: pmc2105@columbia.edu

The Millennium Cities Initiative (MCI) is a project of The Earth Institute at Columbia University, directed by Professor Jeffrey D. Sachs. It was established in early 2006 to help sub-Saharan African cities achieve the Millennium Development Goals (MDGs).

As part of this effort, MCI helps the Cities to create employment, stimulate enterprise development and foster economic growth, especially by stimulating domestic and foreign investment, to eradicate extreme poverty – the first and most fundamental MDG. This effort rests on three pillars: (i) the preparation of various materials to inform foreign investors about the regulatory framework for investment and commercially viable investment opportunities; (ii) the dissemination of the various materials to potential investors, such as through investors' missions and roundtables, and Millennium Cities Investors' Guides; and (iii) capacity building in the Cities to attract and work with investors.

The Vale Columbia Center on Sustainable International Investment promotes learning, teaching, policy-oriented research, and practical work within the area of foreign direct investment, paying special attention to the sustainable development dimension of this investment. It is a joint center of Columbia Law School and The Earth Institute at Columbia University.

Correspondence should be directed at any of the editors.

A separate MCI working papers series on the social sector is also available.

For more information, please refer to the MCI website at: <http://www.earth.columbia.edu/mci/> and the Vale Columbia Center website at: <http://www.vcc.columbia.edu/>.

Copyright © 2009 by the Millennium Cities Initiative (MCI) and Vale Columbia Center on Sustainable International Investment. All rights reserved. Unless otherwise indicated, this working paper may be reproduced, quoted or cited without permission of the author(s) provided there is proper acknowledgement. The responsibility for the contents of this Working Paper remains with the author(s). Accordingly, this publication is for informational purposes only and is meant to be purely educational. While our objective is to provide useful, general information, the Millennium Cities Initiative and the Vale Columbia Center make no representations or assurances as to the accuracy, completeness, or timeliness of the information. The information is provided without warranty of any kind, express or implied. This publication does not constitute an offer, solicitation, or recommendation for the sale or purchase of any security, product, or service. Information, opinions and views contained in this publication should not be treated as investment, tax or legal advice. Before making any decision or taking any action, you should consult a professional advisor who has been informed of all facts relevant to your particular circumstances.



Table of contents

List of acronyms	5
Acknowledgments	5
1. Project overview	6
1.1. Background and objectives.....	6
1.2. Methodology.....	6
1.3. Key findings.....	6
1.4. The Client—MCI.....	7
1.5. Kenya.....	7
1.6. Kisumu.....	8
1.7. Economy.....	8
1.8. Environmental factors.....	9
1.9. Investment environment in Kenya.....	9
1.10. Bamboo bicycles.....	10
1.11. Bamboo.....	10
2. Market opportunity	12
2.1. Current methods of transportation.....	12
2.2. New and used bicycle market.....	12
2.3. Potential markets.....	13
3. Current rural bicycle market	16
3.1. Current rural bicycle market size.....	16
3.2. Addressable market.....	16
3.3. Market penetration rate and gap.....	18
4. Operational considerations	19
4.1. Key findings.....	19
4.2. Bamboo bicycle assembly.....	19
4.3. Cost of the venture.....	20
5. Financial case study	23
5.1. Key assumptions.....	23
5.2. Break-even analysis.....	24
5.3. Demand sensitivity analysis.....	25



Table of contents

6. Implementation and risks	28
6.1. Demand.....	28
6.2. Imported supplies.....	28
6.3. Bamboo.....	28
6.4. Labor.....	29
6.5. Factory.....	29
6.6. Development impact.....	30
7. Conclusion and next steps	31
7.1. Conclusion.....	31
7.2. Next steps.....	31
Appendix 1. Boda Boda market	32
Appendix 2. Calculation of current market size	33
Appendix 3. Potential rural market size	36
Appendix 4. Average household information	38
Appendix 5. Operational considerations	39
Appendix 6. Equipment costs	42
Appendix 7. Training costs	43
Appendix 8. Demand sensitivity	44
References	45



List of Acronyms and Acknowledgments

List of Acronyms

ABC	Africa Bamboo Center
DFID	Department for International Development
FAO	Food and Agriculture Organization
GDP	Gross domestic product
IMF	International Monetary Fund
INBAR	International Network for Bamboo and Rattan
IRR	Internal rate of return
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forest Research Institute
KEBS	Kenya Bureau of Standards
KES	Kenyan shillings
LBDA	Lake Basin Development Authority
MCI	Millennium Cities Initiative
MDGs	Millennium Development Goals
MVP	Millennium Villages Project
NEMA	National Environmental Management Authority
NGOs	Non-governmental organizations
NPV	Net present value
PPP	Purchasing power parity
SIPA	School of International and Public Affairs
UNIDO	United Nations Industrial Development Organization
VAT	Value added tax
WB	World Bank
WDI	World Development Indicators

Acknowledgments

The authors would like to express their gratitude to the many individuals who shared their time, resources and enthusiasm with them in the completion of this working paper. At Columbia, the authors in particular would like to thank Millennium Cities Initiative (MCI) Co-Director Dr. Karl P. Sauvant, Senior Investment Advisor Joerg Simon, SIPA Professor Jenny McGill, Professor John Mutter, Professor Gita Johar and Marty Odlin for their guidance and support. The authors would also like to recognize the contributions of Paulo Cunha and Zach Arney throughout the editing process and the publication of the document. In Kenya, the authors are particularly grateful to Laban Mburu and Ben Obara, who were invaluable assisting with research and interviews for this report. Finally, the authors would like to recognize and thank all the entrepreneurs and representatives of organizations who helped facilitate the research and generously agreed to be interviewed for this study.

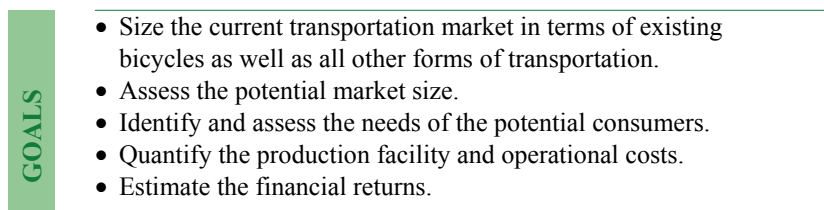
1. Project overview

1.1. Background and objectives

This study was undertaken by Columbia University’s School of International and Public Affairs (SIPA) with support from the Millennium Cities Initiative (MCI) at The Earth Institute. The MCI was launched in 2006 to assist selected mid-sized cities across sub-Saharan Africa in their efforts to achieve the Millennium Development Goals (MDGs).

This study assesses the feasibility of initiating a bamboo bicycle production facility in the Millennium City of Kisumu, Kenya, drawing on a previous study analyzing a similar venture in Kumasi, Ghana, another of the Millennium Cities.

Figure 1. Project goals



Sources: SIPA and MCI.

1.2. Methodology

To ascertain the feasibility of establishing a bamboo bicycle project in Kisumu, from November 2008 – April 2009, a team from the School of International and Public Affairs (SIPA) at Columbia University conducted desk-based research and surveys, individual interviews and focus groups with industry and market participants, government officials, environmental specialists, academics, and businesspeople. The team also made two field research trips to Kisumu in January and March 2009.

During the course of the study, certain assumptions were made to determine the size of the market, estimate the operational costs, and assess the financial returns of this business opportunity. All of the analyses and findings in this report are based on primary and secondary data and information gathered from interviews. A survey was also administered in Kenya. Key assumptions and risks as well as alternative financial and operational scenarios that may be pursued by investors are outlined. All of our currency conversions are made using Oanda (<http://www.oanda.com>) rates from March 2009.

1.3. Key findings

1.3.1. Market opportunity

Market research was conducted for various segments of the population including rural and urban commuters. Presently, many people walk or use whatever informal public transportation is available in Kisumu. Bicycles are a mode of low cost transportation that can be used by rural commuters, students, and even non-government organizations to deliver services. However, bicycles in Kisumu are poor in quality and must be repaired frequently. This study suggests that bamboo bicycles will be more affordable and of a higher quality than the bicycles currently available on the market.

One can estimate that the annual bicycle market size is approximately US\$12 million, with a total potential market size of US\$51 million. The total potential unpenetrated market is approximately US\$39 million.

1.3.2. Pricing

Based on the production of 30,000 bamboo bicycles per year, one can estimate that the cost of producing one bamboo bicycle will be approximately US\$35, the wholesale price will be US\$37 and the expected retail price will be US\$49.

1. Project overview

1.3.3. Financial statement

Based on the output of the planned production facility, the five-year net present value (NPV) of establishing a production facility is approximately US\$86,817. The payback period, or break-even point, occurs in less than two years from the beginning of operations. This scenario sees an internal rate of return (IRR) of 65% (See Financial case study in section 5 for explanation).

1.3.4. Development impact

Launching a bamboo bicycles initiative would have numerous economic benefits for the Kisumu region, particularly with respect to job creation among the youth. Because the project aims to source the bamboo locally, the potential also exists to stimulate the nascent bamboo industry, thereby helping raise the average income level of farmers in many rural areas. Environmental benefits could take place in both the early and late points of production: growing bamboo helps prevent soil erosion, purifies water and air and generates little waste, while production does not use harmful chemicals. Finally, there are positive social externalities. For instance, with bamboo bikes, community health workers and parents would gain access to a more durable and affordable means of transporting the sick to clinics and students to schools.

1.4. The Client—MCI

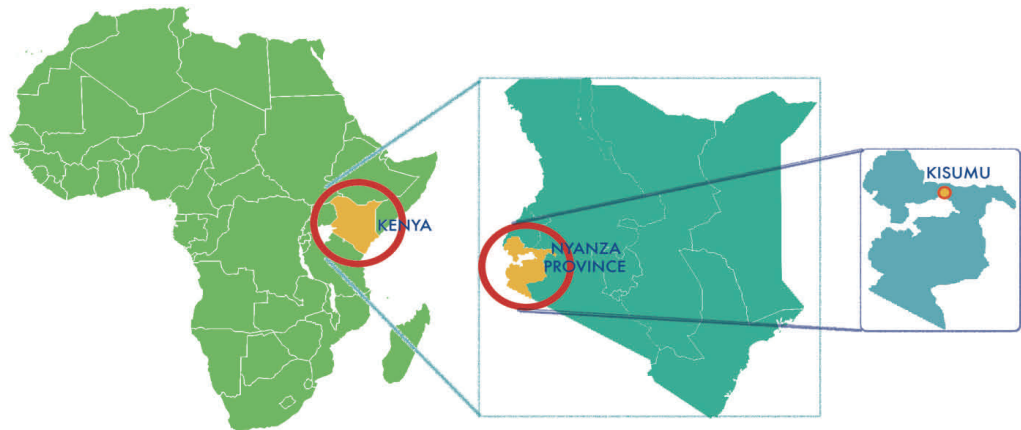
As an urban counterpart to the Millennium Villages Project (MVP), the Millennium Cities Initiative (MCI) assists eleven sub-Saharan African cities to attract investment, reduce poverty and achieve economic growth. In addition, the MCI helps generate needs assessments in the social sectors, in order to develop city development strategies to achieve the MDGs (MCI 2009). Because of its close proximity to the Millennium Village in nearby Sauri, Kisumu was selected as the first Millennium City in 2006 (MCI 2007).

1.5. Kenya

Kenya is a coastal East African country with border access to Lake Victoria. The largest cities are Nairobi, the capital; Mombasa, a port city; and Kisumu, located on Lake Victoria.

Kenya has experienced a decline in per capita income and an increase in income disparity over the last several decades. Estimates from 2006 assert that the wealthiest ten percent of the population account for approximately 40 percent of total income, while the poorest ten percent of the population account for only one to two percent of total income (Library of Congress 2008). As of 2005, approximately 40 percent of Kenyans lived on two dollars per day or less (World Bank Group 2009b). Fortunately, many of the country's development indicators have been improving in recent years: more children are in school, and health and water and sanitation indicators have improved (Department for International Development 2008).

Map 1. Locating Kisumu



Sources: SIPA and MCI.



1. Project overview

1.6. Kisumu

Kisumu is located on the eastern arm of Lake Victoria in the Nyanza Province. The city has suffered in recent times due to aging infrastructure and poor governance (MCI 2007, p. 3). Environmental degradation and over-fishing are also putting crucial natural resources at risk (MCI 2007, p. 18). Over the years, Kisumu’s once efficient road and railway networks have deteriorated and the inability to transport goods efficiently has inflated transportation costs (MCI 2007, pp. 35-36). Additionally, Kisumu was greatly impacted in Kenya’s post-election instability in 2007 and 2008 (Gettleman 2008).

