

CUBA'S TRANSITION TO ECOLOGICAL SUSTAINABILITY

Jan Strömdahl

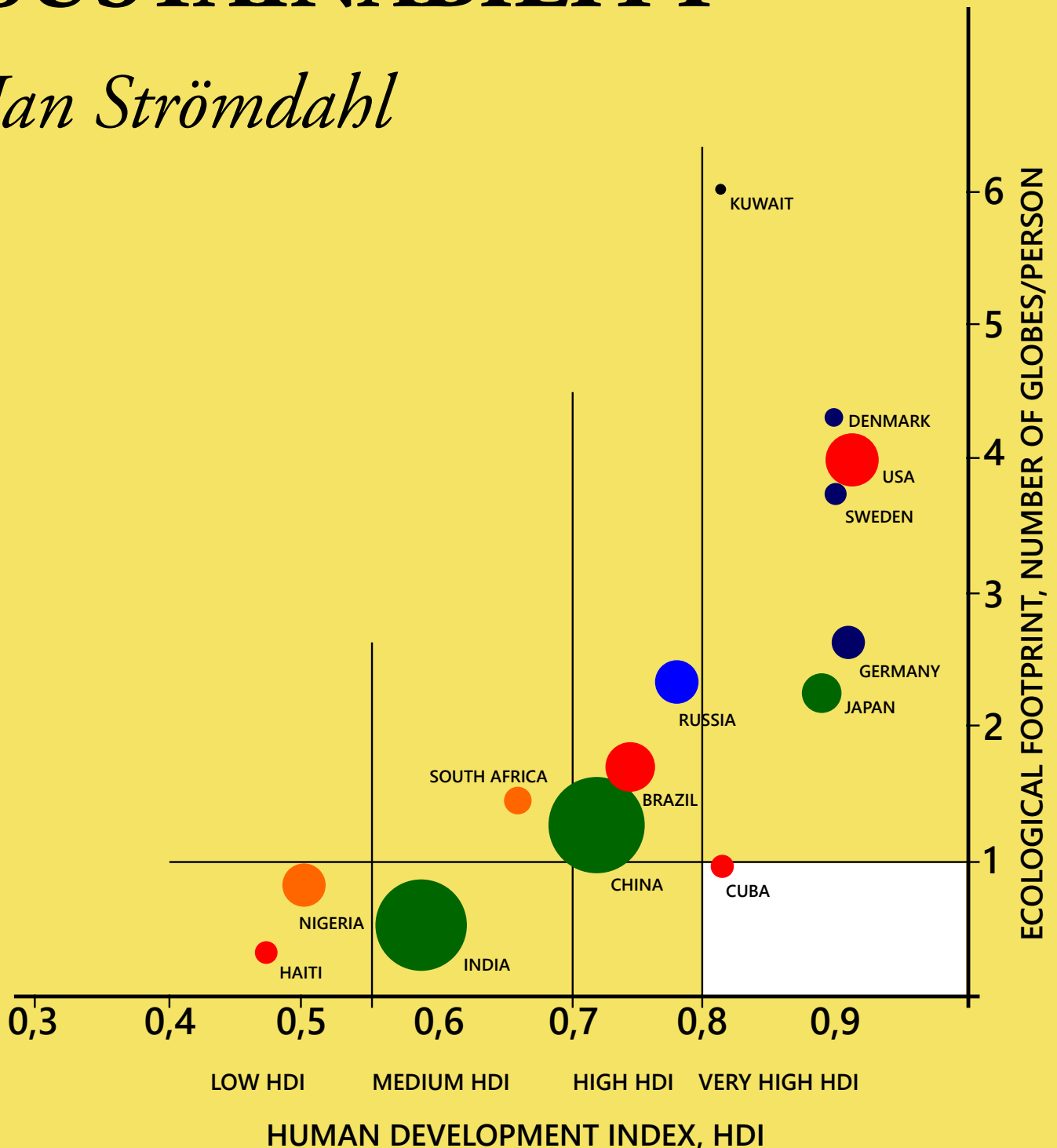


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1. INTRODUCTION

Five years ago, I published CUBA'S TRANSITION TO ECOLOGICAL SUSTAINABILITY in Swedish. It was the result of a study tour led by Eva Björklund but also supported by energy researcher Bruno Henriquez from Havana and energy educator Laurie Guevara-Stone from Colorado, USA, in addition to literature and online studies.

I experienced the Swedish contact horror when it comes to Cuba. The publishing company I worked with suddenly changed contact person when the book was almost ready to be printed. The new contact person insisted on a warning label like the ones on cigarette packages because the book had a positive attitude towards Cuba. I was forced to quickly launch my own publishing company to print it. None of the mass media were interested in reviewing the book, even though the climate change issue had become highly popular. I thus put my own warning stamp on the first page.

The book was however spread to some extent, and I lectured throughout Sweden. In the fall of 2014, I decided to improve my knowledge and update the book. Both the issues of Cuba and climate change have become hotter and it turned out that Cuba remains the only sustainable country in the world. At the same time I was extremely annoyed with all the politicians, scientists and entrepreneurs trying to get credit for using the fashionable concept of sustainability without defining it.

I made a new study tour in January 2015. On my last day - at the research institute INIFAT - I was invited to a Congress on Urban, Suburban and Familiar Agriculture in Havana in April. I returned to Cuba and explained to an international audience in the large congress center why Cuba is the world champion in sustainability. I had the opportunity to take part in series of well-informed seminars on small-scale cultivation. INIFAT's Director General Adolfo Rodriguez offered to assist with the new chapter on agriculture, and to translate and publish the book in Spanish.

This new book contains updated and revised chapters on agriculture, water, energy, transport and housing as well as plenty of new figures and photos. The introductory and concluding chapters are totally new. They put Cuba into a wider context and describe how a sample of other countries could reach sustainability and what the North can learn from Cuba.

I would like to thank Eva Björklund for a great cooperation during both studying and writing. My son Adam designed the cover and the originals for printing. Finally, I thank the Cuban Friendship Institute ICAP's manager for Scandinavia, Claudia Pérez, for important support and the Swedish-Cuban Association's Maria Foundation for a scholarship that enabled production of this book.

Stockholm in October 2015

Jan Strömdahl

2. CUBA AND SUSTAINABILITY

The impetus of this book is a conclusion from the Living Planet Report 2006 stating that Cuba is the only country in the world meeting both criteria for sustainable development based on 2003 data. My curiosity was aroused. How to explain?

Since 1998, the World Wildlife Fund, WWF International, has presented the state of the Earth and various scenarios for development in the longer term. The 2006 report contains for the first time a graph showing how selected countries relate to sustainable development. Along the horizontal axis you find a country's economic and social level ranked by the UNDP's Human Development Index. Along the vertical axis countries are ranked on the basis of their ecological footprints. The Global Footprint Network in California with some 70 partner organizations is responsible for calculating the national footprints.

THE FOOTPRINT AND HUMAN DEVELOPMENT

Sustainable development is a commitment to "improving the quality of human life while living within the carrying capacity of supporting ecosystems" (IUCN *et al.*, 1991).

Countries' progress towards sustainable development can be assessed using the United Nations Development Programme's (UNDP) Human Development Index (HDI) as an indicator of well-being, and the footprint as a measure of demand on the biosphere. The HDI is calculated from life expectancy, literacy and education, and per capita GDP. UNDP considers an HDI value of more than 0.8 to be "high human development". Meanwhile, a footprint lower than 1.8 global hectares per person, the average biocapacity available per person on the planet, could denote sustainability at the global level.

Successful sustainable development requires that the world, on average, meets at a minimum these two criteria, with countries moving into the blue quadrant shown in Figure 22. As world population grows, less biocapacity is available per person and the quadrant's height shrinks.

In 2003, Asia-Pacific and Africa were using less than world average per person biocapacity, while the EU and North America had crossed the threshold for high human development. No region, nor the world as a whole, met both criteria for sustainable development. Cuba alone did, based on the data it reports to the United Nations. Changes in footprint and HDI from 1975 to 2003 are illustrated here for some nations. During this period, wealthy nations such as the United

States of America significantly increased their resource use while increasing their quality of life. This did not hold for poorer nations, notably China or India, where significant increases in HDI were achieved while their per person footprints remained below global per person biocapacity.

Comparing a country's average per person footprint with global average biocapacity does not presuppose equal sharing of resources. Rather it indicates which nations' consumption patterns, if extended worldwide, would continue global overshoot, and which would not. The footprint and the HDI need supplementing by other ecological and socioeconomic measures – freshwater scarcity and civic engagement, for example – to more fully define sustainable development.

Fig. 22: HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS, 2003



LIVING PLANET REPORT 2006 19

Figure 2.1 Ecological Footprints and Human Development Index 2003 as presented in the LPR 2006. The only sustainable country is not named in the figure, but the text can be read: No region, not the world as a whole met both criteria for sustainable development. Cuba alone did, based on the data it reports to the United Nations.



Figure 2.2 Proud students in Cienfuegos. Cuba has tried to give everyone a good and free education.

2.1 THE HUMAN DEVELOPMENT INDEX

Every year since 1990, the United Nations Development Program (UNDP) in the Human Development Reports (HDR) has published the Human Development Index (HDI) which provides a basic picture of welfare of the world's countries. HDI is a composite measure of three dimensions of human development: life expectancy, education (measured by the adult literacy and the enrolment in schools at primary, secondary and tertiary level) and GDP (more recent GNI). The index is not a comprehensive measure of human development. Therefore, UNDP has in recent years supplemented the basic index by inequality-adjusted index, IHDI, index of gender inequalities, GII, poverty index, MPI and gender index, GDI. In this book I have clung to HDI, partly because Cuba has not yet provided full documentation of the various additions, partly to maintain comparability over time.

HDI for Cuba in 2005 was 0.838, ranking the country 51 out of 177 countries providing sufficient data. The four countries with the highest HDI were Iceland (0.968), Norway (0.968), Australia (0.962) and Canada (0.961). Sweden ranked 6 with 0,956.



Figure 2.3 One poster from an Exhibition at pharmacies that provide information about what free medical care really costs. An example of popular education - not included in the HDI.

In the HDR 2014, Sweden has dropped to 12th and Iceland to 13th. Cuba's HDI has decreased slightly to 0.815 while the ranking has climbed to 44th. Cuba is second only to Chile in Latin America including the Caribbean. The life expectancy is 79.3 years, the average school years are 10.2, the expected number of years of school is 14.5. BNI per capita is \$ 19,844 (PPP). UNDP has also introduced a new grading of HDI. Previously called high now is very high (above 0.8). High is between 0.7 and 0.8, medium is between 0.55 and 0.7 and low is below 0.55.

According to the UNDP, it is misleading to directly compare HDI data over time because the structure of the underlying data has changed. I reproduce in figure 2.4 the UNDP adjusted data showing how the HDI for Cuba with sub-components developed from 1980 to 2013. All but life expectancy dive between 1990 and 1995. Something difficult to explain is the reduction in expected number of years in school after 2010.

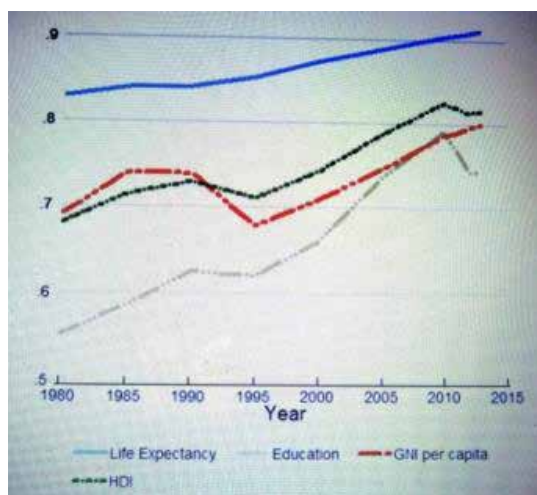


Figure 2.4 Diagram showing how Cuba's HDI and its components developed from 1980 to 2013. Source: UNDP.