Table 1. Kenya and Kisumu in brief

Kenya	Kisumu
Capital: Nairobi	Population: 535,664
Form of Government: Republic	Population of youth (15 – 25): 128,367
Exchange rate (March 2009): US\$ 1 = 82 KES (Kenyan shillings)	Life expectancy: 49 years
Population: 37.5 million	Labor in brief:
Median age: 18.6 years	Employment in agriculture—75%
GDP (PPP): US\$58.8 billion	Wage employment— 10%
GDP per capita (PPP): US\$1,699	Rural self-employed—3%
Unemployment rate: 15% (official 2005 figure), 40% (unofficial estimate)	Urban self-employed—4%
	Total number of unemployed, Kisumu District — 104,657

Sources: Library of Congress 2008, International Monetary Fund 2009, and Office of the Vice-President 2008.

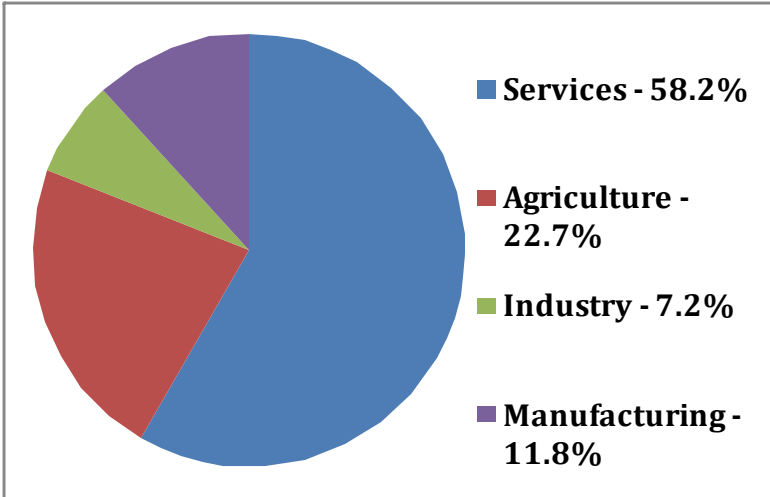
1.7. Economy

Kenya’s GDP (PPP) in 2008 was US\$58.8 billion (calculated in international dollars at the purchasing power parity). In 2007, the economy grew at 7.0 percent and inflation by 9.8 percent (World Bank Group 2009b). Current GDP per capita is US\$1,699.24. Kenya’s economy is heavily reliant on the service industry, which accounts for 58.2 percent of GDP. Agriculture and industry, including manufacturing, support the rest of the economy. Although agriculture only accounts for 22.7 percent of GDP, it employs nearly 75 percent of the country’s population (Library of Congress 2008). The main agricultural products are coffee, tea, sugarcane, maize, sisal, cotton, tobacco and dairy (Foreign and Commonwealth Office 2008).

Despite the distinct challenges of Kenya’s economy, if GDP per capita continues to grow as projected over the next few years, this should translate into increased purchasing power for the average Kenyan, allowing more people to move above the poverty line and making the bicycle as a form of transportation even more affordable.

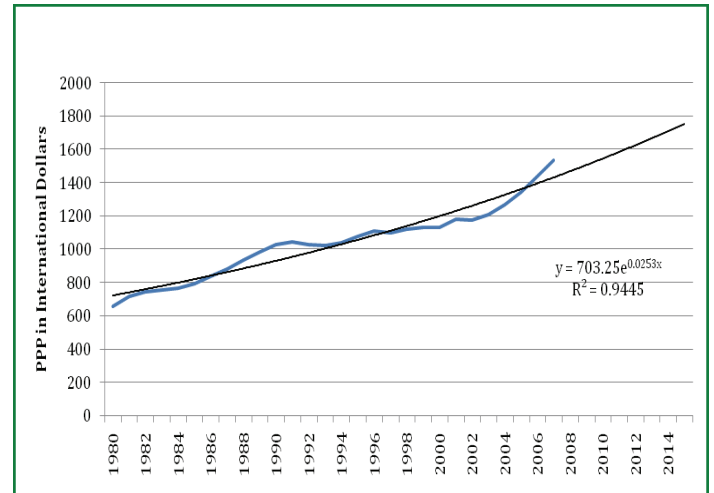
1. Project overview

Figure 2. Kenya GDP (PPP), 2007



Source: Library of Congress 2008.

Figure 3. Projected GDP per capita (PPP)



Source: World Bank Group 2009b.

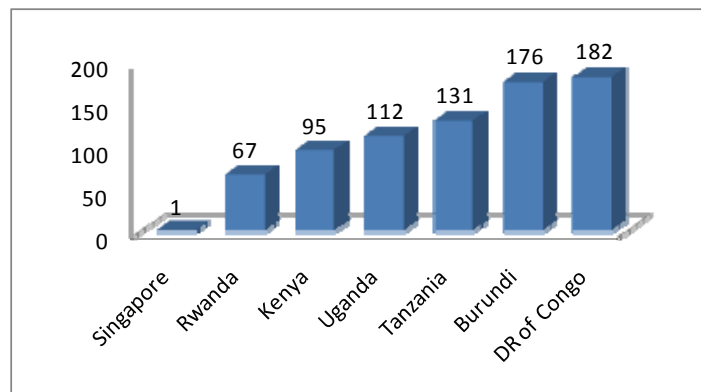
1.8. Environmental factors

The potential production of bamboo for transportation purposes could have a direct and important impact on the natural environment of the country. Today, Kenya faces a number of environmental challenges, including soil erosion, desertification, deforestation and insufficient and poor quality water. The amount of forested land declined by 50 percent over the last three decades to only three percent of Kenya's total land area (Library of Congress 2008). The loss of forest also aggravates soil erosion. In addition, it can create serious challenges for many rural families and especially women, who can spend hours daily in search of firewood and water (Library of Congress 2008).

1.9. Investment environment in Kenya

The World Bank's (WB) 2010 Doing Business Report, which provides quantitative assessments of global business regulations and government enforcement, ranks Kenya 95th out of 183 countries in terms of *Ease of Doing Business*. Despite dropping several places in 2010, Kenya has made strides over the last few years to simplify the business climate for investors. For instance, from 2008 to 2009, the country's ranking for *Ease of Starting a Business* improved from 115 to 109 mainly due to a decrease in the number of procedures and length of time required to start a business. Currently, setting up a new business requires 12 procedures over a 34-day period and funding equivalent to 36.5 percent of income per capita (see table 2). Notably, Kenya is ranked 4th globally in terms of getting credit (World Bank Group 2009a, p. 3).

Figure 4. Ease of doing business, global rank (selected countries)



Source: World Bank Group 2009a.



1. Project overview

Table 2. Ease of starting a business, Kenya rankings 2008-2010

Ease of starting a	2008	2009	2010
Rank	115	109	124
Procedures	12	12	12
Duration (days)	44	30	34
Cost (percent of income/capita)	46.1	39.7	36.5

Source: World Bank Group 2007, 2008, 2009a.

1.10. Bamboo bicycles

1.10.1. History

Bamboo’s strength and versatility make it a very useful material. It has been used by many cultures for products ranging from cups to scaffolding. At the same time, the accessibility, ease of use and relative affordability of bicycles have made them nearly ubiquitous worldwide, providing an effective means of transport for all people, from the rich to the poor. Because of bamboo’s strength and flexibility, it would be a logical material to use on bikes. Additionally, its availability in Kenya makes it an affordable alternative to more expensive imported metal parts.

1.10.2. Research and development

Engineers collaborating with The Earth Institute at Columbia University helped design a bamboo bicycle model that was introduced to Kisumu in March 2009. This prototype is currently being showcased in Kisumu and feedback from businesspeople and various stakeholders in the various market segments is being incorporated into future versions of the bamboo bicycle design. The research is focused on improving the aesthetics and strength of the bicycle, along with the suitability of the local species of bamboo to local road conditions and overall bicycle usage in Kisumu.

Some of the research is also addressing possible alternatives to imported manufactured components by using a greater number of local supplies and alternative components to make future models of the bamboo bicycle even more affordable and “green” than the current model. For instance, Kisumu has a vibrant *Jua Kali* industry that manages much of the metalworking and welding needs of current bicycle owners. *Jua Kali* workers create the iron fork supports and other custom pieces used on bicycles and weld metal frames when they break. As a result, one option is to utilize the *Jua Kali* workers to create some of the metal components needed for bamboo bicycles, thereby further reducing shipping costs.

1.11. Bamboo

Studies by Maseno University’s Tobacco-to-Bamboo project and by the United Nations Industrial Development Organization (UNIDO) have established the economic advantages bamboo provides farmers. Bamboo also has positive environmental benefits and is extremely versatile. In addition, both the Kisumu branch of the Kenya Forest Research Institute (KEFRI) and the Kisumu-based Africa Bamboo Centre (ABC) run workshops devoted to studying the utility and adaptability of bamboo. In addition to these studies, the Kenya Agricultural Research Institute (KARI) oversees bamboo farms from which many of ABC’s bamboo training programs are supplied, and conducts strength testing to establish the feasibility of bamboo for different uses. Research is still ongoing to determine which kinds of bamboo currently available in Kenya are most suitable for bamboo bicycle use.

Bamboo has many qualities that make it suitable for bicycles. In fact, it can carry a load greater than steel at 28,000 Newtons

1. Project overview

per square inch compared to 23,000 Newtons per square inch (KPMG 2008, p. 7). Simultaneously, it exhibits greater flexibility, which translates into a vibration-dampening property when used on bicycle frames (Industry participant interview 2009). This translates into a bicycle that can carry a larger load for a smoother ride than traditional metal bicycles.

1.11.1. History of ban

In 1986, the Government of Kenya issued a Presidential ban on harvesting bamboo for commercial purposes. The ban was instituted for environmental reasons: bamboo was being overharvested and faced local extinction. In addition, it primarily grew in water catchment areas, thereby threatening environmental damage if eradicated (Bamboo industry expert interview 2009; Food and Agriculture Organization 2006, p. 9).

Bamboo has since thrived and now grows in clusters in and around Kisumu as well as on the land surrounding Mount Kenya. Bamboo advocacy groups are pushing for the environmentally responsible development of bamboo and the Government is currently reviewing the ban policy (Bamboo industry expert interview 2009).

Although the ban is still in place, farmers can obtain a permit to grow bamboo. The permit is free and there is no restrictive quota on the number of permits that can be distributed per year (KEFRI informant interview 2009).

Stimulation

Due to the harvesting ban, bamboo use has not yet been fully explored by local handicraft workers. It is just now starting to gain awareness as a highly functional and versatile crop, with potential to improve livelihoods. To this end, programs at KEFRI, ABC and Maseno University are helping to train would-be bamboo traders to use and market bamboo products. In fact, Maseno University's Tobacco-to-Bamboo program is now encouraging tobacco farmers to switch to growing bamboo (Bamboo industry expert interview 2009).

1.11.2. Competitive advantage

The bamboo bicycles' design has a major advantage over that of current metal bicycles: the bamboo bikes are designed for road conditions particular to the Kisumu region, as opposed to the imported metal bicycles, which are designed mainly for leisurely riding on paved roads (Industry participant interview 2009). Additionally, the frames are built as one piece (including the carrier), rather than as a number of pieces, making them both stronger and more viable economically to consumers of bicycles who no longer have to pay for assembly and extra parts.

In short, using local materials is advantageous in at least two ways. First, bamboo bikes are not only more cost effective than metal bikes (since there is no need to import bike frame parts), but they are also a positive investment in the local economy, helping to improve livelihoods and create jobs.



2. Market opportunity

2.1. Current methods of transportation

In Kisumu, people use both motorized and non-motorized forms of transportation.

2.1.1. Motorized transportation

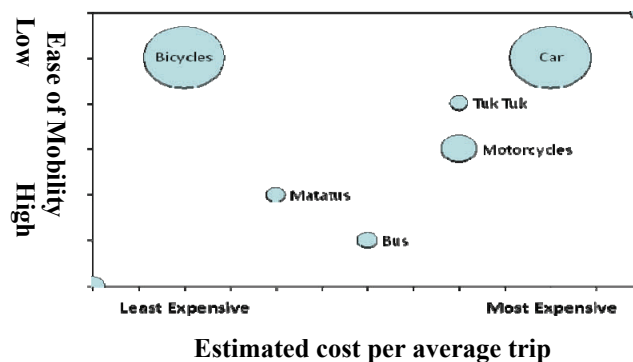
A personal automobile is too expensive for most Kenyans to afford and even more so for residents of Kisumu: the city is one of the poorest in Kenya (Republic of Kenya 2002). Minibuses also known as *matatus* are the main means of motorized transportation for most people. There are approximately 25,000 *matatus* in Kenya (Market participants survey 2009). However, they tend to be a dangerous means of transportation due to their lack of safety features. In most cases, they are over-packed with people, and lack basic safety features such as seat belts. However, they are also the cheapest form of transportation at 20 Kenyan shillings (KES) (US\$0.24) per ride from Kisumu District's rural areas to Kisumu city center (Market participants survey 2009).

In addition to *matatus*, in Kisumu and its surrounding areas, people also hire motorized rickshaws called *tuk tuks* and motorcycle taxis called *piki pikis* to get around. Although both methods of transportation offer speed and the *tuk tuks* offer more cargo space, they tend to be more expensive than *matatus*.

2.1.2. Non-motorized transportation

There are three basic forms of non-motorized travel: by foot, by bike and in some cases, animal transport. The most popular form of transportation is traveling by foot. However, bicycles are also very popular. A person can own or rent a bicycle or hire a bicycle taxi called a *boda boda* to get around. Finally, animal transport is also used to carry heavy cargo, mainly in rural areas and farms.

Figure 5. Current transport market, Kenya



Source: Market participants survey 2009.

2.2. New and used bicycle market

2.2.1. Supplies

Bicycles in Kenya are imported mainly from China and India. The most sought-after brand from China, called the *Phoenix*, is often on the pricier end and tends to be flashier in design but a bit more durable than most bikes. However, this brand is too expensive for the average rider to purchase. The most common bike is the *Raja* from India, which is lower in quality. Second-hand bicycles imported from Dubai are also increasing in number.

In 1998, a total of 140,000 bicycles were imported to Kenya; this number swelled to 240,000 by 2007 (Office of the Vice-President 2008, p. 183), in part due to the removal of the bicycle import tax in 2002 (International Forum for Rural Transport and Development 2008, p. 2). Many bicycles are also traded on the local secondhand market, meaning that some bicycle frames are decades old.

2. Market opportunity

2.2.2. Disadvantages

Most imported metal bicycles are cheap, but also heavy and uncomfortable. On average, imported bikes weigh around 22 kg (49 lbs) (Market participants survey 2009). Many *boda boda* operators need their bicycles to carry large loads, and they often modify the bikes. Their frames tend to warp due to the weight placed on them, creating distortions in handlebars and wheel alignment. This is concerning as *boda boda* operators ride with passengers all day. For those operators that carry large cargo or travel long distances, the combined weight of the bicycle and cargo can cause discomfort and injury. Numerous *boda boda* operators have complained of health problems due to fatigue from the sun, road dust, long hours, and heavy cargo (Market participant interview 2009).

The imported bicycles currently on the market are priced between 4,600 KES - 8,500 KES, or approximately US\$56 - US\$104 (Industry participant interview 2009). To accommodate the Kenyan topography and types of common cargo carried, many bicycles, especially *boda bodas* as mentioned above, need to be reinforced for strength and durability. These modifications on average add an extra 960 KES, or US\$12, to the price of the bicycle (Market participants survey 2009). In addition to these modifications, bicycles often also undergo weekly repairs due to wear and tear.

2.3. Potential markets

A bamboo bicycle has many advantages for a potential customer in Kenya - they can be used for personal or cargo transportation, as well as for commercial purposes.

A number of different market segments can be targeted by a bamboo bicycle initiative. The main segments are *boda boda* owners and operators, rural commuters, students and universities, local non-government organizations and government agencies.

Because of their multi-functionality, all bamboo bicycles should have a cargo aspect to them.

2.3.1. Boda Bodas

Market segment description

Boda boda operators in Kisumu have about ten customers daily and work on average ten hours. They earn an average daily income of 250 KES (approximately US\$3), with most operators earning between 50 KES - 450 KES (US\$0.60 - US\$5.50) (Market participants survey 2009). The majority of *boda boda* operators are poor males, aged 16 to 45. In Kisumu, there are approximately 10,000 operators (*Boda Boda* Association interview 2009). Most operators own their bicycles, which are either inherited or purchased using savings (Market participant interview 2009). Only a few individuals take out loans to purchase bicycles.

The market may be oversaturated due to the explosion in recent years of the *boda boda* industry. Most *boda boda* stands often have several operators idling with no customers. Occasionally, successful *boda boda* operators are able to move upward to motorcycle and *tuk tuk* operations.

Transportation usage

Boda boda operators use their bicycles all day, six to seven days a week. In parts of Kisumu, the roads are adequately paved, but the outskirts and slum areas generally have poor road conditions. Additionally, the lack of bicycle lanes means that *boda boda* operators often have to swerve off-road to avoid passing cars and trucks. This causes a lot of wear and tear on the bicycles, especially as they carry an average of 172 lbs - 441 lbs daily (Market participants survey 2009).

Market opportunity

Bicycle quality, comfort, stability and appearance are important attributes in a bike, but operators are most sensitive to bike price (Market participant survey 2009). According to respondents interviewed, an ideal bike weighs less, is more durable, and carries a larger cargo rack than an average bike.

Due to a lack of resources, most people choose to buy cheap bicycles, while paying a large amount of money over a long period

2. Market opportunity

of time for modifications and maintenance. Without having knowledge of the benefits of a bamboo bicycle, approximately half of the survey respondents said that they would pay 3,000 KES (US\$37) for a bamboo bicycle, or approximately 1,500 KES (US\$18) less than what they would pay for the cheapest quality bikes available (Market participant interview 2009). Upon seeing a bamboo bicycle, many *boda boda* drivers offered immediately to pay more money than they would typically pay for an imported model (Market participants survey 2009). An affordable, higher quality bicycle would encourage *boda boda* operators to replace their current bicycles once they wear out.

2.3.2. Rural commuters

Market segment description

The rural population (i.e. residents living outside of Kisumu city center) comprises approximately 62 percent of the total population of Nyanza Province, home to many of Kenya's poorest citizens. Approximately 47 percent of Nyanza's population works in trade or services, while 42 percent works in agriculture. However, agriculture makes up 75 percent of rural household income. To provide some understanding of the needs of the community, only 11 percent of rural households have access to water through a piped system, whereas 31 percent have access to potable water. On average, the distance from a home to a potable water source is 4 km whereas the average distance to a healthcare facility is 8 km (Republic of Kenya 2002, p. 2-28).

Transportation usage

Many rural residents in Nyanza province commute to Kisumu for jobs, food and higher education needs. These people walk or use *matatus* as a means of transportation. Small food vendors and craftspeople bring their goods to markets using *boda bodas*, *tuk tuks* and *matatus*. Local crafters store their items in a city storage room. When a new shipment of goods arrives, they use carts and other modes of transportation to carry them to their market stalls (Market participant interview 2009).

In rural areas, many women and children gather food and water from long distances, walking an average of four to five km daily (Industry participant interview 2009). Additionally, since they have limited access to health services, they often pay for transportation.

Market opportunity

Clearly, bicycles benefit the rural market in many ways. An affordable bicycle can make jobs that were previously inaccessible due to distance more accessible. Merchants can carry goods on a bamboo bicycle rack to market, improving efficiency and productivity. Additionally, a bicycle can help a family access food, water and healthcare services that were previously inaccessible, and provide income opportunities.

2.3.3. Students

Market segment description

The enrollment rate in primary school-aged children is quite high but drops drastically when children reach secondary school age (see table 3). The one major university in Nyanza, Maseno University, has a total enrollment of 5,686 students.

Transportation usage

Students typically either walk or take transportation to attend school. Maseno University has two campuses, one at Maseno, just outside Kisumu city within Kisumu District, and one in Kisumu city center. Many students commute to and in between these two campuses.

2. Market opportunity

Table 3. Enrollment rates, Nyanza province

Nyanza Province	Primary students	Secondary students
Population	900,489	405,408
Enrollment rate	80%	27%

Source: Republic of Kenya, 2002.

Market Opportunity

Bicycles make schools more accessible for many students, particularly those in secondary schools. With the abolishment of secondary school fees for public schools in Kenya, there could be an increase in secondary school enrollment if bamboo bikes were made available to this segment (Evans and Miguel 2007, p. 3). University students also commute to school, particularly after work if they attend part-time. One Kenyan university representative expressed interest in a school bike share-style program to rent out bicycles to students who commute long distances (Market participant interview 2009).

2.3.4. Non-government organizations

Market description

Because it is in one of the poorest regions of Kenya, there are many non-government organizations (NGOs) operating in Kisumu. A number of these NGOs are working with community health workers to deliver assistance to poor rural areas. The majority of community health workers are female (Market participant interview 2009). With a shortage of healthcare professionals, these aid workers are trained to provide basic health services as well as food and water to three to four patients per day.

There are also many NGOs helping farmers improve their farming methods, increase profits by selling in bulk, and acquire better farming tools. One NGO, for instance, expressed interest in acquiring bicycles to help officers deliver services and assist farmers in recording yields.

Transportation usage

Community health workers walk an average of four hours daily and provide healthcare services to about four patients per day (Industry participant interview 2009). When necessary, they hire *boda bodas* or other means of transportation to bring patients to the hospitals in the city center.

Non-government organizations working with farmers also hire *boda bodas* to visit rural farmers on a daily basis. The sprawling distances they travel require a more effective means of transportation.

Market opportunity

Many healthcare providers would benefit from having a bamboo bicycle to deliver medicine, food and water to patients and to transport the sick to hospitals and clinics when necessary. When easy road transportation is not available, a bamboo bicycle can serve as a cheap and convenient ambulance. A bicycle can be used by either a health services worker or by families that visit hospitals often. With a bicycle, a community health worker can visit more patients and deliver more care, especially in urgent situations. Most healthcare workers currently cannot afford a bicycle and would not have access to a bicycle mechanic for repairs. A bamboo bike would not only be cost friendly, but also provide a light, strong means of transport to help carry heavy loads.

The only caveat is that since most community health workers are female, there is some cultural stigma attached to women driving their own bicycles. However, many younger females typically know how to ride a bicycle (Market interview participant 2009).

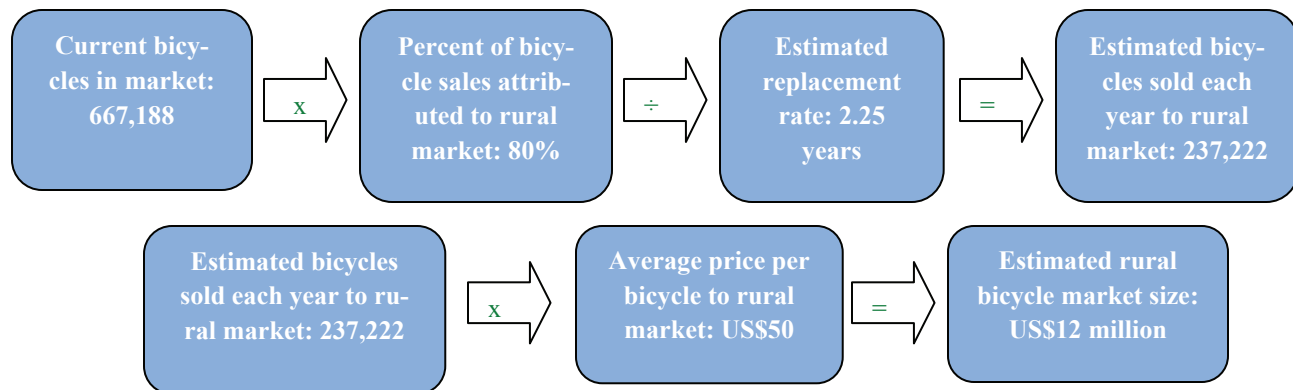
3. Current rural bicycle market

3.1. Current rural bicycle market size

The current bicycle market includes all of Kenya and consists of urban and rural markets. The urban market is comprised of *boda boda* bicycles (see appendix 1), whereas the rural market includes both *boda bodas* as well as regular commuters and NGOs.

The current rural bicycle market size in Kenya is approximately 237,222 annually. Due to differences in the imported bicycle data received from the Ministry of Trade and Industry's Customs and Excise Department (Office of the Vice-President 2008), the current bicycle market was calculated in four different ways (see appendix 2). The average of all four methods was also calculated. The number of current bicycles in the market is approximately 667,188. Because 60 to 65 percent of Kenya's population is rural (and more bicycles go to this market), it was assumed that 80 percent of the bicycles bought went to the rural market. In appendix 3, the replacement rate of the bicycles was calculated at 2.25 years (Office of the Vice-President 2008). This resulted in the current market size of 237,222 bicycles. Based on a retail price of approximately US\$50 (see figure 6), the total estimated current rural bicycle market size is US\$12 million.

Figure 6. Current rural market size, Kenya



Sources: SIPA and MCI.