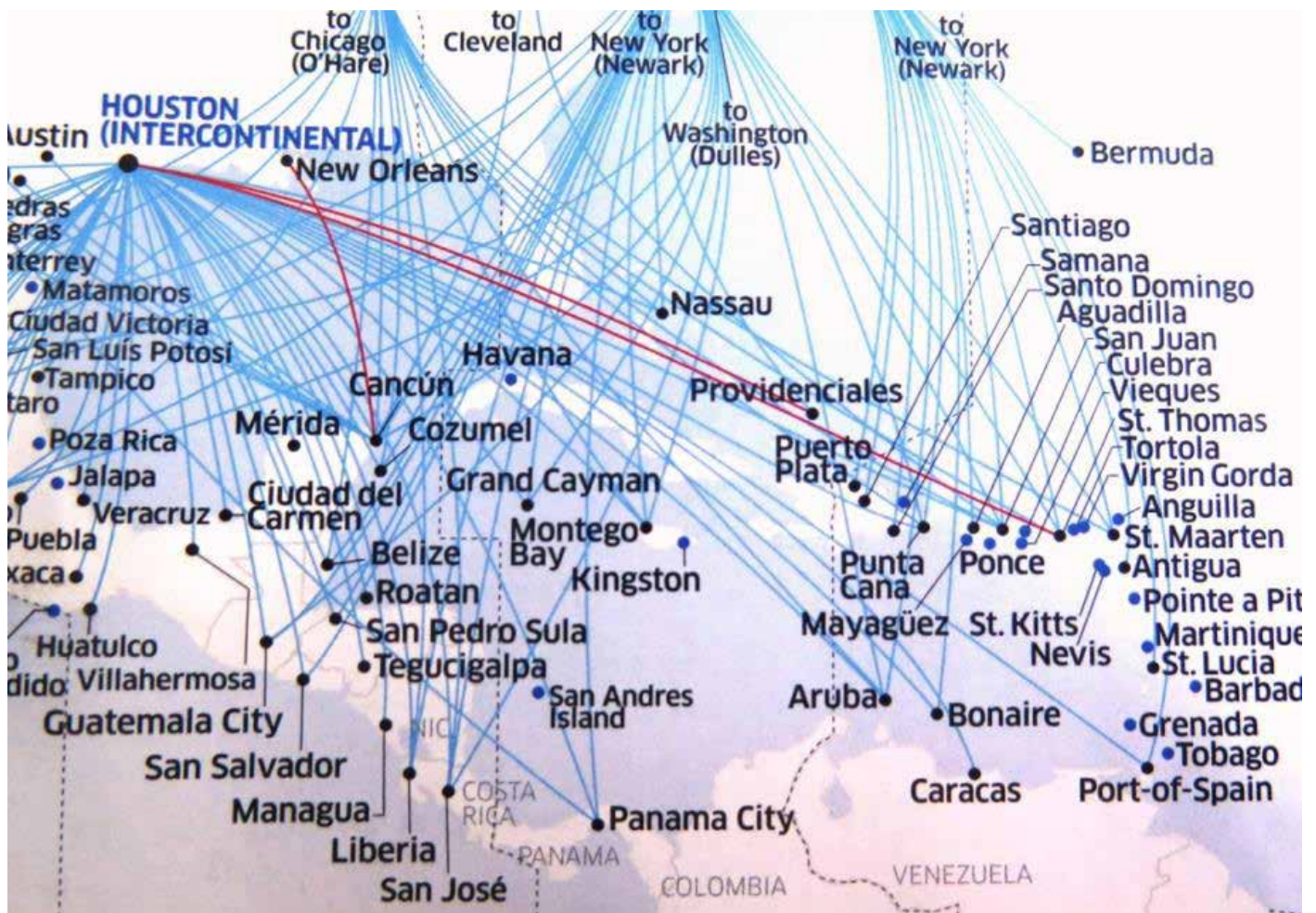


Figure 2.5 Clear expression of the US blockade. The world's largest airline company, UNITED, flies extensively over Cuba but does not land. Map display from flight magazine during a trip between Panama City and NY

The explanation of Cuba's high HDI values lies in the purposeful investments in education and health care during the revolution first phase. This has put Cuba on the same level as countries in North America and Europe. The right to free education and health care is established in the Constitution. But it is not just the Cubans themselves who benefit from these investments - education and healthcare are the main ingredients in both exports and aid. For example Cuban medical personnel were strongly contributing to the relatively quickly stopping Ebola epidemic in West Africa.

When it comes to Cuba's economy, it is not as high ranked as the countries of the North. It was mainly the economy that fell in the early 90s when the Soviet Union went down. But the recovery has been fast and now Cuba has the highest value of the BNI (PPP) throughout Latin America after Chile. However, I am not sure the BNI model is capable to describe a socialist economy with large common sector in a completely fair manner.

2.2 ECOLOGICAL FOOTPRINT

The Ecological Footprint (EF) is a measure of how much land and water the consumption by a given population requires. The footprint can be specified for an individual, a municipality, a region, a nation or the world as a whole. The method was created by Mathis Wackernagel and William Rees at the University of British Columbia in Canada in 1993. It has been used and developed by the Global Footprint Network and 70 international scientific partners. The results are widely accepted and used by, inter alia, WWF and the EU. The ecological footprint is measured in global hectares per capita, but for pedagogic reasons, I have converted into number of globes. The EF- system describes a consumption perspective, including the footprints from imported products.

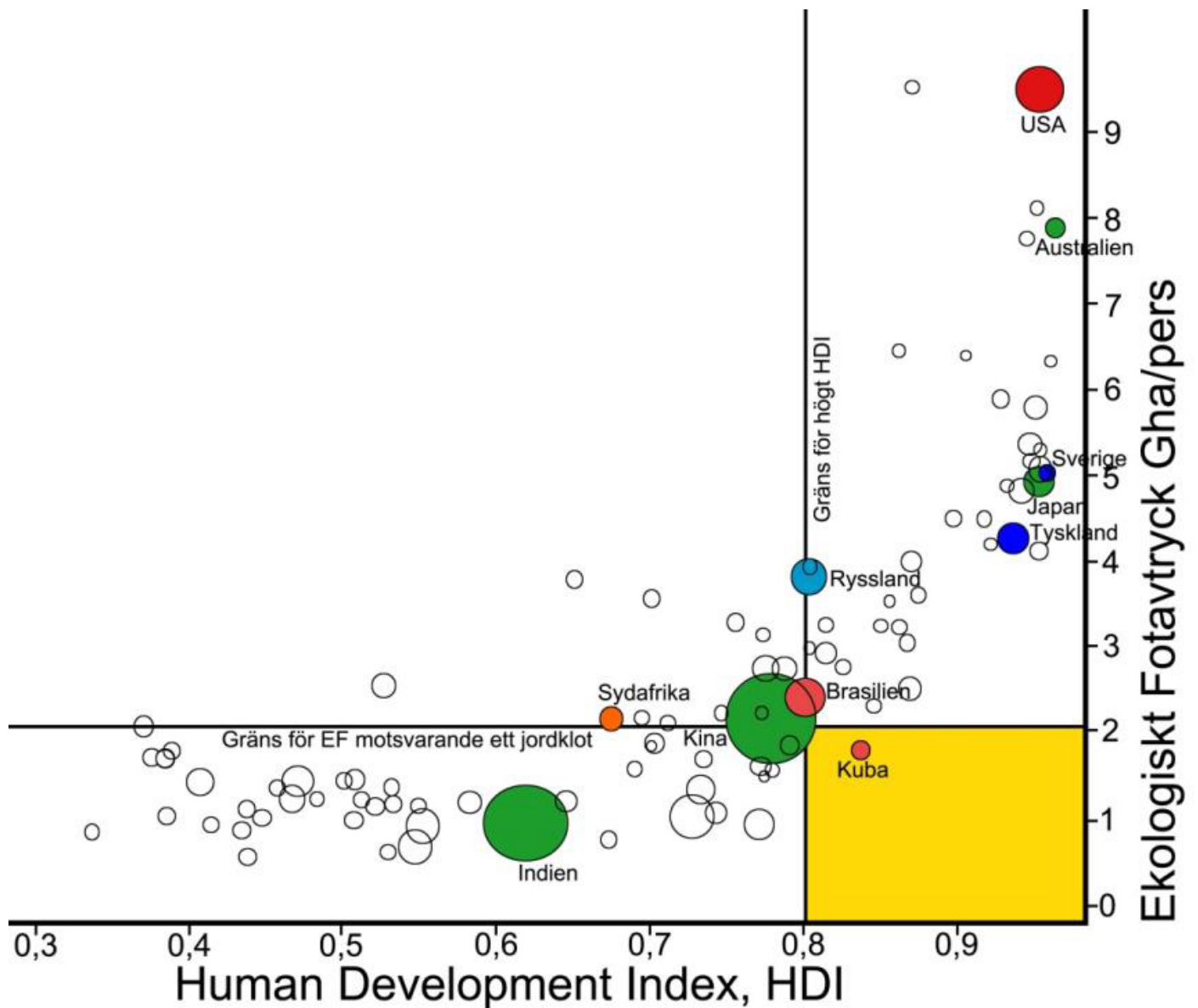


Figure 2.6 The WWF did not present any sustainability graph in the LPR 2008. This one is self-made based on data from the LPR and HDR. Graph from the 2010 edition of my book in Swedish.

A country's EF include the land area required to meet the average citizen's consumption from cropland (food, feedstuff, fiber, and oil), grazing land (meat, hides, wool, and milk), fishing grounds (fish and seafood) and forest products (wood, pulp and firewood). It also includes the land spent on infrastructure and buildings, and to absorb the carbon dioxide released by burning fossil fuels minus the amount absorbed by the oceans.

Nuclear power's footprints were included in the LPR 2006 equated with footprints from the equivalent amount of energy from fossil fuels. Sweden had the largest nuclear footprint, 0.96 globes per person. The overall nuclear footprint was only 0.05 globes per person. In later reports the footprints from nuclear energy are dropped, reflecting a scientific disagreement and successful nuclear lobby. The impact, however marginally, affect the built-up land footprint.

The global ecological footprint 2003 exceeded the earth's capacity by almost 1/4. The global average was 1.22 globes per person. But the consumption of resources was and is very unevenly distributed, both between countries and within countries. The United Arab Emirates had the largest national footprint, 6.9 globes per capita, followed by the USA with 5.6. Sweden's EF was 3.6. Cuba was clearly below the global capacity with 0.9 globes per person. All countries of the North were well above the asset but China, India and all African countries were below. If all countries' inhabitants would consume like the inhabitants of the world's low- and middle-income countries, there would be no danger to the climate and the earth's future.

According LPR 2008 (data 2005) the global population exceeded the biocapacity by 30%. Carbon and agriculture are the most demanding. Carbon accounted for 52% of the global footprint and cropland for 24%, followed by grazing land (10%), forests (9%), fishing ground (3%) and built-up land (3%). Consequently carbon dioxide emissions and agriculture jointly exploit the earth's total biocapacity.

WWF excluded the interesting sustainability graph in the LPR 2008. I tried to get an explanation. The only thing close to an explanation was that they wanted to give the water footprint a big space. Most likely, however, it was too painful for institutions with close ties to the United States to once again be enforced to certify that Cuba was the only sustainable. It may even strive against the blockade rules, or at least against their purpose.