3.2. Addressable market

The primary market is the rural one. The rural market includes regular commuters as well as non-governmental organizations and rural *boda boda* operators.

The annual rural market size for bamboo bicycles in Kenya is approximately 1,011,000 bicycles. The following methodology was used to arrive at this number: First, the total population of Kenya (37.5 million) was multiplied by the estimated rural population, which is 63 percent, totaling approximately 23.6 million people (Office of the Vice-President 2008). Next, this number was multiplied by the percentage of the population aged 15 to 64 (which is more likely to buy and ride bicycles) (see figure 7), which resulted in a total population of 13 million.

It was also assumed that all of those above the poverty line can afford a bicycle, which resulted in slightly over six million people. This was divided by the estimated replacement rate of 2.25 years per bike to get an estimate of 2.727 million potential annual sales to rural Kenyans.

Finally, 2.727 million annual sales were divided by 3, the average number of working-age individuals per household (see appendix 4) which resulted in an addressable bamboo bicycle market size of approximately 909,000.

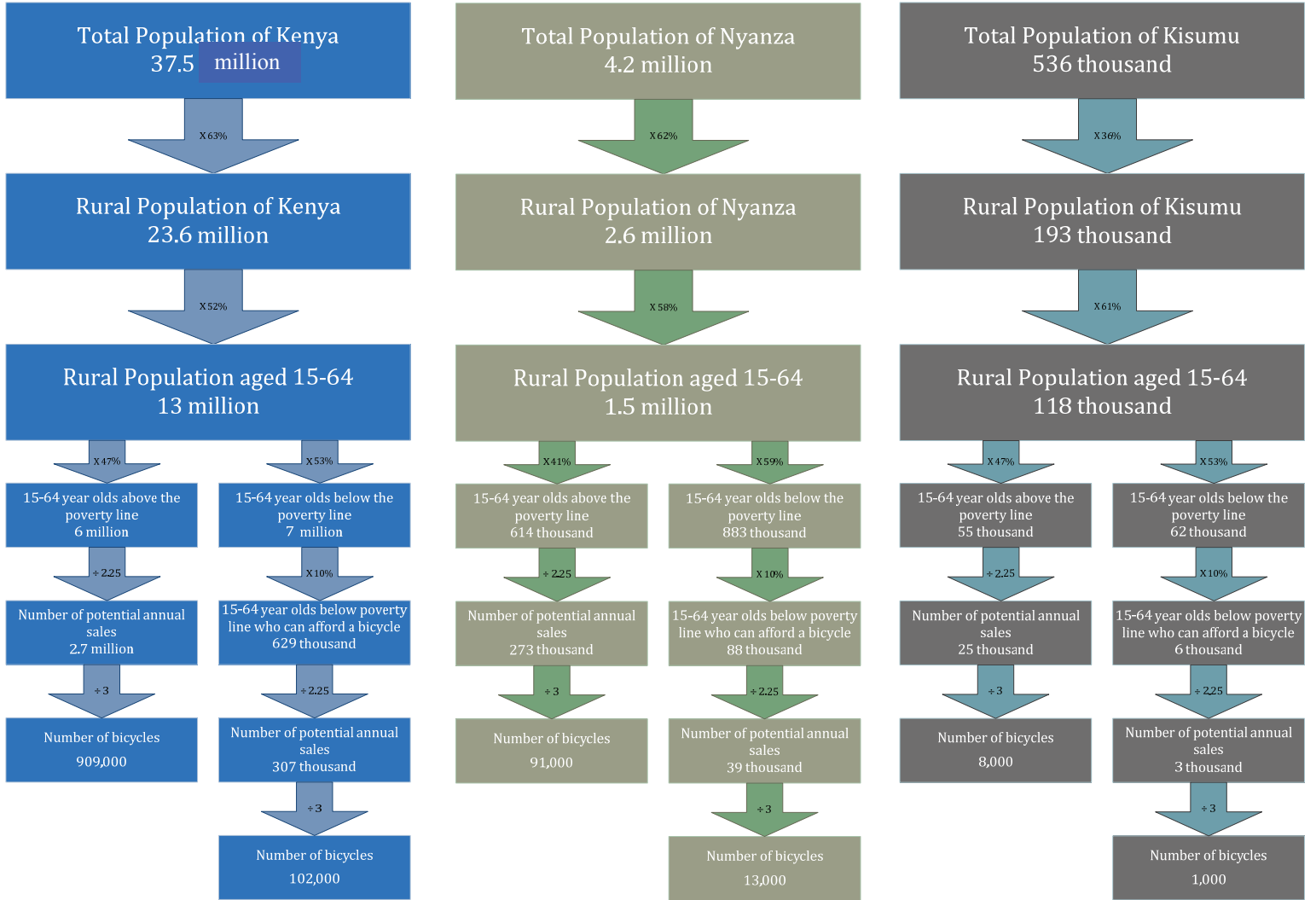
It was assumed that ten percent of those below the poverty line will be able to afford bicycles; adding those in, the total addressable bicycle market size is approximately 1.011 million.

By doing the same calculations for Nyanza Province and Kisumu District, one can see that there is a potential addressable mar-

3. Current rural bicycle market

ket in these locations of 104,000 and 9,000, respectively (refer to figure 7 for further details).

Figure 7: Potential addressable markets



Sources: SIPA and MCI.

3. Current rural bicycle market

3.3. Market penetration rate and gap

There is an estimated market penetration rate of 41 percent for the rural market in Kenya. The potential unpenetrated market is 774,000 bicycles, for an approximate value of US\$38,700,000.

Figure 8. Potential unpenetrated market

	US\$
Actual market	11,850,000
Potential unpenetrated market	38,700,000
Total potential market size	50,550,000

	Number of bicycles
Actual market	237,000
Potential unpenetrated market	774,000
Total potential market size	1,011,000

Sources: SIPA and MCI.

4. Operational considerations

4.1. Key findings

Constructing a single bamboo bicycle will take approximately 81 minutes and cost approximately US\$35. A bamboo bicycle facility with 20 workers capable of producing 30,000 bicycles per year will cost approximately US\$1,050,000 in the first year, with setup costs totaling approximately US\$84,000. The break-even point takes place after two years.

4.2. Bamboo bicycle assembly

One bamboo bicycle can be constructed in approximately 81 minutes by an assembly line of 20 workers using advanced power tools. A two-person team working with hand tools can assemble a bike in 120 minutes (KPMG 2008, p. 14).

4.2.1. Production format

Constructing a bamboo bicycle can be accomplished through either an assembly line format or from start to finish by two people. The assembly line would consist of 20 workers, each of whom would be responsible for one part of the construction. To contrast, a two-person team working together to construct one bicycle could produce four bicycles per person (80 bikes total based on 20 workers) per working day (KPMG 2008, p. 14), whereas our calculations show that an assembly line of 20 workers could increase this output to approximately 6.3 bicycles per person per day (127 bikes total with 20 workers) (Industry participant interview 2009). To reach more of the market, the assembly line format would allow the business to increase its capacity with added workers.

4.2.2. Construction process

Hand tools will be used for the majority of the process, but power tools, particularly a drill press, are necessary to maintain precision when mitering bamboo.

There are three main steps to constructing a bamboo bicycle. First, the bamboo must be cut to size to increase its strength and resistance to damage. Second, the bamboo is mitered and assembled into a bicycle frame on a jig and bound together with resin and sisal fiber. Finally, after a period for drying, the manufactured components are fitted onto the bamboo frame.

Step 1

There are two options for increasing the strength and durability of bamboo: treating the bamboo with chemicals such as borax or treating the bamboo with heat and flame. From the standpoint of effectiveness, flame and heat treatment strengthens the bamboo more than chemical treatment. There are also health and environmental benefits as workers do not have to come into contact with or dispose of the borax and other chemicals. Bamboo is treated with a flame torch until it browns, after approximately two minutes, and then is heated at 100°C for 1.5 hours (Industry participant interview 2009).

Step 2

Using two drill presses, two miter jigs and prepared bamboo, mitering enough bamboo for one bicycle takes approximately five minutes. Fixing the bamboo tubes together and then binding the joints with resin and sisal fiber is the most time-consuming part of the construction, taking between 50 and 60 minutes of labor. After the joints are bound, the resin on the bike must dry over a period of several hours (Industry participant interview 2009).

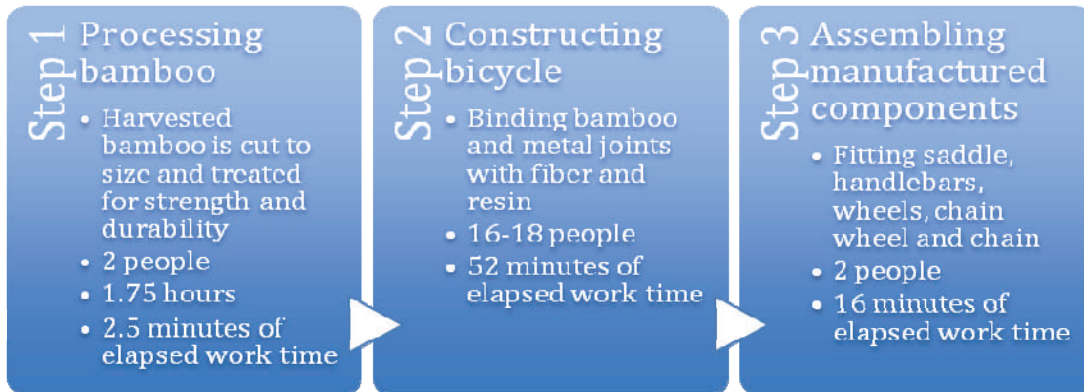
Step 3

The manufactured components are fitted onto the bicycle, including wheels, pedals, chain, handlebars and a saddle. This takes between 10 and 20 minutes (Industry participant interview 2009).

The total elapsed time of active work for the three steps of production is approximately 81 minutes. An assembly line of 20 workers can produce approximately 127 bicycles per day, as opposed to 10 two-person teams that can produce approximately 80 bicycles per day (KPMG 2008, p. 14) (see appendix 5 for additional details and an alternative scenario).

4. Operational considerations

Figure 9. Bamboo bike construction process



Sources: SIPA and MCI.

Research

Research into more economically and socially responsible production processes is ongoing. For example, industrial solar ovens could be developed for bamboo treatment. These ovens can be easily incorporated as the business develops. However, the calculations in this study are based on traditionally used tools and equipment.

4.3. Cost of the venture

4.3.1. Base-case scenario

The base-case scenario is the production of 30,000 bicycles in one year. This is approximately the number of bicycles that can be produced per year by 20 assemblers with appropriate training from The Earth Institute.

Total cost of first-year operations

Sources suggest that initial setup costs (including, for example, equipment purchases and license registration) will cost approximately US\$84,000 (Industry participant interview 2009 and Government informant interview 2009). Total operational costs for the first year of production are approximately US\$790,000 assuming the factory will produce at 75 percent capacity. This is a conservative assumption accounting for staff turnover and a production learning curve (Industry participant interview 2009). This translates into approximately US\$35 per bicycle. In addition to startup costs, the total costs for the first year of operations will be approximately US\$875,000.

4.3.2. Investment cost

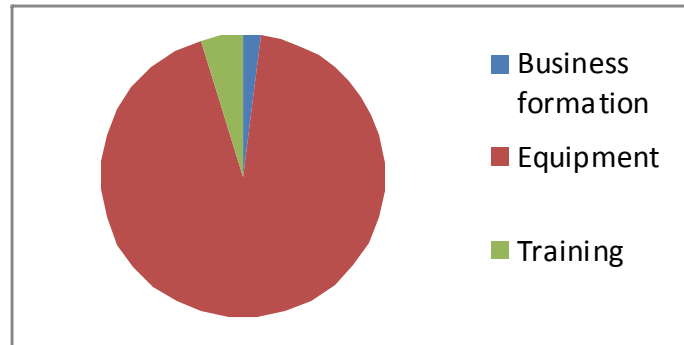
Setup costs will total approximately US\$84,000 in the first year as detailed below.

4. Operational considerations

Table 4. Investment costs by category

Category	Cost (US\$)
Business formation	1,669
Equipment	77,930
Training	4,000
Total cost	83,599

Figure 10. Investment costs



Sources: SIPA and MCI.

Business formation – US\$1,669

Kenyan law requires that potential projects, including business ventures, pay for an Environmental Impact Assessment conducted by the National Environmental Management Authority (NEMA) (NEMA informant interview 2009). In the case of a bamboo bike business, this fee would translate to US\$67 (see NEMA website at <http://nema.gov.ke>).