I had to take the matter in my own hands and made a graph based on the facts behind the LPR 2008. I published this in the 2010 edition of this book. It shows that Cuba alone remains sustainable and that other countries follow a path missing the yellow box.

2.3 LATER LIVING PLANET REPORTS

In the LPR 2010 the graph of the relationship between HDI and EF is back. This time it is more dimmed and indistinct despite the fact that Cuba no longer fit into the yellow box. Now Peru is the only sustainable country. Cuba has not really weakened their data but as the world population increases, the limit of one globe decreases and biocapacity per capita decreases. Cuba with 1.03 is placed slightly over the limit of one globe, like Colombia and Ecuador. The Latin American countries have always been closest to sustainability.

In the 2012 report, WWF has chosen to supplement the HDI with IHDI. It is the inequality-adjusted index. The graphs are small and difficult to read, but no country qualifies in the now green box. IHDI moves all countries to the left in the graph. They get a much lower value on the horizontal axis, since no equal countries exist. Cuba's EF then is 1.07 globes and it depends mostly on increasing ecological footprints from cropland.

The latest report from the WWF (autumn 2014) once again publishes a small difficult-to-read graph - now just as IHDI version. It is not possible to understand which countries are included, but in the HDR 2014 it is possible to see that IHDI data are missing for quite a number of countries. For Cuba UNDP sources in Havana relate that the work is in progress. It will be interesting to see how the equality situation in Cuba will be perceived by the UN institution.

Again I introduce a self-made sustainability graph with HDI / EF for a small sample of countries. Cuba is back in the yellow box. No other countries with very high HDI qualify within one globe. Most notable is otherwise that primarily US, but also Germany has reduced their ecological footprint considerably in recent years. For US there is a clear connection to the economic crisis. However, Germany? Could it depend on all the renewable energy?

I also reproduce a graph from the LPR 2014 showing how the different components of ecological footprint have increased over the last 50 years. Carbon dioxide emissions are mostly increasing (transport), but also cropland (food). Globally the population now consume on average the equivalent to 1½ globe per capita. Carbon is the major scoundrel, overexerting the soil and climate.

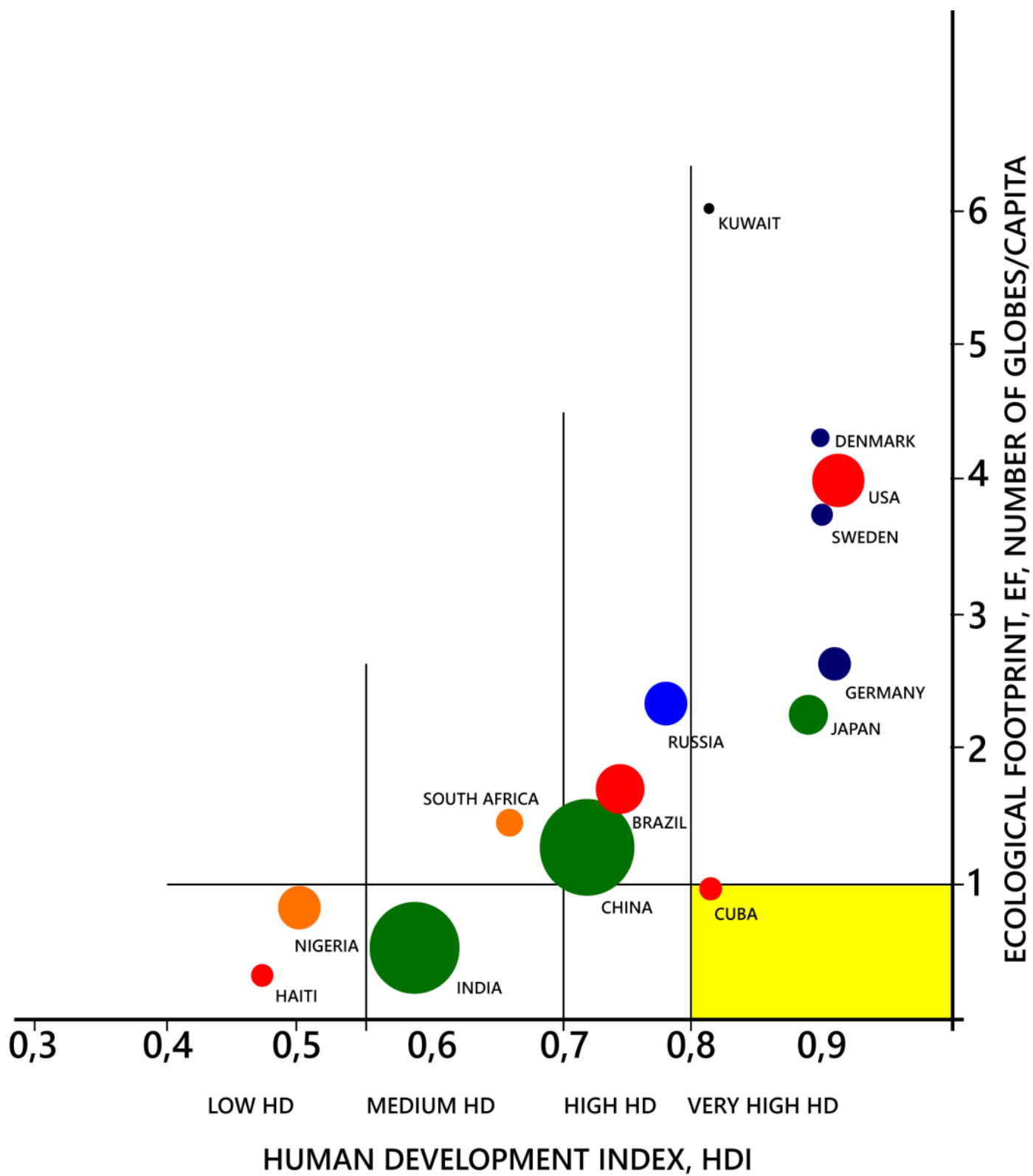


Figure 2.7 Sustainability graph showing the correlation between HDI and EF according to latest available data in HDR and LPR 2014. Self-designed.

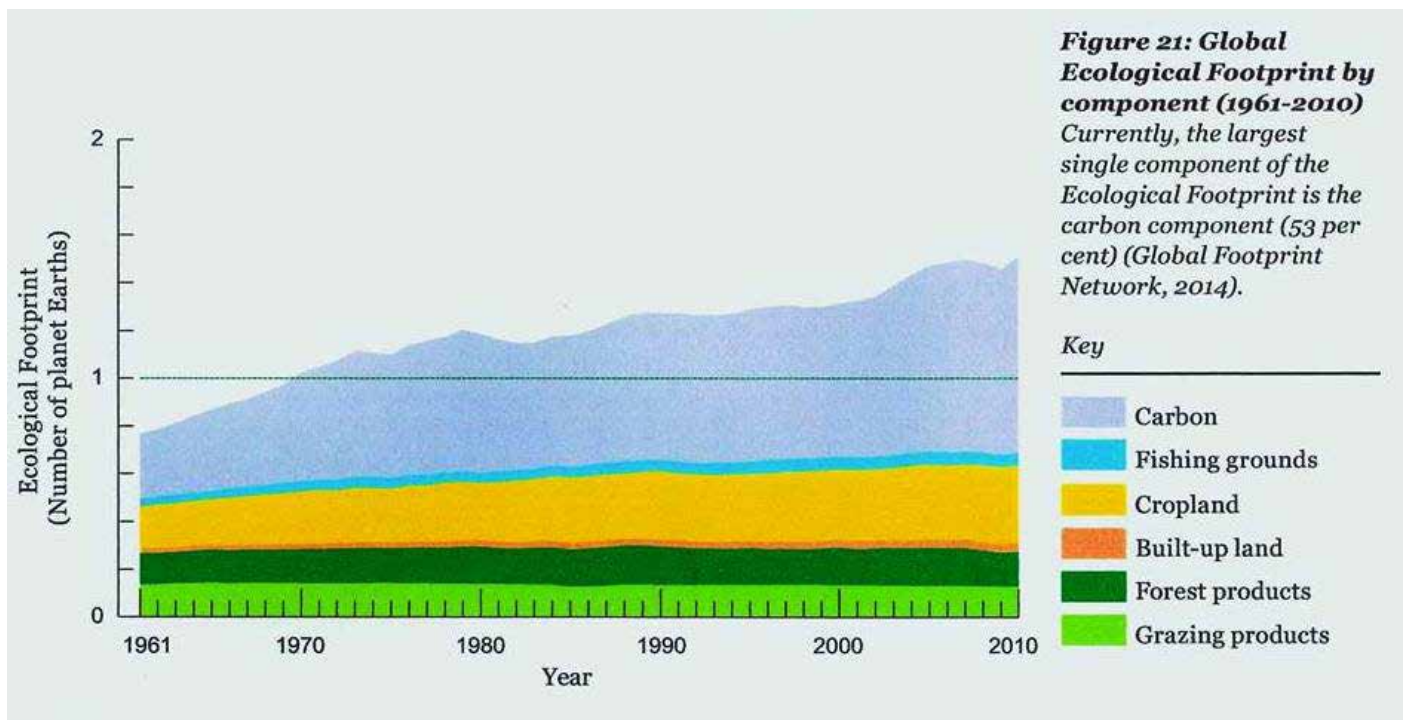


Figure 2.8 Global footprints for 50 years. From LPR 2014.

2.4 CONCLUSIONS IN THE LIVING PLANET REPORTS

We are headed for collapse but so far we can survive with the large carbon emissions to the atmosphere and the oceans from the rich countries and the over-exploitation of resources from poor countries with a starving majority. Clear symptom, however, is climate change.

WWF identifies key areas where we need to change lifestyle and economy in order to break the trend and start moving towards a situation where we do not over-exploit the earth's resources. The authors behind LPR mean that it is possible if we want. At the same time they say it requires a concerted and forceful leadership, and that the market will lead to wrong decisions. WWF believes it is possible to get rid of the excess by mid-century through a series of measures, wedges, which help to turn the curve. It is primarily about the energy, the root of both exceeding and climate change. It's urgent and every country have some responsibility.

WWF describes a solution of the energy issue connecting to and complementing the IPCC scenarios. It is based on three parallel strategies: to increase energy efficiency and savings, to increase the use of renewable energy and to cut emissions and store carbon dioxide.

Regarding other actions to achieve sustainability, WWF points at the importance of reducing birth surplus, personal consumption and waste production. Cities should be built for pedestrians and not for cars. Communication can be built by mobile phones rather than cars. Agriculture can be more effective and developed on land not used for other purpose. Food may be increasingly produced locally.

	INDIA	CUBA	CHINA	WORLD	SW	US	DEN
Cropland	0,20	0,27	0,31	0,32	0,50	0,60	1,48
Grazing land	0,01	0,12	0,08	0,12	0,32	0,18	0,50
Forest prod	0,07	0,05	0,09	0,14	0,83	0,40	0,63
Fishing gr	0,01	0,02	0,06	0,06	0,11	0,05	0,35
Built-up land	0,03	0,01	0,06	0,03	0,11	0,04	0,14
Carbon	0,20	0,50	0,64	0,83	1,85	2,70	1,20
Total EF	0,52	0,97	1,25	1,50	3,72	3,97	4,29

Figure 2.9 Selected countries' ecological footprints in 2010, expressed in number of globes per capita, totally and per component. Basic data from the Living Planet Report 2014.

2.5. ANALYSIS OF ECOLOGICAL FOOTPRINTS FOR SELECTED COUNTRIES

A weakness of the EF system is that all data are 3-4 years old when the results are published. I have received no explanation other than there is a large amount of data to be managed. A greater interest from the political sphere might be able to increase funding and speed up reporting.

The figures presented in the table are based on data from 2010, presented in the LPR 2014. These are the latest available until autumn 2016.

World average is just 1½ globe. If the world's population would emit the same amount of carbon as an average Indian - or a poor European - the world citizens would be able to increase their food consumption significantly within the earth's capacity.

India's ecological footprint has long been about ½ globes. India is below the world average in everything except built-up land. Outstanding is the low level for cropland and grazing land. And carbon emissions are exemplary small.

Cuba is closely balancing on the limits of one globe. Historically, Cuba is back on the 60s level. Recently the cropland footprint decreased while carbon increased. That is worrying and indicate that Cubans eat less and use more cars or AC. The transition from fossil fuels to renewable sources has barely started. On the contrary, it looks like oil dependence has increased. Cubans must reduce their carbon emissions significantly. Then they will be able to increase their consumption from other components, such as food and housing - within the context of one globe.

China is often criticized because of large carbon emissions. Yet they are only half of Denmark's, or a third of Sweden's. Of course we have to look at the per capita figures. Then it is also obvious that China is close to the world average in everything except carbon, where the emissions are considerably lower. China has increased its overall footprints in recent years, but is still well ranked compared to countries in the North. A halving of carbon is enough to stay within one globe.

Sweden has a difficult situation and the trend is negative. The Swedes are about to overtake the US. Quite a large footprint from food consumption, very high from forest products and almost four times as large as Cuba from carbon emissions - despite high shares of renewable energy and nuclear power. For the Swedes it is not enough to reach 0-emissions if they want to qualify within the planetary boundaries. They must also approach to the world average of cropland, grazing land and forest products. It is a hard project, but the Swedes can learn from Cuba.

The United States has reduced its overall footprints in the last decade. Now it is midway between Sweden and Denmark. Carbon dioxide emissions dominate and accounts for more than 2/3 of the US total. Cropland and forest footprints are high too - but not as high as for Denmark. For the US, it is almost enough to reach 0-emissions.

Finally Denmark passed the United States a few years ago - despite moderate carbon emissions. But the Danes over-consume significantly within all other components. How Denmark can become sustainable is a mystery to me.

2.6 GLOBAL TARGET FOR SUSTAINABILITY

International research and policy on climate and sustainability has focused entirely on emissions of greenhouse gases and especially carbon dioxide. There is a fairly strong consensus about the two degrees target, i.e. the earth's mean surface temperature must not be allowed to rise more than 2 degrees Celsius compared to the time before industrialization. There are researchers arguing that the two-degree target is insufficient and that 1 degree or perhaps 1½ should be the target of global actions. There are also scientists and activists focused on the amount of carbon dioxide in the atmosphere claiming that the carbon dioxide concentration must stop at about 400 ppm (parts per million) or be reduced to 350.

	INDIA	CUBA	CHINA	WORLD	SWE	US	DEN
Cropland	0,20	0,27	0,31	0,32	0,50	0,60	1,48
Grazing land	0,01	0,12	0,08	0,12	0,32	0,18	0,50
Forest prod	0,07	0,05	0,09	0,14	0,83	0,40	0,63
Fishing gr	0,01	0,02	0,06	0,06	0,11	0,05	0,35
Built-up land	0,03	0,01	0,06	0,03	0,11	0,04	0,14
Carbon	0,20	0,50	0,64	0,83	1,85	2,70	1,20
Total EF	0,52	0,97	1,25	1,50	3,72	3,97	4,29
New Carbon	0,15	0,15	0,15	0,15	0,15	0,15	0,15
New total EF	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Space +/-	+ 0,53	+ 0,38	+ 0,24	+ 0,18	-1,02	-0,42	-2,24

Figure 2.10 The Figure 2.9 supplemented with carbon emissions within about 1 ton (0,15 globes) and the total ecological footprint within the earth's biocapacity (1,0 globe). The results are in terms of increased or reduced space for remaining consumption. With a small reduction in carbon dioxide emissions Indians may on average more than double their remaining consumption within one globe. Cuba and China must make bigger carbon reductions but get considerable space for more consumption. The countries of the North must reduce considerably both emissions and other consumption. All data are converted to number of globes per capita.

According to the Intergovernmental Panel on Climate Change, the IPCC, we are likely headed for a temperature increase of 4 or 6 degrees Celsius and decisive action is necessary if we are to prevent climate change, particularly threatening islands and the poor.

Cuba is a small island country, able to influence the global climate situation very marginally. At the same time it is important that all countries on earth contribute and take responsibility based on its area and population. The hitherto negotiations on the UN climate conferences are unclear and inadequate when dealing with fairly limited percentage emission reductions for countries or regions. It would be much more distinct if all countries were demanded to present an action plan and timetable for the country's own carbon emissions reaching the target of one ton per capita. There must be about a consumption perspective, i.e. the population's total emissions from production in the country including imports. It must also include international flights.

The one ton target should be combined with the one planet target which has the consumption perspective measuring not only carbon - in the form of the forest land needed to take care of the emissions oceans and atmosphere cannot absorb - but also other consumption from the earth's resources. And as far as there is only one planet earth, it is educational simply to explain that all countries must have the target not to consume more than this single planet can cope with.

Cuba's carbon emissions in 2013 were 39 Mt. That's equal to 3.5 tons per person per year. The corresponding figures for Sweden are 45 Mt and 4.7 tons per person, a surprisingly small difference. The explanation is that these data from the Global Carbon Atlas refers to emissions just from domestic production. The Swedes per capita emissions from consumption, including from imported goods and services, were 11.1 tons. It is far more appropriate to use the consumption perspective, but there are no good international statistics. The best way is to look at carbon in ecological footprints. There the Swedish is 1.85 globe and Cuban 0.50, approximately 30% of the Swedish.

Cuba's project according to this perspective would be a reduction in carbon dioxide emissions to one ton per person equivalent to about 0.15 globes. It would provide space for almost doubled consumption from other fields.

2.7 MEASURES FOR PROTECTION AGAINST CLIMATE CHANGE

Global overconsumption and excessive greenhouse gas emissions are already realities affecting the situation, not least in the relatively small island nation with a tropical climate.

The main threats to Cuba are:

- Extreme weather with storms and floods. On average, there is one hurricane every other year.
- Heat and drought leading to desertification and forest fires, particularly in the eastern provinces.
- Sea level rise leading to reduced coast areas and threats to mangroves and coral reefs.
- Contamination of water, soil and air.
- Reduced biodiversity.
- Reduced access to drinking water.
- Increased spread of diseases such as malaria.



Figure 2.11 Just a few days after an extremely sunny and warm period in April 2015 Havana was drowned by a violent rainstorm with two deaths and 24 destroyed buildings.

Disaster preparedness is organized based on the fact that Cuba has already for some time been exposed to disasters and threats. The civil defense organization can contribute to implement planned evacuations. As a result Cuba has had very few deaths from hurricanes unlike Haiti and the US. A special National Climate Change Program is adopted by the government and kept continuous updated. The public health system with one doctor per 137 inhabitants and the public school system, free for all, are important too.

Examples of measures implemented:

- Increased investments in environmental protection.
- Increased household investments in water and sanitation.
- Removal of settlements from extremely sensitive areas. No new settlements in low-lying areas.
- Protection of sensitive coastal ecosystems.
- Development of fish farming to reduce pressure on coral reefs.
- Replanting of mangroves and original varieties in coastal zones.
- Increased environmental education

2.8 HOW HAS CUBA SUCCEEDED SO FAR?

The combination Soviet Union collapse and United States tightened blockade constituted an economic shock for the Cubans. It was difficult to provide enough healthy food for the entire population. But the situation also enforced an ingenuity and ability to grow to find alternative and resource-efficient solutions. In all fields there has been cooperation between research and practice.

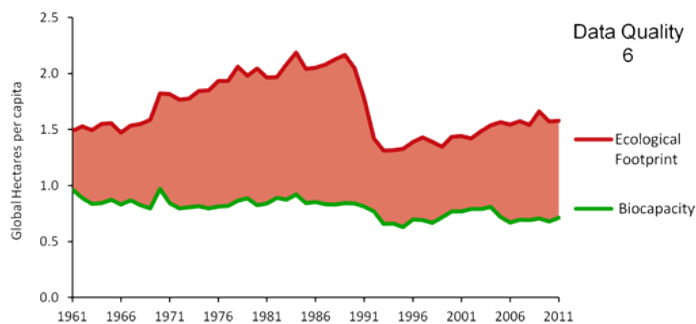


Figure 2.12 Cuba's ecological footprint and biocapacity during 50 years. EF dropped dramatically when the Soviet Union fell. From Global Footprint Network

Oil and chemistry-free agriculture developed. The non-motorized transports were of great importance. The sun was introduced in local and small-scale energy supply.

High quality education and health care and agro-ecological methods were developed even before the special period. It could continue despite lack of teaching materials and medicine. There was for example, an important knowledge of how to use the rich flora of medicinal plants.

Subsequently the enforced ingenuity and resource-efficiency have walked hand in hand with policy and a purposeful planning of national resources.

Thus, it is not difficult to explain why Cuba has had a sustainable development during the past two decades. The question is whether the country might be able to continue like that. I discuss the possibilities in coming chapters, but it is crucial that Cuba manages to dismantle its dependence on oil. I also try to assess the signification of normalization of relations with the ravenous neighbor next to the north.

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3. AGRICULTURAL AND OTHER LAND USE

Cuba was "discovered" by Christopher Columbus in 1492. The Spanish colonialists were looking for gold, but found a sheltered harbor for the Navy and forest land to exploit for its livelihood. The original population was wiped out almost completely and the sugar plantations violent expansion in the 1800s transformed the entire island's geography. By the year 1900 only half of the forests remained and in 1959 the forests covered only 14% of the land. When the Cubans were reaching the victory over the Spanish colonial power, the USA occupied their country and took over the sugar industry. In 1956 Cuba started its liberation from the US neocolonial power. The economy and the sugar industry expanded with Soviet oil, tractors and fertilizers. The Soviet system's collapse meant the end for these deliveries, and the harsh US blockade forced Cuba to develop their own methods and manage the country on her own. Small scale organic farming and reforestation are essential elements of the rescue plan. The UN Food and Agriculture Organization have rewarded Cuba for climate-friendly and organic agriculture and for the achievement of fast reduction of fossil energy in fertilizers and fuels by 70%.

3.1 EXPLOITATION AND REVOLUTION - A HISTORICAL BACKGROUND

Sugar cane was introduced as early as in 1512. Cuba was a sparsely populated Spanish colony in the late 17th century when sugar production was initiated on a larger scale. This expanded in the late 18th century with the increased importation of slaves from West Africa, and particularly fast in the early 19th century after the slave uprising in Haiti. This resulted in a blockade of Haiti by the colonial powers and Cuba took over Haiti's role as leading producer of sugar and coffee.

The introduction of railways for sugar transport in 1837, the use of steam engines in the sugar mills and reduced coffee production in the middle of the century was decisive for the absolute dominance of sugarcane in the country's economy. Around 1880, the Spanish sugar monopoly nourished North American ambitions to take over the control of Cuba.

Land ownership was dominated by large estates, however largely ruined during the protracted liberation war against Spain. After the US invasion of Cuba in 1898, most of the large estates were taken over by North American companies. The sugar was harvested by hundreds of thousands of farm workers. Most were landless, some were tenant farmers or crofters. They got lousy wages during the six months of sugar harvest and no income at all in the other half - if they didn't have access to land. They had no access to hospitals and schools. They were mostly illiterate and had no protection by social legislation. The richest left their Spanish colonial habits to copy the US lifestyle. In the 1920s the tourist industry also started, turning Havana into a competitor to Las Vegas.