Additionally, the business will need to register with various government agencies including the Kisumu Municipal Council and Kenya Bureau of Standards (KEBS). A more complete list can be found on the Kenya Investment Authority's website at: <http://www.investmentkenya.com>. These registration fees total US\$748. It also must purchase a municipal license costing US\$854 (Kenya Investment Authority informant interview 2009). Additional costs for intellectual property rights may occur.

Equipment – US\$77,930

Equipment consists of the tools needed to build the bicycles, including jigs and stands to support bicycles through production, and the import and transport costs required to bring the equipment to Kisumu (see appendix 6). The equipment needed includes the following: truck, automated flame-treaters, industrial ovens, two drill presses with various drill bits, two miter jigs, bamboo pull saws, two-sided files, picture jigs, one die for stamping dropouts and an assortment of g loves, goggles and aprons.

Training – US\$4,000

Training will take place over ten days and carried out by two volunteers from The Earth Institute (see appendix 7). While only 20 assemblers will be trained in our base-case scenario, if ongoing market research shows that the market is expanding at a great rate, more assemblers can be trained, adding more value to the factory than the cost to train and pay those assemblers.

4.3.3. Operational costs

Production costs to amount to approximately US\$35 per bike based on information from various sources.

Manufactured components - US\$29.00

Manufactured components are the largest cost component of bamboo bicycles. The cost includes an import tax on bicycle components as well as a value added tax (VAT). Binding materials and transport costs from component countries of origin, such as China, are also budgeted.

4. Operational considerations

Labor - US\$0.46

The legal minimum wage for a machinist is 5,888 KES per month, or approximately US\$72. As unskilled workers gain experience, they become skilled and their wages increase. Labor considerations reflect this.

Bamboo - US\$1.62

Bamboo costs include the cost of growing the bamboo itself, the cost to transport bamboo from Nyanza Province to Kisumu and the cost of propane and electricity needed to treat the bamboo. Bamboo prices are expected to remain relatively stable over the next few years. However, there is always the possibility of fluctuations in the bamboo price (Bamboo industry participant interview 2009).

Indirect costs - US\$3.80

Indirect costs consist of the salaries of a manager and other administrative staff at market rates. It also includes the costs of leases, utilities, marketing programs, annual license renewals, employee benefits, pensions, ongoing employee training, safety supplies, and depreciation.

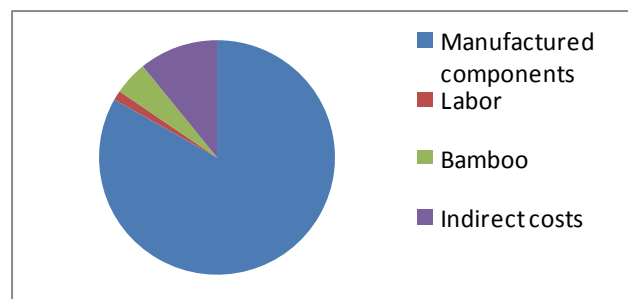
One of the largest costs for a business in Kenya is electricity. Because of high fixed and variable electricity costs, including a marginal fee based on kilovolt consumption, some companies are contemplating switching to generators (Industry participant interview 2009). Electricity charges are based on a five-tier consumption scheme of Commercial and Industrial (CI) categories. CI-1 represents the least consumption and CI-5 represents the most. Most Kisumu businesses fall into the CI-2 category. One CI-2 business owner, whose commercial space measures 11,000 ft², estimated that his electricity costs nine KES/unit (Industry participant interview 2009). Electricity consumption costs would be similar for a bamboo bicycle facility. This is a conservative estimate based on a comparison of the square footage needed by the bamboo bike facility and the power tools used in bamboo bike production.

Much of the marketing done in Kisumu occurs through word of mouth. For this reason, a budget category to account for giving away 20 bamboo bicycles to influential and well-connected partners that can help promote the bikes is included.

Table 5. Operational costs by category

Category	Cost per bicycle (US\$)
Manufactured components	29.00
Labor	0.46
Bamboo	1.62
Indirect costs	3.80
Total cost	34.88

Figure 11. Operational costs



Sources: SIPA and MCI.

5. Financial case study

5.1. Key assumptions

- 20 trained bicycle assemblers in an assembly format will build 31,600 bicycles per year. Assuming a scrap rate of five percent leaves the business with 30,000 quality bicycles.
- 100 percent of bicycles produced are sold each year.
- Average price of bicycle is US\$37 based on average seven percent markup of bicycles and ability to pay.
- Growth rate of bicycle industry at zero percent.
- Discount rate set at 20 percent.

Figure 12. Financial case study

	0	1	2	3	4	5
Year	0					
Revenues (US\$)						
Number of bicycles		22,500	30,000	30,000	30,000	30,000
Price per bike		37	37	37	37	37
Total revenues		832,500	1,110,000	1,110,000	1,110,000	1,110,000
Operational costs (US\$)						
Direct material		684,188	912,251	912,251	912,251	912,251
Direct labor		18,320	18,320	18,320	18,320	18,320
Overhead	4,700	79,324	93,463	93,463	93,463	93,463
Income taxes		12,950	23,540	23,540	23,540	23,540
Less: Depreciation		7,499	7,499	7,499	7,499	7,499
Total operational costs	4,700	787,284	1,040,075	1,040,075	1,040,075	1,040,075
Capital expenditures (US\$)	78,745	177	177	376	713	177
Total cash flow (US\$)	(83,445)	45,040	69,748	69,549	69,212	69,748

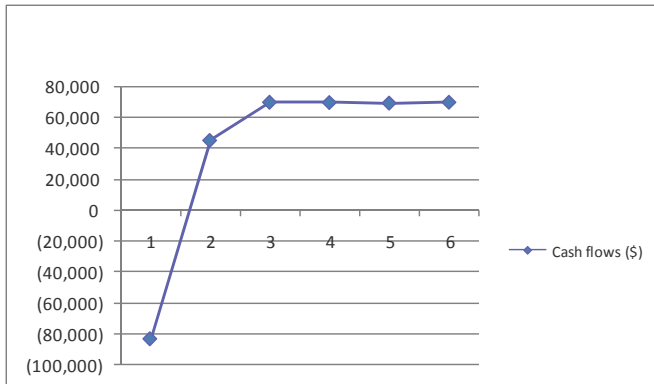
Sources: SIPA and MCI.

The bamboo bicycle venture in Kisumu is an attractive investment opportunity based on the assumptions made above. In this base case scenario, the net present value of producing 30,000 bicycles a year with a twenty percent discount rate would be US\$86,817 with an internal rate of return of 65% percent. The payback period for this base case is less than two years.

In the first year, it is assumed that only 75 percent of potential production is reached.

5. Financial case study

Figure 13. Expected cash flows (base case)



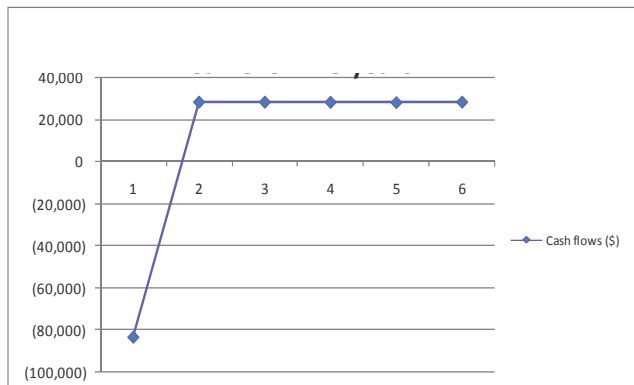
Net present value	US\$86,817
Payback period	< 2 years
IRR	65%

Sources: SIPA and MCI.

5.2. Break-even analysis

The break-even point can be calculated in two ways. In the first method, a discount rate of 20% is used to compute how many units it would take to reach a net present value of US\$0 in a five year time span. Using this method, the production facility must produce 12,316 bicycles each year for five years.

Figure 14. Break-even analysis



Net present value	US\$0
Payback period	5 years
IRR	10%

Sources: SIPA and MCI.

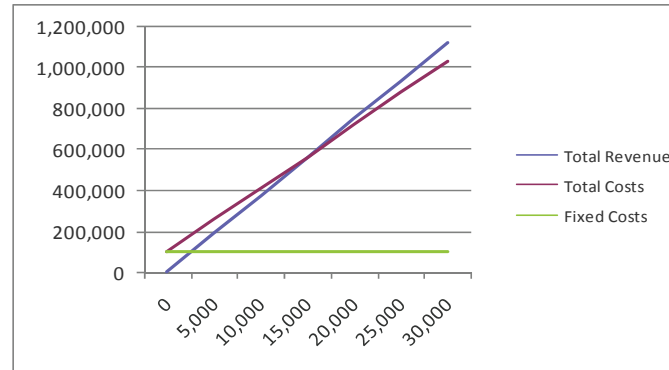
In the second method, the number of units it would take to break even is computed. In year one, fixed costs amount to approximately US\$101,000, variable costs of approximately US\$30.6 per bicycle and an wholesale price of US\$37 per bicycle (see section 4.3.).

$$\text{Break Even} = \text{Fixed Cost} / (\text{Unit Price} - \text{Variable Unit Cost})$$

This method gives us a total of 15,780 bicycles to break even.

5. Financial case study

Figure 15. Revenues and costs



Sources: SIPA and MCI.

5.3. Demand sensitivity analysis

There are a number of alternative scenarios depending on our market size and penetration (see appendix 8 for other scenarios not summarized here).

5.3.1. Current bamboo bicycles market

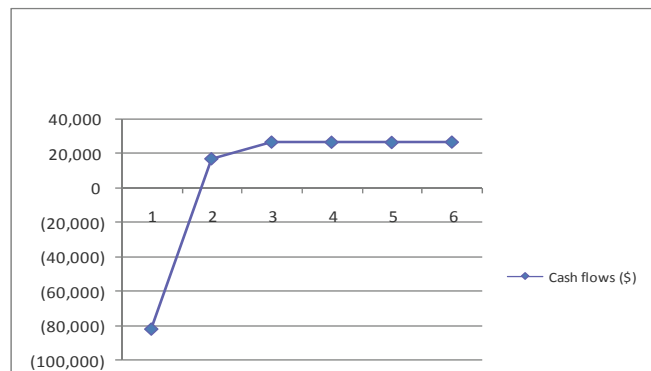
The following analysis is based on the current bicycle market and the assumption that current bicycle owners are the only potential customers. This market is sized at 237,000.

Five percent penetration of the current market

A five percent penetration assumes a production of 11,850 bicycles per year. This will result in a net present value of (US\$9,516) and an IRR of 14 percent.

Figure 16. Five percent penetration of the current market

Penetration rate	5.00%
Net present value	(US\$9,516)
Payback period	< 4 years
IRR	14%



Sources: SIPA and MCI.

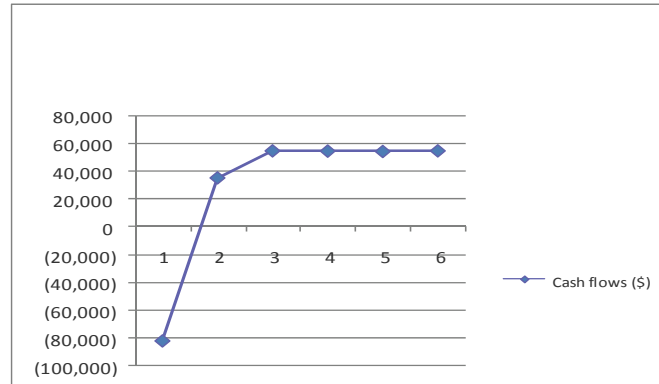
5. Financial case study

Ten percent penetration of the current market

A ten percent penetration assumes a production of 23,700 bicycles per year. This will result in a net present value of US\$53,379 and an IRR of 49 percent.

Figure 17. Ten percent penetration of current market

Penetration rate	10.00%
Net present value	US\$53,379
Payback period	< 2 years
IRR	49%



Sources: SIPA and MCI.

5.3.2. Total addressable bicycle market

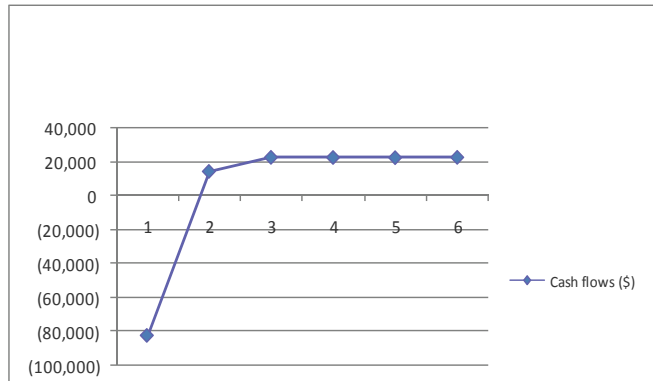
The following analysis is based on the total addressable bicycle market which is sized at 1,011,000.