In the 50s US companies owned not only about 1.2 million hectares of the best land in the country but also the electricity and telephone companies, the oil and mining companies, the banks and an important part of small industry such as for example dairy. The victory of the Revolution changed everything. In accordance with the Moncada program an agrarian reform was carried out in 1959 giving tenant farmers and crofters access to the land they used. Land ownership over 400 hectares was expropriated and turned over to the tenant farmers or crofters or converted to state farms. A second land reform reduced the upper limit of private holdings to 67 hectares. In parallel, private small farmers started to organize themselves in a peasant association, ANAP, and in service cooperatives for bank loans, machinery, seeds and technicians.

After the United States as early as 1959-60 took the first steps in its economic warfare ending both sugar import from and oil export to Cuba, trading with the Soviet Union started. The conditions gave Cuba a fixed price on sugar, higher than the world price, and fixed lower costs for imported oil. It saved the country from collapse and laid the foundation for rapid economic development, but also led to a significant dependence on oil as energy source.

The yearly sugar production increased to a peak of 8.5 million tons in 1970. It was anyhow a setback in relation to the plan of 10 million tons. During the 60's a diversification was also initiated for increased food production also including livestock. Before 1959 almost everything was imported from the United States. Production increased steadily despite the US biological warfare with swine fever and leaf fungus. The agriculture developed with the methods that were dominating both the east and the west with advanced large-scale mechanization and chemical fertilizers.

All commerce was nationalized 1968 to prevent hoarding and higher prices. The farmers sold their production to state wholesale institutions that distributed them to the state grocery stores with subsidized prices. Free farmers' markets were introduced in the late 70s in order to improve the supply of fresh products.. But 80% of the cultivated land was state-owned and to great extent used for export of sugar and citrus fruits. At the same time root vegetables, rice, fruit, cattle, pigs, chickens and eggs for domestic supply expanded on state, cooperative and private land.

After the fall of the Berlin wall in 1989 and the Soviet collapse in 1991 basically all trade with the former Warsaw Pact countries that had counted for some 80 % of Cuban trade disappeared. The most devastating was that the highly industrialized agriculture was cut off from the fuel, fertilizers and fodder and spare parts it depended on. And the sugar and citrus exports lost their markets. Thus there were virtually no export earnings for payment of food imports. Although the rationing of food, clothing and other consumer goods introduced in the early 60's guaranteed an equitable distribution of resources available, there was not much of it and caloric intake dropped drastically. The question was whether the Cuban society could survive.

The big fishing fleet practically disappeared when the ships could not leave harbor because of the lack of fuel. The same was valid for the merchant marine. Cars, buses, tractors stood still. Electric power failure occurred up to 18 hours a day. The production of meat, eggs and milk decreased significantly. To avoid collapse Cuba had to quickly implement drastic measures. Urban farming on agro-ecological base developed, sugar cane plantations were converted to food production and tourism expanded with foreign capital to bring in hard currency to pay for imports.

Population structure

In the 50s about half of the population lived in rural areas. During the past four decades, the rural population decreased by about 0.6% per year, while the urban population has increased by 2%. Currently one quarter is living in rural areas and three quarters (77%) in urban areas. Over the past 10 years, the Cuban population decreased by 0.01% a year but Havana has decreased much more, about 1% per year, mostly in the city centers.

About 87% of the rural population was engaged in agriculture in 1960. In 2000, this proportion had fallen to 66%. In 2014, 540,000 persons work in agriculture, which is 10% of the total labor force. Unlike almost all other areas, women are heavily underrepresented. Just 19% of the labor force in agriculture is women.

Ownership structure

A new farm bill in 1993 laid the foundations of new workers' cooperatives and restoration of free agricultural markets (the farmers' markets of the 80s had been closed at the end of the decade). Workers' cooperatives were established in the former state sugar plantations. Those were divided and transferred to employees cooperatives with usufruct for organic food production. Later fallow land was allotted also to individuals who undertook production of food as a primary task. Other initiatives such as the protection of forests, timber production and livestock were also encouraged.

Workers' Cooperatives in the old sugar plantations, UBPC, got the right to use the land rent-free. Each family was allowed self-sufficiency while accepting a commitment to grow food for the domestic market. Already the CCS- and CPA- cooperatives existed. The former were introduced at the time of the first agriculture reform in 1959. With time approximately 200,000 former tenant farmers got private or cooperative ownership to approximately 20% of the country's farmland.

Today, the growing private and cooperative sector has a central place in agricultural production. CPA is a form of co-operatives where private landowners have merged their lands.

PIAL –Individual Local Agriculture Production – local small farms is a special model for potato growers. The idea comes from the National Institute of Agricultural Sciences (INCA) and attracts especially women. PIAL started in 2000 and has so far included 50,000 farmers in nine of Cuba's 14 provinces. It works with Local Centers for Agricultural Innovation (CLIA), forming networks of local actors interested in innovative technology and where farmers constitute the core.



OFICINA NACIONAL
DE ESTADÍSTICA E INFORMACIÓN
República de Cuba

AGRICULTURA, GANADERÍA, SILVICULTURA Y PESCA AGRICULTURE, LIVESTOCK, FORESTRY AND FISHING

9.1 - Distribución de la tierra del país y su utilización según formas de tenencia en junio de 2013

Land distribution and its use, according to tenure forms on June 2013

CONCEPTO	Miles de hectáreas					
	Superficie			No estatal		
	Total	Estatad	Total	UBPC	CPA	CCS y Privados
Total	10 988,4	5 932,1	5 056,3	1 952,0	614,3	2 490,0
Superficie agrícola	6 342,4	1 851,7	4 490,7	1 677,5	621,5	2 291,7
Superficie cultivada	2 645,8	471,8	2 174,0	851,3	264,9	1 057,8
Superficie no agrícola	4 646,0	4 080,4	585,5	274,5	92,8	198,3

Fuente: Ministerio de la Agricultura (MINAG).

Figure 3.1 Soil distribution in Cuba divided in state and non-state ownership. The non-state land is divided in various forms of cooperatives and private management. Just under half of the agricultural land is cultivated. Original Table 9.1 from the Cuban office for statistics and information ONEI, 2015.

3.2 PRESENT SITUATION

Just over half of the country's land is agricultural (6.3 million ha) and 48% of that land is cultivated (2.6 million ha) of which 82% are non-state owned. The non-state land is divided into UBPC (39%), CPA (12%) and CCS and individuals (49%). Sugarcane is grown on a quarter of the cultivated area.

The Ministry of Agriculture, MINAG, has the task to allocate 1 million ha of the fallow land to new farmers, with usufruct, who then also receive training. A maximum of 67 hectares per capita can be handed out. So far among the new farmers one quarter are young people.

Forests cover just over a quarter of the total land area and built territory around 5 %. The state owns most of the forests and the non-agriculture territory.

Reduced sugar industry

During the last 300 years up to 1990, monoculture sugar dominated the agriculture and economy. The originally dominant forests were cut down, especially during the first half of the 1900s. In the late 1980s, Cuba was the third largest sugar producing nation in the world (after Brazil and India) and the world's largest sugar exporter. In the early 1990s, there were one or more sugar mills in 125 of the country's 169 municipalities. More than 40% of the cultivated land was used for sugar production, and the sugar industry directly or indirectly employed more than 50% of the total work force. But the loss of markets in Eastern Europe / Soviet Union, the US blockade and the low prices on the world market left Cuba with an unprofitable sugar industry.

From the beginning of the 1990s MINAZ, the now closed Sugar Ministry, got the task to take a number of measures to restructure the sugar industry. The aim was to reduce production and costs. Until 1996, almost half of the sugar mills (76 mills) closed. However, it has not resulted in any significant increase in efficiency and the sugar production in recent years has come down to around 1 million tons per year, which is the lowest figure in 100 years. The cultivated area is cut down to 360,000 ha while yields have increased slightly.

Sugar cane is still dominating in agriculture, but less than before. Rice and corn are the most important grains. With a tropical climate and a year-round season, many kinds of fruit and vegetables are grown. Root vegetables and tropical fruits are staple food in the Cuban diet along with rice. Oranges and grapefruit are the major commercially grown citrus fruits. Mango is biggest among other fruits.



Figure 3.2 Reforestation is now taking place also with new species. The Neem-tree is a fast-growing mahogany tree tolerating extreme drought. Neem oil is extracted from the fruits. It is a biological pesticide and also important in health and pharmaceutical industries.

Growing forest coverage

Prior to 1959 there was a rapid deforestation. In 1400-1500's the forest coverage was 95% and in 1959 it was down to 14%. The planting initiatives implemented since the beginning of the 60s received broad popular support and led to an increase in forests of about 30 000 hectares per year. Currently 27.3% of the territory is forest, according to the UNDP 2014.

The national environmental strategy includes large scale, comprehensive measures to prevent deforestation and improve forest management. It involves a combination of school and popular education and rules to stop violations of the legislation, support for forest restoration in mountain areas and sensitive ecosystems as well as conditions for increased use of forests for biomass.

Soil problems

The soil is periodically threatened by erosion, poor drainage, salinity, acidification and compaction. This affects in varying degrees 80% of the country's arable land. In the eastern provinces the desertification is accelerating. One-third, or 3.4 million hectares have been affected by soil acidification. Over a million hectares of agricultural land in the country, has a high salt content, which reflects the impact over several decades of low quality irrigation and problems caused by the construction of canals and dams. Hurricanes in 2008 have exacerbated the situation.

A special problem for Cuba is the impenetrable marabou shrubberies occupying soils fallow after sugar cane monocultures. They are now covering 85,000 hectares of arable land.

Protected areas

Approximately 15% of the land area is officially protected land (category 1-7) where all construction and land exploitation is prohibited. There are 11 national parks and four of them are biosphere reserves according to UNESCO. Approximately 50 areas are nature reserves or protected areas. These areas are of great importance for a sustainable development.



Figure 3.3 253 protected areas of different categories are occupying 20% of Cuba's land area including the small islands. From "Impacto del Cambio Climático y Medidas de Adaptación en Cuba".

Tobacco

Everyone knows that Cubans make the best cigars in the world. The growing popularity of Cuban cigars in the 1990s lured some foreign capital to the tobacco industry. Companies from Spain, France, Brazil and the Netherlands invested and developed cooperation with the Cuban tobacco industry that managed well during the otherwise tough economic times. Tobacco is grown on relatively limited areas in the western provinces. Cigars are important export commodities, second after sugar in economic value.



Figure 3.4 Tobacco drying in a wooden barn in Pinar del Rio.

Mines

Mineral resources - mainly nickel production - contribute to significant export revenue. The nickel reserves are the world's fourth largest, and the reserves of nickel-bearing laterites are the world's largest. Moreover, cobalt is a major by-product of nickel handling. The nickel extraction is managed by a Cuban-Canadian joint venture.

Cuba also produces limited amounts of other products based on natural resource such as asphalt, cement, copper, feldspar, natural gas, gold, gypsum, iron and steel, kaolin, lime, nitrogen, salt, sand and sulfur. From a climate perspective, especially cement production with its large emissions of carbon dioxide is problematic. Work is under way to develop "ecological" cement with lower carbon dioxide emissions described in Chapter 7.

Tourism industry

Over the past 20 years the country has become an increasingly important holiday destination in the Caribbean. Despite the US ban for its nationals to make tourist trips to neighboring Cuba, tourist visits amounted to more than 3 million in 2014, mainly from Canada and Europe. The tourism industry generated an income of 2.7 billion CUC 2014.

Almost 40% of the tourists come from Canada (1,175,077 in 2014). Britain is the second largest with 139,136 tourists in 2014. Next are Germany, France, Italy and the United States. From Sweden just over 10,000 per year are travelling to Cuba. Tourism has a peak in March with more than 350 000 visitors. In September, they are only 150 000. Luxury tourism dominates - 75% of the tourists are staying in 4- or 5-star hotels. Adding to tourist visitors some 300 000 Cubans living in the USA visits their old homeland.



Figure 3.5 Tourism is not only luxury hotels in Varadero. At Las Terrazas in Artemisa nature conservation and tourism for domestic and foreign guests are combined.

To cope with the increase in tourism, the number of hotel rooms has more than doubled over the past decade, mainly by foreign investment in joint venture. The accommodation in private houses, Casa particular, is also increasing. The hotels covering over the year is approximately 60%. Thus, there is a capacity for increased tourism, especially if the Cubans manage to equalize the covering over the year.

In the beginning of the tourist industry expansion in the 1990s, only about 12% of products and services for tourism emanated from domestic production. Almost all food, beer and bottled water needed for tourist hotels and restaurants were imported. Today, the ratio is entirely different. Now about 70% of tourism's consumption comes from domestic production. Some exclusive food products are still imported for the tourism industry.

Tourism is one of Cuba's most important sources of income, but it is also competing for the scarce resources of food and oil. The advantages probably outweigh the disadvantages.

There is a common question if Cuba could handle a million invasion of new tourists from the United States following normalized relations. Given that this invasion has already taken place from another North American country without seriously harming Cuba physically or mentally, it would probably not be a major disaster. Most of the tourists live in their luxury bubbles on the beaches of Varadero and does not interfere with the Cuban daily life. And a small number will surely continue to seek various forms of eco-tourism that can contribute to enhanced relations between peoples and a deeper understanding of Cuban culture and nature. And off organic farming, smart energy and transport solutions, a lean but rich life.

3.3 FOOD SECURITY

According to the UN Food and Agriculture Organization FAO, the average Cuban consumption exceeded 3,000 kilocalories per person per day 1985-89. The daily consumption fell to 2099 kilocalories in 1993. The recommended minimum consumption is 2100-2 300. For those who were most dependent on government rations it decreased to 1450 calories per day during the worst years of the economic crisis.

After that per capita consumption has gradually returned to the level before the 90's economic crisis, or 3,277 kilocalories per person per day in 2011. Consumption content has changed significantly. Before the economic crisis animal products represented 690 calories, or about a quarter of total consumption. In recent years, the calories from animal products have dropped to about 50% of the late 1980s level.

Food composition in 2011 according to the FAO:

- Grains 37.5%
- Sugar and honey 16.8%
- Meat 8.1%
- Root vegetables 7.3%
- Oil and fats 6.0%
- Milk and eggs 5.5%

Among grains rice represents 630 kcal, wheat 374 kcal and corn 225 kcal. That could be compared with pork 126 kcal.

This food composition is an important contribution to Cuba's low Ecological Footprint. Scarcity of meat and dairy products are simply important contributions to a better climate.

The Ministry of Agriculture, MINAG, is responsible for the management and control of agricultural and forest production, to meet the popular need of food as well as raw materials for industry and tourism. MINAG is also responsible for animal welfare, plant health, environmental protection and industrial safety. Because of the big importance of sugar industry it previously was supervised by its own ministry, MINAZ. It is now closed.

Since Fidel Castro, at an early stage (March 2007) warned against the trend to produce fuel (ethanol) for cars in the North instead of food for people in the South, Cuba has had a policy not to use their land for fuel. This has been - and is - an important contribution to the global climate and environmental debate, well worth following.



Figure 3.6 Cuban traditional dish. Rice with black beans, some pork, vegetables and roots

Import and export of agricultural products

The rapid economic development led to Cuba's agricultural imports almost doubled between 2000 and 2006. The farmers in the United States forced the government to allow them exemption from the law that prohibits trading with "enemy" and sell to Cuba. Despite the blockade US companies are responsible for some of Cuba's imports. It applies to food and medical equipment. Out of Cuba's agricultural imports in 2014, the United States accounted for 15%. These are mainly chicken, soya and cereals (excluding wheat). The goods be transported on US-owned ships and Cuba must pay in cash because the US does not allow any form of credit.

In 2011 Cuba totally imported agricultural products including fish with a value of 1,937 billion US\$. The largest items were (in million USD\$):

- Wheat 323
- Corn 241
- Dry Milk 185
- Chicken meat 172

Exports are considerably smaller. Cuba mainly exports services but among agricultural goods the following are most important (million US\$):

- Sugar 374
- Cigars 184
- Rum 92
- Fish 60

The food import represents 40% of the costs for the food consumed by the population and tourists. At the same time, agricultural products are a small part of Cuba's foreign trade. Cereals and meat products account for 11.4% of total imports, dominated by hardware, electrical equipment and vehicles. Cuba's exports are dominated by refined petroleum products, sugar and pharmaceuticals. Somewhat surprisingly, Cuba exports more oil products (395 million €) than importing oil (382 million €).

According to a representative for the Ministry of Agriculture the large wheat imports depend on the fact that Cuba so far has not found any wheat variety working in Cuba, but research is ongoing. The domestic corn and rice plantation increases but provides a fairly low return and some import is necessary. Corn and soy are needed primarily for livestock production. The large chicken imports depend on the fact that intensive breeding on the island is very expensive. Potatoes cannot be grown organically and require imported fertilizers.

Imports of fertilizers amounted to 130,000 tons in 2014, 13 times less than in 1989 and imports of pesticides (1.3 million tons) have also decreased as much.

3.4 ORGANIC FARMING

After the collapse of the Soviet Union and the Comecon Cuba's agriculture was close to collapse. Imports disappeared and it became almost impossible to get hold of artificial fertilizers, animal feed, tools, seeds, animal vaccines, fuel for farm machinery and irrigation systems, tires, batteries, spare parts, etc.

Cuba had to find new methods and the country has now become one of the world leaders in organic plantation. Cuban farmers and researchers develop together traditional and alternative technologies collaborating with colleagues in Canada, UK and USA. The reason that the change could happen so fast in Cuba in response to the acute crisis in the 90s also is the fact that the Cubans were well prepared. During the 80s, Cuba had started to build up "the entire people's defense" against the threat of war from the Reagan reign in the USA. This included being able to survive total isolation, and produce the food and medicine needed. In a speech in 1985 Fidel Castro also predicted that the Soviet bloc would cease to exist.

To achieve the entire people's defense researchers developed farming methods without chemical additives and without fuel. In 1987 they started experimental organic urban farming for food and medicinal plants. Older and "alternative" technologies were developed in transports, housing and energy. Renewable energy sources were investigated as well as Cuban oil production. The armed forces that during the 90-century crisis were forced to self-sufficiency in food, had taken the lead and military conscription focused on food production.

When the economic crisis hit in the early 90s the organic urban farms spread all over the country and the concept organopónico emerged - from organic and bed plantations. A new environmental policy was adopted for sustainable development based on an ecological outlook and confidence in their own forces. In 1994 Cuba adopted the Rio Conference Agenda 21 as law.

With its socialist society system Cuba could plan and carry out a comprehensive restructuring of agriculture and energy policies for survival and eventually on a more sustainable basis regain and surpass the standard of living that was destroyed by the economic crisis.



Figure 3.7 Greengrocery in Havana

FAO defines organic agriculture as follows: It is a holistic production management system promoting and enhancing ecosystem health, including diversity, biological cycles and biological soil improvement. It prefers the use of domestic production instead of foreign import taking into account that regional conditions require local adaptation. Added to this comes the use of cultural, biological and mechanical methods instead of synthetic material.

According to a common understanding the organic agriculture is more severe than the ecological when it comes to abstention from oil and chemical inputs. Other does not see any differences. The agriculture in Cuba is neither totally organic nor ecological but 2003 the agriculture used less than 50% of the diesel used in 1989, less than 10% of chemical fertilizers and less than 7% of chemical pesticides. A system of 220 biological control centers offered safe alternatives for pest control. The national program for the protection and improvement of land concerned 475,000 hectares of land in 2004. The annual output of 5 million tons of worm compost from a network of farms is part of this development.

Shortly after the trade agreements with the Soviet Union had been signed in the beginning of the 60s imports of tractors quickly increased from 9,000 till 68,000. After the fall of the USSR Cuban farmers had to revive old skills and traditions because of the severe shortage of fuel and spare parts. The imports of tractors stalled and 1997 instead 400,000 oxen, 282,000 working horses and 32,000 mules worked in the agriculture.

3.5 ORGANIC URBAN AND SUBURBAN AGRICULTURE

The plan and methods for self-sufficiency in the event of war that was developed during the 80s later could attain the survival of the Cuban people during the food crisis following the collapse of the USSR. Urban and suburban farms have since been developed and have become extremely popular. They occupied 14% of the country's agricultural land or 8150 hectares of land in 2014 and produced half of the vegetables consumed in the country. More than 350 000 people are engaged in the expanding sector of which 160 000 work in urban organopónicos. Many of them are retired, getting a richer life. Urban agriculture is not just to produce food. It is also socially enriching.

At the end of 1987 the Cuban government had decided on a program of urban agriculture. In August 2009, President Raul Castro declared that food production is a national security issue that must involve as many as possible. This was the start of a new suburban agriculture program based on urban farming principles. All municipalities must plan for its inhabitant's necessary consumption of vegetables and set aside land 2-10 km from the center for organic farming. 2013 the government complemented with a program for small-scale family farms. There are more than half a million family farms of maximum 800 square meters.



Figure 3.8 INIFAT's director Adolfo Rodríguez Nodals sees how the Cuban Agriculture Minister Gustavo Rodríguez Rollero greets a delegate from Peru at the International Congress of urban, suburban and family agriculture in Havana's Congress Palace in April 2015

The agricultural research institute, INIFAT, Instituto de Investigaciones Fundamentales en Agricultura Tropical "Alejandro de Humboldt", is the leading institution for research, development and training in agriculture and especially urban, suburban and family agriculture. Every second year INIFAT in collaboration with MINAG, OXFAM and others organizes a big congress where current projects are presented and discussed.

The organic small farms produced 1.26 million tons of fresh vegetables and herbs 2014. They are supported by the state and the municipalities and they are nowadays recognized as key elements in physical planning. They come in the following main types:

1. Organopónicos (organic urban and suburban farms)
2. Huertos Intensivos (intensive plantations)
3. Patios y Huertos Caseros (courtyards and gardens)
4. Parcelas (plots)
5. Fincas Suburbanas (suburban farms)
6. Áreas the Autoabastecimiento de Empresas y Organismos (farmland for self-sufficiency for companies and organizations)
7. Cultivos domésticos (small plantations at home)
8. Cultivos sin suelo (plantations without soil)
9. Cultivos Protegidos (protected plantations)

Farming is often complemented with animals. Pigs, cattle and chickens are the most common. Furthermore, there are a large number of fruit plantations (mostly cooperatives) producing about 150 million tons a year. Additionally many of the medicinal plants sold in Cuban pharmacies are grown on small farms, especially in the mountainous regions.



Figure 3.9 Minimal plantation in Old Havana.

The activities are supported by networks for seeds, organic manure, worm compost, biological pest control, plant nurseries, insemination, veterinary clinics, animal feed and repair shops.

An important aspect is that urban and suburban farms contribute to minimize transports. Most of the products are sold to local residents and some to hotels and restaurants nearby.



Figure 3.10 Small garden in Vedado, Havana.



Figure 3.11 Vermicompost is an important part of organic farming.



Figure 3.12 Semi-protected part of the Organoponico Alamar in Havana. The net protects from excessive sunlight and increases the harvest.