One percent penetration of the total addressable market

A one percent penetration assumes a production of 10,110 bicycles per year. This will result in a net present value of (US\$18,752) and an IRR of 8 percent.

Figure 18. One percent penetration of total addressable market

Penetration rate	1.00%
Net present value	(US\$18,752)
Payback period	< 5 years
IRR	8%



Sources: SIPA and MCI.

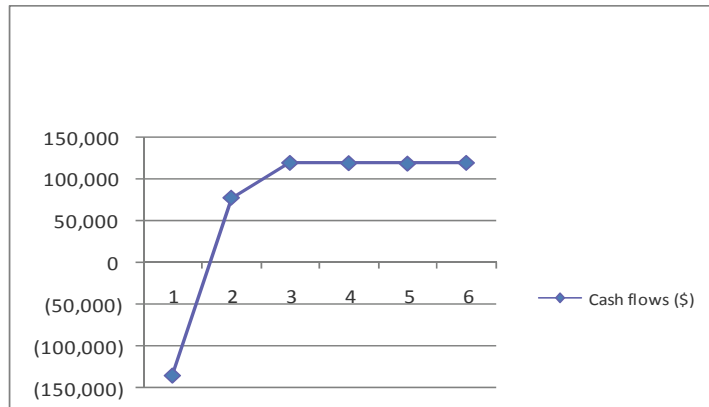
5. Financial case study

Five percent penetration of the total addressable market

A five percent penetration assumes a production of 50,550 bicycles per year. This will result in a net present value of US\$151,933 and an IRR of 68 percent.

Figure 19. Five percent penetration of total addressable market

Penetration rate	5.00%
Net present value	US\$151,933
Payback period	< 2 years
IRR	68%



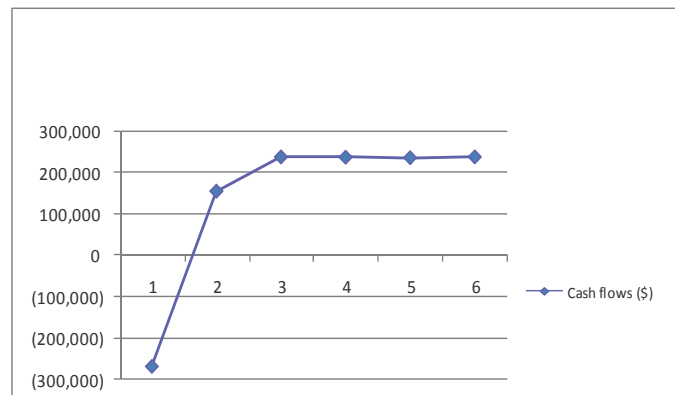
Sources: SIPA and MCI.

Ten percent penetration of the total addressable market

A ten percent penetration assumes a production of 101,100 bicycles per year. This will result in a net present value of US\$306,797 and an IRR of 68 percent.

Figure 20. Ten percent penetration of total addressable market

Penetration rate	10.00%
Net present value	US\$306,797
Payback period	< 2 years
IRR	68%



Sources: SIPA and MCI.

6. Implementation and risks

6.1. Demand

6.1.1. Current situation

The limited number of bamboo products currently being manufactured or sold in Kenya make the prospect of a bamboo bicycle a true novelty. In March 2009, a prototype was showcased at the Kisumu MCI office and tested by the *Boda Boda* Association. Initial feedback was positive. Members of the Association were impressed by the high quality of the parts and the bike's light weight, strength and comfort. Currently, bamboo is seen as a high-class product, whereas bicycles are not; this juxtaposition will make for interesting marketing of the product.

6.1.2. Potential risks

Even though the bamboo bicycle was received positively, there is a perception that the bamboo is not strong enough to withstand being used on a bicycle. Additionally, if better and cheaper parts cannot be secured, the demand for bamboo bicycles will not exceed that of metal bicycles. Finally, the bicycle industry demand would be too limited if confined to Kisumu and Nyanza Province.

6.1.3. Potential solutions

Before full production, a few bicycles should be handed out to *boda boda* drivers, health care workers, NGOs, and farmers, among others, not only for testing purposes, but also to help change the perception in the community that bamboo is a luxury product. Heavy advertisement, primarily through word of mouth, should begin before full production. At the same time, improvements can be made to the bicycle design. During production, other prototypes should be researched for diversification of future products. Exports should also be considered to increase the market size.

6.2. Imported supplies

6.2.1. Current situation

Most current bicycle parts are shipped from India or China through Mombasa and Nairobi before reaching Kisumu where they are sold by various distributors, mainly bicycle retail and repair shops. However, the imported parts are poor in quality and need to be replaced constantly due to bicycle usage and road conditions in Kenya. By contrast, when the bamboo bicycle was showcased to *boda boda* operators, they were impressed with the high quality parts from the United States.

6.2.2. Potential risks

If the existing distributors are cut out of the process, a valuable distribution chain would be lost. Additionally, if existing distributors cannot supply the parts for bamboo bicycles, their businesses may be impacted negatively if bamboo bikes replace imported bikes. With the global economic crisis, there may also be price fluctuations for both parts and transport.

6.2.3. Potential solutions

In order not to jeopardize the existing distribution chains, it may be better to work with existing distributors to import better parts. Furthermore, because of established relationships, negotiation of trade terms to absorb the shock of fluctuating transport costs could be simplified. For instance, to mitigate the fluctuating price of goods, foreign exchange forward contracts could be utilized.

6.3. Bamboo

6.3.1. Current situation

There is plenty of native bamboo growing on government-owned land in Kenya, with a comparatively small amount growing on farms. Harvesting bamboo on government land is illegal, so the bamboo bicycle facility must purchase bamboo harvested from farmers with a permit to cut bamboo. The permit is free and there is no limiting quota. As a result of projects being imple-

6. Implementation and risks

mented by Maseno University and KEFRI, an increasing number of farmers are beginning to grow bamboo. KARI also has its own bamboo farms from which it sells bamboo. Projections provided by the ABC indicate there will be enough domestic bamboo available to produce at least 30,000 bicycles per year (Bamboo industry participant interview 2009).

6.3.2. Potential risks

Because the nascent bamboo industry has no reliable supply chain or distribution network, it might be difficult to ensure effective supply and quality. Testing is being done on indigenous bamboo to ensure quality of strength; results are pending. Also, bamboo needs large quantities of water in its first three years to grow properly. Access to water in certain areas may be an issue.

6.3.3. Potential solutions

Providing support to bamboo farmers through bamboo specialists will help to ensure the quality of the bamboo. Negotiating fair contracts will also help to ensure proper supply. Distribution networks are starting to develop between farmers and distributors. With increasing demand, bamboo infrastructure is also forecasted to improve (Bamboo industry participant interview 2009).

6.4. Labor

6.4.1. Current situation

The unemployment rate in Kisumu is high, at 37 percent (Republic of Kenya 2002). Many local businesses pay their employees less than the minimum wage; however, as this is illegal, the transgressors run a risk of huge fines. The bicycle industry includes bicycle repairmen, dealers, and craftspeople. These people could potentially be employed to work on bamboo bikes.

6.4.2. Potential risks

One of the potential risks for labor is retention of trained employees. Many workers in Kisumu are seasonal workers who work on their farms for parts of the year. High turnover results in increased training costs, loss of industry knowledge, and delays in production.

6.4.3. Potential solutions

Bamboo bicycles will pay laborers at least a minimum wage depending on skill level. In order to retain trained workers, there will be monetary incentives, benefits and promotion tracks, as well as a flexible work program allowing workers to enter and exit the factory workforce on a seasonal basis.

6.5. Factory

6.5.1. Current situation

One of the primary issues in starting a new factory is finding a proper location. A corresponding issue is whether to purchase land for a factory or rent an existing space. A factory located in or close to the Kisumu city center would be ideally located. In urban locations, basic infrastructure is often already provided, so there should be no need to arrange for the routing of water, sewage and electricity, for example. However, because city centers are prime locations, few spaces are often available for rent.

In rural areas, if infrastructure is lacking, start-up costs will be much higher. In addition, establishing water and electricity provision in an area that has no existing infrastructure will take significant time and effort. However, by locating a factory in a rural area, an investor can provide cheaper wages (i.e. on average, rural workers are paid less than their urban counterparts) (Industry participant interview 2009).

Purchasing land provides greater long-term stability; however, it is estimated that up to 15 years are required before a break-even point is obtained (Industry participant interview 2009). With support from intermediaries such as the Lake Basin Development Authority (LBDA), it might be possible to obtain land, particularly for a development venture such as bamboo bikes.

On average, to purchase a 5000 ft² space costs between 15,000,000 KES to 25,000,000 KES (or between US\$182,927 and



6. Implementation and risks

US\$304,878), with an additional 4.4 percent of the purchase value being allocated to property taxes. Rent for a similar space costs approximately 200,000 KES (or US\$2,439) per month (Industry participant interview 2009).

6.6. Development impact

6.6.1. Economic development

Bamboo bike production can have a positive impact on the local economy. Setting up a local bamboo bike industry might not only create jobs for the youth and *Jua Kali* of Kisumu, but also establish a significant value chain for distributors, suppliers, and farmers. The local government would be supported through taxes. A bamboo bike industry would also help address the transportation needs of rural dwellers.

6.6.2. Environmental impact

Bamboo bicycles also have a positive impact on the environment in both the early and late stages of production. Bamboo itself has a number of environmentally friendly qualities and a lower negative environmental impact than traditional metal bicycles.

Bamboo benefits

Bamboo helps improve air and water quality in areas where it is harvested. Additionally, its root system is constructed in such a way as to reduce soil erosion, a major concern for many farmers. It does not leach many nutrients from the ground, and as it pulls silica from the soil, it is well-suited for the kind of sandy agricultural land found in the Kisumu region (Bamboo industry participant interview 2009).

There are over 2000 documented uses of bamboo according to Dr. Jacob Kibwage of Maseno University (2009). In addition, leftover bamboo can be used for items such as furniture production, thereby helping to reduce waste.

Process benefits

Less electricity is needed to build a bamboo bike than a traditional metal bike. Also, the bamboo used for bamboo bikes is not treated with the same chemicals used for other bamboo treatment processes in Kenya. As a result, there is no need to dispose of chemicals, and people do not come into contact with chemically-treated bamboo.

6.3. Social impact

Health care delivery

A community health worker can visit more patients and deliver urgent care using a bamboo bicycle than with an imported bike. In addition, bamboo bikes are in some ways more reliable as a form of transportation to help carry patients to hospitals or clinics.

Education

The number of primary schools in Kenya significantly outnumber the number of secondary schools, and as a result, many rural children (and their parents) are forced to travel long distances to get to these schools, walking, in some cases, up to 2 hours daily. This is one reason why many children drop out of school. By increasing the affordability and accessibility of bicycles, school enrolment and attendance rates may increase.



7. Conclusion and next steps

7.1. Conclusion

In many ways, Kisumu is an ideal location for the production of bamboo bicycles.

In particular, there is a large potential market in rural areas. Additionally, the end user's price of approximately US\$50 is cheaper than all other models on the market in Kenya. Further, the US\$50 bamboo bicycle will be of much higher quality than currently available imported metal bicycles.

However, the customer perception of bamboo could be a significant impediment to bamboo bicycle production. While some people are aware of the functionality and versatility of bamboo, others perceive it as a weak material and, in some cases, a luxury good (Bamboo industry expert interview 2009). To overcome these perceptions, a pilot program could help spread information about the bamboo bicycles initiative by "word of mouth." A pilot program would also allow the potential investor to determine demand levels more accurately.

7.2. Next steps

This business plan sought to determine the feasibility of a bamboo bicycle venture in Kisumu, Kenya. Our research suggests that such a venture is viable and can be profitable. The next steps are outlined below.

7.2.1. Investors

In order to generate employment and further economic development in the region, the bamboo bikes project seeks an investor in Kisumu. A local investor would be ideal, although international investors are also encouraged to inquire about opportunities. Other potential investment opportunities include joint ventures, such as a public-private partnership based in Kenya, or a coalition of NGOs pooling their resources together to invest in the project.

Further research needs to be conducted with respect to the potential market for government community health workers. Should this market be viable, there is significant potential for government procurement contracts as well.

One option to reduce costs is to import more durable parts directly from China. The threat of the Chinese market with regard to bamboo bicycles has not been determined, although sources have claimed that Chinese suppliers have flooded bicycle markets with bikes when new competitors have arisen in other locations (Industry expert interviews 2009). If China is brought into the equation as a potential investor, this threat may be dampened.