The high level of education among Cuban farmers, both old and new, and the massive human and structural resources spent on research has led to rapid progress. Cooperation has developed between universities, farmers' organizations, ministries and NGOs. Complemented with popular education it has generated a large ecological awareness among both professionals and more gradually among the public.



Figure 3.13 The majority of sales occurs nearby to the plantations. La Calzada in Cienfuegos.

3.6 PERMACULTURE

Permaculture is an extension of the organic farming including construction, energy and water supply, water treatment, etc in a recycling process. Nothing should perish and transports and waste should be minimized. One origin is the vertical plantation in the forests of Kerala in India and Chagga in Tanzania. The philosophy behind permaculture was launched by Australians Bill Mollison and David Holmgren in 1978. The basis is caring for the earth and humans, as well as fair distribution.

Permaculture is an extension of the organic farming including construction, energy and water supply, water treatment, etc in a recycling process. Nothing should perish and transports and waste should be minimized. One origin is the vertical plantation in the forests of Kerala in India and Chagga in Tanzania. The philosophy behind permaculture was launched by Australians Bill Mollison and David Holmgren in 1978. The basis is caring for the earth and humans, as well as fair distribution.

The ideas agreed well with the philosophy of organic urban gardens developed in Cuba. An agreement was reached in 1993 with an Australian solidarity group and in 1995 the ideas were realized for the first time in Cuba.

Now various forms of permaculture are developed by FANJ, Fundación Antonio Núñez Jiménez, that encourages, organizes and supports a network of facilities around the country, mainly in Sancti Spiritus. On a farm near Cumanayagua in Cienfuegos the plantation is complemented with experimental theater activities by the group Los Elementos.



Figure 3.14 There are many forms of permaculture. From a presentation by Roberto Pérez Rivero

In 2009 70 model plants had been built in five provinces. More than 800 people have been trained and there are 300 designers of permaculture. Cuban teachers are also training activists in Colombia, Ecuador, Argentina, Dominican Republic and Canada.

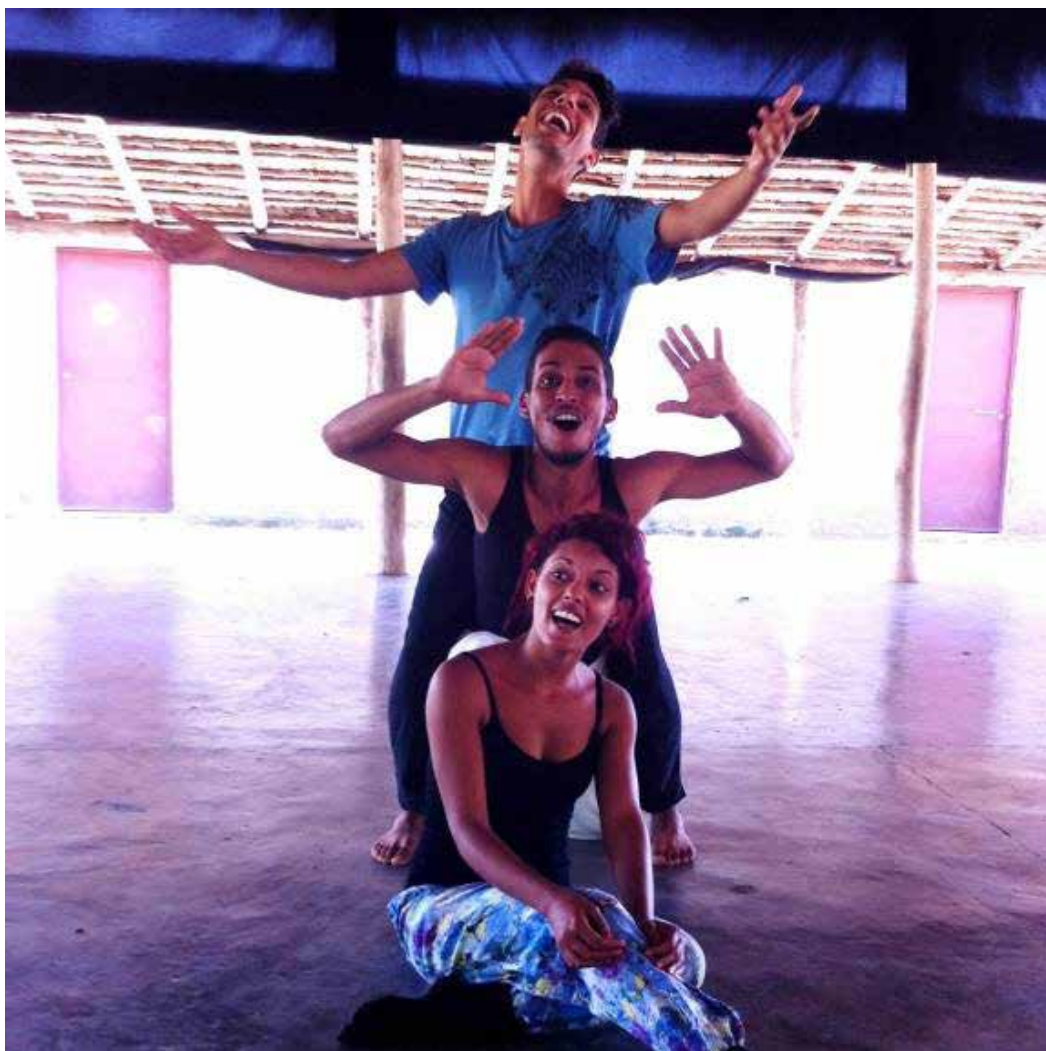


Figure 3.15 Permaculture can also be theater. Los Elementos in Cumanayagua.



Figure 3.16 Composting is an important part of small farms. Permaculture at Cumanayagua, Cienfuegos.

3.7 ENVIRONMENTAL AND HEALTH ASPECTS

Cuba's focus on organic rather than traditional agriculture use means that most of the agro-environmental and health problems will be avoided or limited. Biological control of pests instead of using chemical pesticides, natural fertilizers instead of imported polluting fertilizers, animal instead of polluting tractors changes the whole situation. The remaining environmental problems are about greenhouse gas methane from livestock. The amount can be reduced by decreasing meat production and by using feed additives and anti-methane vaccine.

Urban and suburban agriculture means that a large part of the population has access to fresh and non-toxic diet not transported long distances.

The resurrected tradition of producing and using medicinal herbs is an important health aspect. Dr. Fernando Funes has told the story like this: "The Cuban armed forces were the first to start this movement. No one could ever imagine something like that because the military was always regarded as the destroyer or war makers. Well, the Cuban armed forces started the wonderful movement that aims at the use of plants to save human lives. -- It was not just that we lacked food. We also lacked medicines, so we discovered that wild marjoram was good for breathing. Some other releases us from rash or other diseases. In that time the army played an important role but nowadays the Ministry of Agriculture has taken over. So we have started a big production of medicinal plants in Cuba. They are used not only in prevention but also for curative purposes."

From Mercedes Garcia's chapter Green Medicine in the book Sustainable Agriculture and Resistance a useful list of medicinal plants is reproduced. The list presents plants used in Cuba and the diseases they can treat.

3.8 OUTLOOK

Cuba's successful transition from chemically intensive to organic farming helps to lift the island to a completely new situation after the crisis of the 1990 collapse of trade relations with the East combined with the United States tightened economic warfare. This shows that organic agriculture actually can serve as the basis for an entire nation's agricultural sector despite the fact that many Western agricultural experts say the opposite.

The development of the sugar cane industry that started in the 80s to produce not only sugar but valuable by-products like resins, pharmaceuticals, building panels, biofuels, solvents, paper etc. gained new momentum during the 90s and can be developed further. Many of the studies needed have already been implemented in an UNDP project.

The Latinamerican and Caribbean ALBA cooperation specifically addresses food security. Treaties with Venezuela include the formation of a joint venture to promote the development of agriculture, education and biodiversity. For years, Cuba has contributed with knowledge and techniques to develop the organic urban agriculture also in Venezuela.

There is a concern that Cuba could be encumbered by "modern" farming practices, chemical pesticides and fertilizers from the US when lifting the blockade. Hopefully the deep knowledge, the widespread awareness and the strong connection with Latin America are sufficient to stop such an invasion.

ENGLISH NAME	LATIN NAME	AILMENT
Aloe	<i>Aloe barbadensis</i>	Asthma, common cold, minor cuts and bruises, burns
Anis	<i>Piper auritum</i>	Stomach pain, rheumatism
Sago palm	<i>Maranta arundinacea</i>	Diarrhea
Licorice verbena	<i>Lippia alba</i>	Headache
Senna	<i>Cassia grandis</i>	Fungal infections
Chili Pepper	<i>Capsicum annuum</i>	Rheumatism
Lemon Eucalyptus	<i>Eucalyptus citriodora</i>	Fever, cough
Lemongrass	<i>Cymbopogon citratus</i>	Asthma, common cold, fungal infections, high blood pressure, throat ailments
Orange mint	<i>Mentha citrata</i>	Diarrhea, fever
Dill	<i>Anethum graveolens</i>	Stomach ache
Muraya	<i>Murraya paniculata</i>	Headache
Eucalyptus	<i>Eucalyptus globulus</i>	Asthma, common cold, earache, cough
French oregano	<i>Coleus amboinicus</i>	Common cold, cough
Fennel	<i>Foeniculum vulgare</i>	Gastritis
Plantago	<i>Plantago major</i>	Common cold, stomach pain, mouth sores, burns, cough
French senna	<i>Cassia alata</i>	Fungal infections
Guava	<i>Psidium guajava</i>	Diarrhea, fungal infections
Ginger	<i>Zingiber officinale</i>	Gastritis, cough, vomiting
Chamomile	<i>Matricaria chamomilla</i>	Diarrhea, stomach pain, fungal infections, gastritis, mouth sores
Linden	<i>Justicia pectoralis</i>	Common cold, nervous disorders
Mint	<i>Mentha spicata</i>	Common cold, gastritis
Sage	<i>Salvia officinalis</i>	Common cold, fungal infections, kidney ailments
Lemon	<i>Citrus aurantifolia</i>	Circulatory problems, stomach ailments
Gourd squash	<i>Cucurbita moschata</i>	Parasites
Kidney tea	<i>Orthosiphon aristatus</i>	Kidney problems
Passion fruit	<i>Passiflora incarnata</i>	Nervous disorders
Sour orange	<i>Citrus aurantium</i>	Circulatory problems, stomach pain
Periwinkle	<i>Lochnera rosea</i>	Conjunctivitis
Royal itamo	<i>Pedilanthus tithymaloides</i>	Stomach pain, mouth sores
Five-leaf jasmine	<i>Jasminum grandifolium</i>	Nervous disorders
Tamarind	<i>Tamarindus indica</i>	Constipation, kidney problems
Wild indigo	<i>Indigofera suffruticosa</i>	Lice
Rue	<i>Ruta graveolens</i>	Nervous disorders
White basil	<i>Ocimum basilicum</i>	Stomach pain, high blood pressure
Garlic	<i>Allium sativum</i>	Asthma, common cold, circulatory ailments, stomach pain, fungal infections, parasites, high blood pressure, back pain
Japanese mint	<i>Mentha arvensis</i>	Stomach ache, gastritis

Figure 3.17 List of selected herbs and their use. They are sold in Cuban pharmacies. From Mercedes Garcia.

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4. WATER

Water has a very central role for an island nation like Cuba. The sea surrounding the islands – Cuba island, Isla de la Juventud and from 1,600 to 4,000 islets and cays in the archipelagos - represent both proximity and separation. Historically, the sea has offered communication, but it is also a means for the demarcation and self-esteem characterizing Cuba after the revolution. The sea provides food, energy and attracts tourists. In the archipelago many important animals and plants live. But the sea can also ruin the nature and built environment when hurricanes attack in the autumn, salting soils and drinking water.