7.2.2. Quality assurance

Research on the design and durability of the bamboo bicycle is ongoing. To ensure the longevity of the venture, periodic assessments for quality assurance will need to occur.

7.2.3. Impact assessment

This business plan proposes that bamboo bicycles could potentially have a positive local environmental, social and economic impact. Monitoring and evaluating the positive and negative impact of the project will be crucial.

7.2.4. Millennium Villages Project (MVP)

Collaboration with the MVP in Sauri provides an opportunity to develop an agro-processing link with the Millennium City of Kisumu and strengthen farm-to-market linkages in the region. Additional research needs to be conducted to determine the viability of the various bamboo species in the area. In particular, Maseno University's Tobacco-to-Bamboo Project and KEFRI are both working to test various local and foreign bamboo species for suitability as bicycle components.

7.2.5. Attitudinal barriers

Further research needs to be conducted regarding existing attitudes towards bamboo and its use as a bicycle material. While initial reaction to the product has been very positive, other potential issues may come up once the novelty of the product has worn off. Understanding perceptions will also aid in the marketing of the product.



Appendix 1. *Boda Boda* market

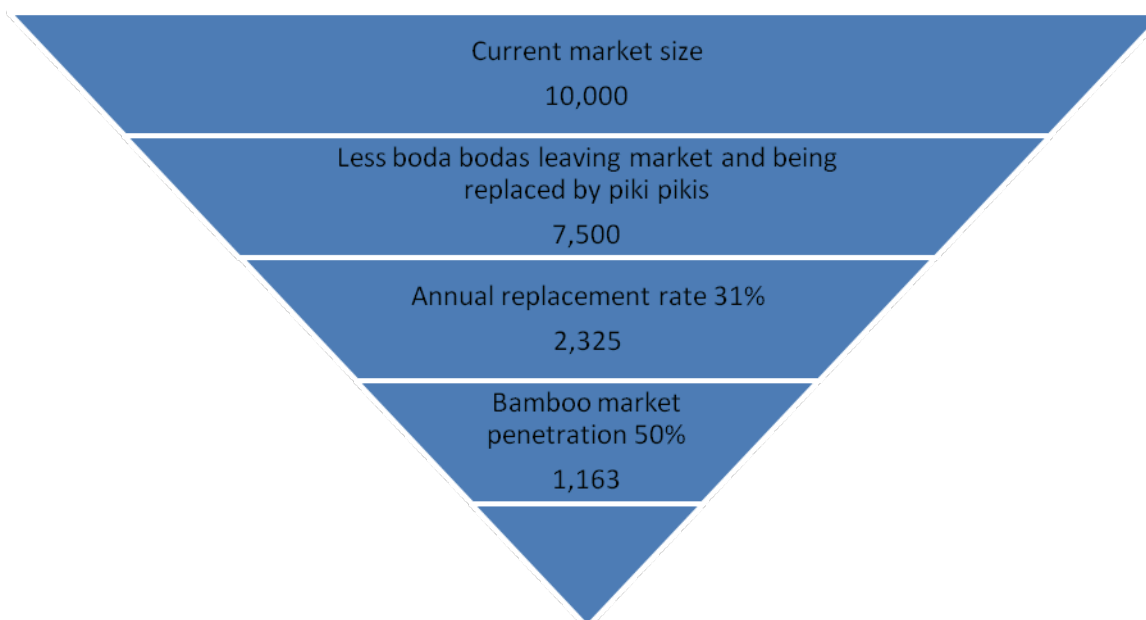
Appendix 1. *Boda Boda* market

To assess the size of Kisumu’s *boda boda* market, the following methodology was employed. First, the current market was size the growth rate determined. This was followed up by interviews with the *boda boda* drivers. The current replacement rate and amount spent annually on repairs was also assessed. Whenever repair costs reached the cost of a new bicycle (including reinforcement), this was considered as “replacing” the bicycle (see below). With this method, a replacement rate of 31 percent was calculated.

Several other indicators were used, including GDP per capita, which grew at four percent in 2007 (according to the Office of the Vice-President 2008). Also, due to their increasing popularity, imports of motorcycle taxis more than quadrupled from 5,212 in 2006 to 29,072 in 2007 (Office of the Vice-President 2008, p. 183). However, bicycle imports have dropped or remained constant for the last several years (see appendix 2). As a result, the *boda boda* market size is estimated to decrease by 25 percent from the current market size.

Finally, it was estimated that with proper marketing and the “novelty” factor, 50 percent of bicycles replaced in the next year will be replaced by bamboo bicycles, resulting in a total market of 1,163 bamboo bicycles in the first year.

Figure A1.1: *Boda boda* market, first year (number of bicycles)



Sources: SIPA and MCI.

Table A1.1. Replacement rate for *Boda bodas*

Replacement rate = 1 / (annual repair per bike / cost of bike + alteration)

Market segment	Annual amount spent on repairs, per bike (KES)	Cost of bike (KES)	Alteration (KES)	Replacement rate
<i>Boda boda</i>	17,441	4,500	960	0.31

Sources: SIPA and MCI.



Appendix 2: Calculation of current market size

Appendix 2. Calculation of current market size

Method 1

In this first method, it is assumed that a portion of imported bicycles over the last 10 years have remained in the market. The sum of all imported bikes over the last ten years is used to calculate the current market size.

Table A2.1. Bicycle imports by year, 1998-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bicycle quantity	139,547	158,760	135,221	246,941	386,503	446,637	722,407	300,214	213,554	240,850
Percent still in market	10%	10%	10%	10%	10%	10%	50%	75%	90%	100%
Bicycles still in market	13,955	15,876	13,522	24,694	38,650	44,664	361,204	225,161	192,199	240,850
Total bicycles still in market	1,170,774									

Source: Office of the Vice-President 2008.

Method 2

In the second method, it is assumed that 100 percent of imported bicycles over the last two years (213,554 + 240,850) remain in the market.

Table A2.2. Method 2 for calculating the current market size

Total bicycles still in market	454,404
---------------------------------------	----------------

Source: Office of the Vice-President 2008.

Method 3

The method used to calculate the current market size is similar to the first method. However, in this case, Ministry of Trade data is used rather than data from the Office of the Vice-President.

Appendix 2. Calculation of current market size

Table A2.3. Number of bicycles imported by country, 2005-2007

	2005	2006	2007
Australia	112	2	21
Austria	--	2	--
Belgium	--	7	--
Brazil	--	1	1
Bulgaria	--	--	150
Canada	10	1	417
China	96,843	90,414	163,809
Cyprus	10	6	13
Denmark	--	--	4
Eritrea	--	1	--
France	11,441	11	10
Gambia	--	300	--
Germany	72	1,065	114
Hong Kong	5,321	--	1,301
India	144,509	139,661	66,158
Iran	--	--	1
Ireland	--	32	--
Israel	10	5	--
Italy	104	52	52
Japan	--	1,764	--
Japan	1,411	--	1,610
Korea	7	--	400
Malaysia	15	--	3
Netherlands	233	147	67
New Zealand	16		--
Norway	--	1	3
Pakistan	1	21	--
Saudi Arabia	9	24	8
Singapore	--	--	2
South Africa	12	--	--
Spain	--	10	--
Sweden	2	--	18
Switzerland	433	82	533
Taiwan	32	2	490
Thailand	155	324	560
United Arab Emirates	12,953	5,183	2,256
United Kingdom	7,145	332	1,721
United States	3,684	321	1,131
Total number of bicycle imports	284,540	239,771	240,853
Growth rate		-16%	0.45%
Percent of bicycles still in market	50%	75%	100%
Number of bicycles still in market	142,270	179,828	240,853
Total bicycles still in market, 2005-2007	562,951		

Source: Based on information obtained from Ministry of Trade 2009.



Appendix 2. Calculation of current market size

Method 4

In the fourth method, it is assumed that 100 percent of the imported bicycles from the last two years (239,771 + 240,853) remain in the market using the Ministry of Trade figures.

Table A2.4. Method 4 for calculating the current market size

Total bicycles still in market	480,624
---------------------------------------	----------------

Source: Based on information obtained from Ministry of Trade 2009.

Appendix 3. Potential rural market size

Appendix 3: Potential rural market size

To estimate the potential rural market size, different replacement rates according to potential repair costs for the rural commuters was used. For the purposes of this study, the middle scenario (scenario two) was used, with annual repairs of 2,000 KES and a replacement rate of 2.25.

Table A3.1. Possible scenarios for calculating the bicycle replacement rate

	Annual repair per bike (KES)	Cost of bike (KES)	Replacement rate
Scenario 1	1,000	4,500	4.50
Scenario 2	2,000	4,500	2.25
Scenario 3	4,500	4,500	1.00

Source: SIPA and MCI.

Scenario 1: A replacement rate of 4.5 gives us a total market for Kenya of 505,000 households, 52,000 households for Nyanza province and 4,000 households for Kisumu district.

Table A3.2. Scenario 1—calculating the potential market

	Total population, below and above poverty line (thousands)	Proportion in rural / any area	x Age of 15-64	x Above poverty line	x 10% Below poverty line	/ Replacement rate	/ Working-age individuals per household, on average	= Potential market (thousands)
Kenya above poverty line	37,530	63%	55%	47%		4.50	3	454
Kenya below poverty line	37,530	63%	55%	53%	10%	4.50	3	51
Nyanza above poverty line	4,164	62%	58%	41%		4.50	3	45
Nyanza below poverty line	4,164	62%	58%	59%	10%	4.50	3	7
Kisumu above poverty line	536	36%	61%	47%		4.50	3	4
Kisumu below poverty line	536	36%	61%	53%	10%	4.50	3	0

Sources: SIPA and MCI.



Appendix 3. Potential rural market size

Scenario 2: A replacement rate of 2.25 gives us a total market for Kenya of 1,011,000 households, 104,000 households for Nyanza province and 9,000 households for Kisumu district.

Table A3.3. Scenario 2—calculating the potential market

	Total population, below and above poverty line (thousands)	x Proportion rural / any area	x Age of 15-64	x Above poverty line	x 10% Below poverty line	/ Replacement rate	/ Working-age individuals per household, on average	= Potential market (thousands)
Kenya above poverty line	37,530	63%	55%	47%		2.25	3	909
Kenya below poverty line	37,530	63%	55%	53%	10%	2.25	3	102
Nyanza above poverty line	4,164	62%	58%	41%		2.25	3	91
Nyanza below poverty line	4,164	62%	58%	59%	10%	2.25	3	13
Kisumu above poverty line	536	36%	61%	47%		2.25	3	8
Kisumu below poverty line	536	36%	61%	53%	10%	2.25	3	1

Sources: SIPA and MCI.

Scenario 3: A replacement rate of 1.00 gives us a total market for Kenya of 2,276,000 households, 234,000 households for Nyanza province and 20,000 households for Kisumu district.

Table A3.4. Scenario 3—calculating the potential market

	Total population (thousands) below and above poverty line	x Proportion rural / any area	x Age of 15-64	x Above poverty line	x 10% below poverty line	/ Replacement rate	/ Working-age individuals per household, on average	= Potential market (thousands)
Kenya above poverty line	37,530	63%	55%	47%		1.00	3	2,045
Kenya below poverty line	37,530	63%	55%	53%	10%	1.00	3	231
Nyanza above poverty line	4,164	62%	58%	41%		1.00	3	205
Nyanza below poverty line	4,164	62%	58%	59%	10%	1.00	3	29
Kisumu above poverty line	536	36%	61%	47%		1.00	3	18
Kisumu below poverty line	536	36%	61%	53%	10%	1.00	3	2

Sources: SIPA and MCI.



Appendix 4. Average household information

Appendix 4. Average household information

In the 1999 Census, there were 6,371,370 households in Kenya (with a total population of 28,686,607), and approximately 4.5 persons per household. It is assumed that 50 percent of working women don't ride bicycles, per interviews conducted in March 2009. As a result, dividing 4.5 persons per household by 1.5 (assuming there is 1 working male and 1 working female per household) results in 3 working-age individuals per household on average.

Appendix 5. Operational considerations

Appendix 5. Operational considerations

There are a number of different options for setting up a bamboo bicycle facility. The assumption made for the base-case scenario is that all steps of production are in-house and bicycles will be distributed from the factory ready to ride. The production model assumes 250 eight-hour working days per year. The productive capacity of the factory will be approximately 31,600 bicycles per year; assuming a five percent scrap rate leaves the business with 30,000 quality bicycles to sell per year. This translates to about 127 bamboo bicycles produced by the factory per day.

This calculation is reached by assigning realistic amounts of time to each step in the production process, using a workforce of 20 workers based on interviews with industry participants. Any extra time a worker has in a given workday would be allotted to other steps in the production line that take longer. The time it would take for one worker to complete each step of the production process per bicycle is detailed below in table A5.1. Estimated times are based on what the factory could produce once it is already running; slower bicycle buildup times at the start of operations are reflected in our assumption that the factory will produce at 75 percent capacity in its first year.

Table A5.1. Bicycle production steps overview

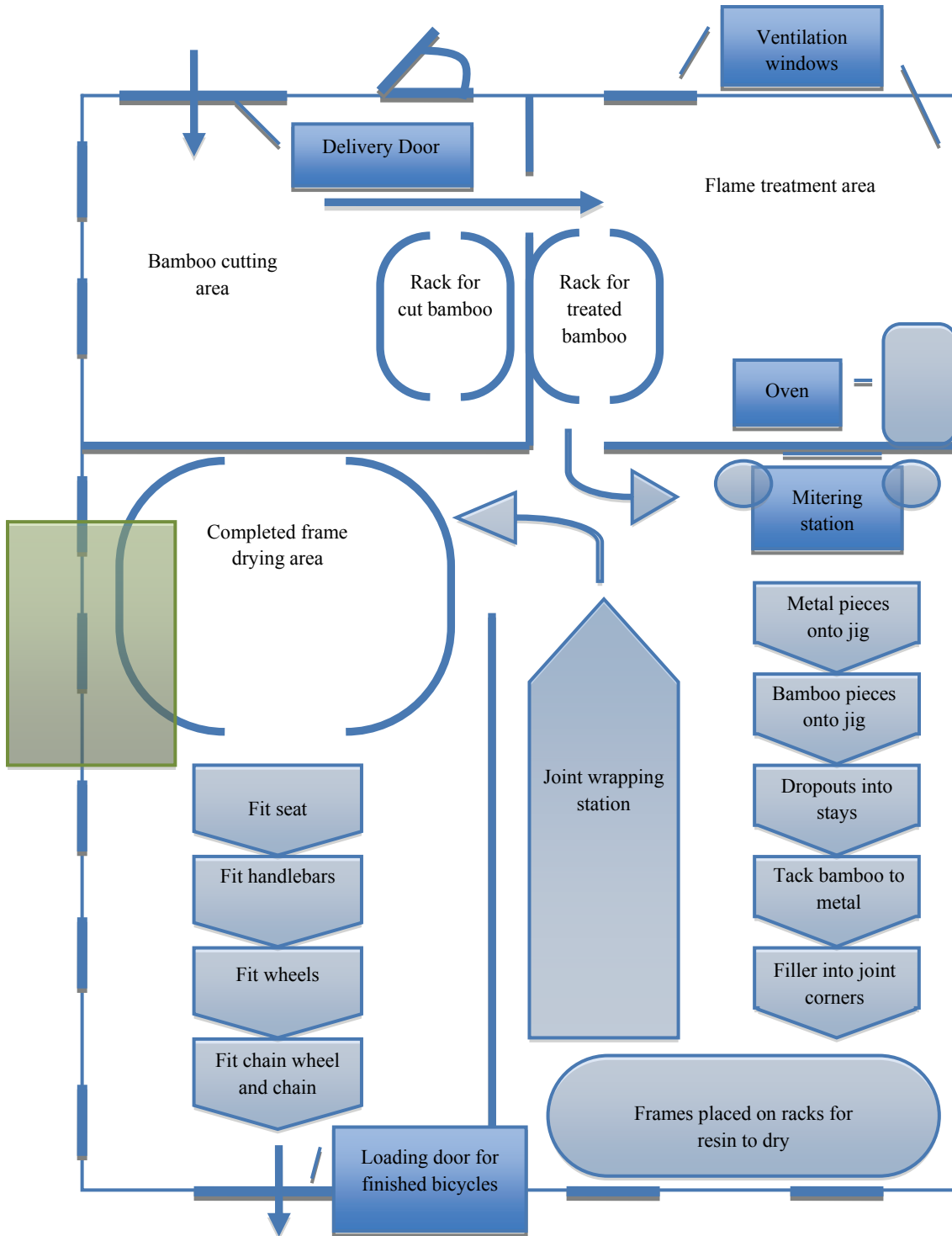
Production step	Description	Minutes per bicycle
Step 1		
Cutting bamboo	Cutting bamboo pieces to size	5
Mitering bamboo	Mitering bamboo pieces to fit together	5
Step 2		
Metal on jig	Assembling metal tubes on jig	1.5
Bamboo on jig	Assembling bamboo tubes on jig	2
Dropouts into stays	Fitting metal dropouts into bamboo stays	2.5
Tacking bamboo	Preliminarily gluing pieces together	9
Packing filler	Packing filler into bicycle joints to prepare for joint wrapping	10
Wrapping joints	Wrapping joints with resin-soaked fiber	30
Step 3		
Fitting metal components onto completed bicycle	Attaching seat, handlebars, chain wheel, chain, wheels to bicycle	16
Total		81

Source: SIPA and MCI.

A potential layout of a model bamboo bicycles factory can be found in figure A5.1. This layout would be applicable for production of different quantities of bicycles, as the main constraints are simply factory space and number of workers.

Appendix 5. Operational considerations

Figure A5.1. Potential layout of a bamboo bicycle facility



Source: SIPA and MCI.



Appendix 5. Operational considerations

Another option worth pursuing is outsourcing the third step of production. Bicycle distributors currently hire local mechanics to assemble bicycles for sale. Assembling the metal components of the bicycles is one of the most time-consuming steps, taking approximately 16 minutes to complete. Outsourcing this step while maintaining a workforce of 20 workers would increase post-scrap bicycle production to 38,000 bicycles per year.

Table A5.2. Bamboo bicycle type of production overview

Type of production	Time to complete one bicycle*	Bicycles produced per day	Bicycles produced per year	Quality bicycles produced per year (post-scrap)
Complete in-house	81 minutes	126	31,600	30,000
Outsourcing third step	65 minutes	160	40,000	38,000

Source: SIPA and MCI.

*This time does not include the approximately 14 minutes needed to flame treat the bamboo and the 90 minutes needed to heat it in an oven. These steps were discounted because they will be mechanized.

Appendix 6. Equipment costs

Appendix 6. Equipment costs

The pieces of equipment needed for bamboo bicycle production are detailed in the below table. The costs were gathered from various sources.

Table A6.1. Bamboo bike equipment cost breakdown

Expenses	Cost in US\$
Equipment	
Drill press ¹	195.12
Drill bits ¹	97.56
Miter jig ¹	400.00
Industrial oven ¹	1,216.00
Automated flame treaters ¹	400.00
Picture jigs ¹	199.76
Truck ¹	63,414.63
Computer ²	536.59
Pull saws ³	30.97
Files ¹	48.00
Die ¹	1,600.00
Subtotal:	68,138.63
Import costs	
Import tax ¹	2,591.51
Subtotal:	2,591.51
Shipping costs¹	
Overseas	3,900.00
Overland	3,300.00
Subtotal:	7,200.00
Total equipment cost:	77,930.14

¹: Industry participant interview 2009.

²: <http://arcticcomputershop.com>, accessed May 2009.

³: <http://www.made-in-japan.bz/kabasawa>, April 2009.

Appendix 7. Training costs

Appendix 7. Training costs

Training costs were calculated based on the assumption that the volunteers themselves will not be financially compensated but that all of their travel costs will be covered by the initiative. The approximately \$4,000 in expenses includes two round-trip tickets to Kisumu, 14 days of housing at a local guest house, two weeks of meals based on local prices, and additional funds for transportation and other expenses. Expenses are detailed below in Table A7.1.

Table A7.1. Training costs (2 volunteers) [not sure if costs below are very realistic]

Description of cost	Cost in US\$ per person per unit	Total cost in US\$ for two weeks
Round-trip plane tickets from New York City to Nairobi ¹	1,304	2,608
Round-trip plane tickets from Nairobi to Kisumu ²	181.60	363.20
Housing in Kisumu per night ³	12	336
Meals per week ⁴	50	200
	TOTAL	3,507.20

¹Price obtained 24 April 2009 from <http://www.orbitz.com>.

²Price obtained 13 March 2009 from Journey Corp, MCI's travel agent.

³Price based on Sooper Guest House's rate for a single room.

⁴Price estimate based on the SIPA team's experience in Kisumu.

Appendix 8: Demand sensitivity

Appendix 8: Demand sensitivity

For a market penetration rate of 20 percent and a total market size equal to our current market, the following net present value and internal rate of return were calculated.

Table A9.1. Net present value and internal rate of return for market penetration rate of 20 percent and total market size equal to current market

Penetration rate	20.00%
Net present value	US \$142,283
Payback period	< 2 years
IRR	68%

Sources: SIPA and MCI.

<i>Bicycle market size</i>	<i>Amount needed to produce</i>
237,000	47,400

For a market penetration rate of 20 percent and a total market size equal to our total addressable market, the following net present value and internal rate of return were calculated.

Table A9.2. Net present value and internal rate of return for market penetration rate of 20 percent and total market size equal to total addressable market

Penetration rate	20.00%
Net present value	US\$616,524
Payback period	< 2 years
IRR	69%

Sources: SIPA and MCI.

<i>Bicycle market size</i>	<i>Amount needed to produce</i>
1,011,000	202,200



References

- Artic Computer Shop online. <http://arcticcomputershop.com> (last visited May 2009).
- Department for International Development. <http://www.dfid.gov.uk/countries/africa/kenya.asp> (last visited November 2008).
- Evans, David K. and Edward Miguel. "Orphans and schooling in Africa: A longitudinal analysis demography," *Demography*, 44 (February 2007), pp. 35-57.
- Food and Agriculture Organization of the United Nations (FAO) and International Network for Bamboo and Rattan (INBAR). *Global forest resources assessment 2005: Kenya, country report on resources* (Nairobi: FAO and INBAR, 2006).
- Foreign and Commonwealth Office (FCO). <http://www.fco.gov.uk> (last visited November 2008).
- Gettleman, Jeffrey. "Protests bring new violence in Kenya," *The New York Times*, January 17, 2008.
- International Forum for Rural Transport and Development. *Forum News: The Bicycle Debates*, June 14, 2008.
- International Monetary Fund. *World economic outlook database*, <http://www.imf.org> (last visited November 4, 2009).
- Kabasawa online. <http://www.made-in-japan.bz/kabasawa> (last accessed April 2009).
- KenInvest. <http://www.investmentkenya.com> (last visited November 4, 2009).
- KPMG. *Bamboo bicycles in Kumasi, Ghana* (New York: KPMG, 2008).
- Library of Congress, Federal Research Division. *Country profile: Kenya*. <http://lcweb2.loc.gov/frd/cs/profiles/Kenya.pdf> (last visited December 2008).
- Maseno University. *Kenya Tobacco Control Research Group*, <http://www.tobaccotobamboo.com/index.php?PID=2> (last visited November 4, 2009).
- Mbithi, Mary and Jamuhuri Mainga. *Doing business in Kenya: Procedures and regulations, opportunities, sources of finance and incentives: A handbook for local investors* (New York: UNDP, 2006).
- Ministry of Trade, <http://www.trade.go.ke/>, (last visited November 13, 2009).
- Millennium Cities Initiative (MCI). *Invest in Kenya: Focus Kisumu* (New York: Columbia University, 2007).
- Millennium Cities Initiative, The Earth Institute at Columbia University. <http://earth.columbia.edu/mci> (last visited November 4, 2009).
- National Environmental Management Authority, <http://www.nema.go.ke/> (last visited November 4, 2009).
- Oanda.com. <http://www.oanda.com/> (last visited March 22, 2009).
- Office of the Vice-President and Ministry of Planning and National Development. *Statistical Abstract of Kenya* (Nairobi: Central Bureau of Statistics, 2008).
- Orbitz.com. <http://www.orbitz.com> (last visited April 2009).
- Republic of Kenya. *Kisumu district development plan 2002-2008* (Nairobi: Office of the Vice-President and Ministry of Planning and National Development, 2002).
- UNIDO. *Eastern Africa bamboo project*, <http://www.unido.org/index.php?id=6915> (last visited November 4, 2009).
- UN Habitat. *Kisumu City development strategy (2004-2009)*. http://www.unhabitat.org/downloads/docs/3589_41974_kisumu_cds.pdf. (Nairobi: United Nations, 2004).
- World Bank Group. *Doing Business 2008: Common Market for Eastern and Southern Africa (COMESA)* (Washington, DC: The World Bank, 2007).
- World Bank Group. *Doing Business 2009: Country profile for Kenya* (Washington, DC: The World Bank, 2008).
- World Bank Group. *Doing Business 2010: Kenya* (Washington, DC: The World Bank, 2009a).
- World Bank Group, *World Development Indicators database*. <http://web.worldbank.org> (last visited November 4, 2009b).