Rains provides for the vital freshwater to people, animals and plants. It can be derived from lakes, rivers and underground water bodies, aquifers. It is also stored as groundwater. So far, Cuba has generally had adequate access to fresh water, but the climate change induced by the rich world threatens to lead to increased heat and drought.

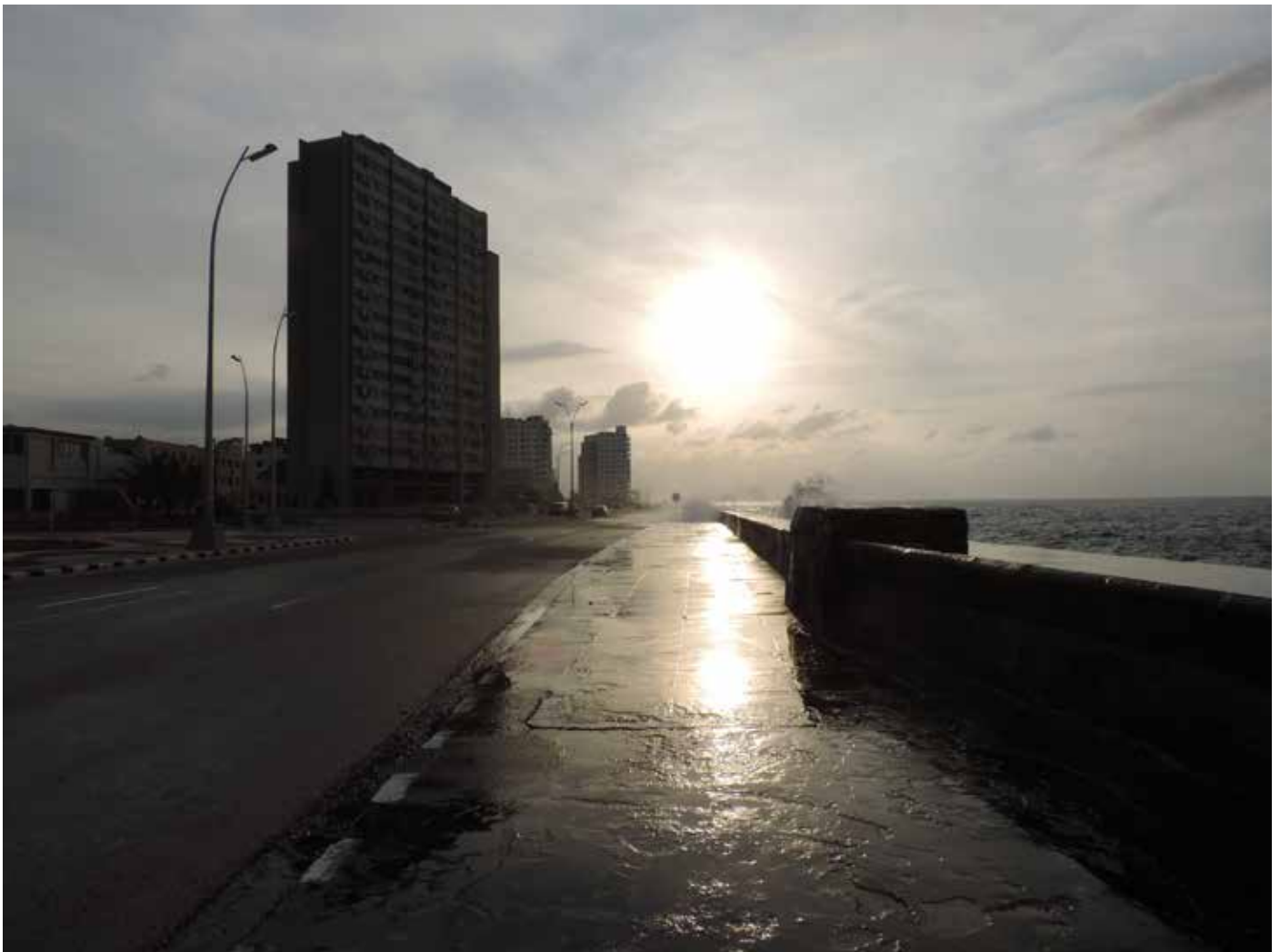


Figure 4.1 Forces of nature meet in Havana's seafront Malecon



Figure 4.2 Storms and salt water is hard on the promenade buildings

4.1 PRESENT SITUATION

The extensive sandy beaches are some of Cuba's most important sea-based natural resources, considered some of the best in the Caribbean. The Cuba Island is narrow and 1,200 kilometers long and has a 5,746 km long, irregular coastline. It has more than 200 bays and more than 300 natural beaches plus many ports.

Another sea-based resource is the good availability of fish and seafood along the coast. There are also a large number of pristine coral reefs. But according to an IPCC study using data from 1977-2001 the Caribbean's coral reefs get reduced with an average of 17% in the year after a hurricane, without showing signs of recovery for at least eight years after the impact. A higher sea temperature due to the high emissions of greenhouse gases also damage coral reefs.



Figure 4.3 One of the hundreds of beaches attracting tourists



Figure 4.4 Possible to swim in fresh water too. Las Terrazas in Artemisa

Freshwater

Cuba has had a relatively safe situation concerning freshwater but the country is also facing problems. Even with an abundant annual rainfall there may be a shortage of fresh water during dry seasons and a need for rationing. The long narrow island has few larger rivers and limited surface water. Aquifers have been partly contaminated by heavy metals and by saltwater intrusion in coastal areas. The infrastructure for drinking and waste water is often in need of extensive renovation.

Cuba suffered a dry period in the early 2000s, probably one of the worst in the country's history. The situation became so serious so that in 2005 the World Food Program launched food aid to Cuba to help the most affected in the eastern and central parts of the country. The drought was less severe in 2005 and rainfall has since been more normal, but the pattern has changed. The average annual rainfall in Cuba 2007 was 1,624 mm and 2014 it was 1,268 mm, most of it in Guantanamo and Santiago de Cuba. The rainy season usually occurs from May to October.

Cuba is one of the countries in the Caribbean that uses most fresh water. The outlet 2014 was 8,024 billion cubic meters or 714 cubic meters per person per year. 58% were used in agriculture, 22% in households and 13% in industry. Particularly sugarcane and rice require a lot of water, 90% from rain. In order to better store and distribute rain water ponds, reservoirs and aqueducts are built. 57% of the consumed fresh water is drawn from lakes and rivers and 36% from aquifers. 7% is unused returned water.

4.2 WATER FOOTPRINT

As a parallel to a country's ecological footprint, its water footprint can be calculated and analyzed. Arjen Y Hoekstra and Mesfin M Mekonnen from the National Academy of Sciences have showed this on the basis of data from 1996 to 2005. The results are partly accounted for by WWF in the Living Planet Reports 2010-2014.

The water footprint can refer to consumption or production. The most relevant in the context of this book is the consumption aspect, and especially per capita consumption, which also includes the water used, for example, in cultivating cereal imports.

The water footprint consists of three components, the vast green and the smaller blue and gray. The green is the volume of rainwater stored in the soil and emitted in form of vegetation. The blue is fresh water from lakes, rivers and reservoirs, groundwater and water from aquifers. The gray is waste water and in reality the volume of water needed to sufficiently dilute the wastewater.

Cuba's water footprint of consumption is about 1,700 cubic meters per person per year. It is about the same as Denmark's and Venezuela's. The world average is just under 1,400, and the US's is more than 2,800. The green represents 63%, the blue 6% and the gray 31%.

Consumption of cereal generally gives the largest contribution to the water footprint (27%), followed by meat (22%) and dairy products (7%).

The blue water is most sensitive to a country's sustainability. For Cuba, the situation is acceptable.



Figure 4.5 Irrigation with the blue water accounts for a fraction of what plants get from the green rain water. But it is important for leveling the water supply. Organoponico Alamar, Havana



Figure 4.6 Ernest Hemingway catches a super swordfish. Photo: Unknown

4.3 FISHERIES

Before the revolution, the fishing was slight and concentrated to coastal waters with a focus on traditional and indigenous fish and shellfish species. Catches were mainly delivered to the tourism industry. However, the fishing industry changed dramatically as a result of the revolution. New state fishing companies were created and saw a flourishing fishing industry as a way to increase food security and exports. In addition, it could contribute to protect Cuba's coastal areas at a time when the threat of invasion from the United States made the coastal security an important issue. Cuba built up its long-distance fleet, developing into the most technologically advanced fleet in Latin America in the 80s. Cuba's large trawlers operated outside South Africa's and Canada's coasts, and in both the Atlantic and Pacific Oceans off South America. The majority of the catch was relatively low-valued fish, mainly for domestic consumption, although some species exported. At the same time the coastal catches of valuable species such as lobster, shrimp, squid and sea bass expanded, mainly for export.

After the collapse of the USSR and Russia's alignment with the US blockade, Cuba could no longer import fuel for its long-distance fisheries fleet. About 1993-94, most of these ships were docked in Cuban ports.

But the most inshore fishing increased. Several European companies invested in joint venture and contributed with equipment for processing and packaging of Cuba's valuable catches of lobster and shrimp. They also accounted for shipping and marketing expertise and for export to the European and Canadian markets. Furthermore Cuban and foreign companies have jointly invested in growing fish farming operations.

ONEI statistics note declining catches after the peak year of 2009, but a slight increase in the last two years. The total catch in 2014 was 52,672 tons. Half was farmed fish and a quarter was seafood. Among farmed fish tench is dominating and among seafood lobster dominate prior to farmed prawns. The value of 2014 exports of fisheries products was 60 million US \$, implying that they rate four among agricultural exports after sugar, cigars and rum.

The tourism industry has revived the sport fishing Ernest Hemingway highlighted with *The Old Man and the Sea*. Annually a big fishing competition is arranged in Havana to the author's honor. Many hotels and marinas in the archipelagos have been specialized in sport fishing.



Figure 4.7 Now-a-days fishing in Havana is more modest

4.4 WATER POLLUTION

The treatment of waste water in the urban plants is very limited. Only 1/3 of the waste water is purified before it is discharged into Cuban rivers or bays.

This is a major environmental problem and already in 1997 the responsible Ministry stated: "pollution in our groundwater and seawater has gradually increased ... the reason is mainly lack of maintenance of the sewerage network and partial extension." UNEP reported that approximately 341,716 tons per year of organic material were discharged into the Cuban waters.



Figure 4.8 Almendares project will save the quality of the river running through Havana.



Figure 4.9 pelicans are back in Havana bay with rising oxygen content and hence fish. Photo Lars Edqvist

The impact on the environment has been severe. Cuban bays were generally known as among the most polluted in the world. Almendares river flowing through Havana brought previously untreated sewage from over 42,000 people directly to the city's coastal waters. There were signs that the underground aquifer providing 36% of the city's drinking water just below Almendares could be infected. Now a major project is carried out by means of several treatment plants and wetlands constructed. The population of the area has been actively participating - not least students.

Another major project that has been going since 1998 is the purification of Havana Bay. It was extremely polluted by industries, domestic sewage and ships dumping. Now pollutants are reduced by 60% through cooperation with industries, relocated sewer systems, afforestation and control of vessels. Here too, population and schools participated and pelicans returned.



Figure 4.10 New water pipe in Old Havana. No problems with frost

4.5 WATER AND SEWAGE SUPPLY

There are three ways to get access to clean water for a household in Cuba. Either the building is connected to the municipal aqueduct or water is supplied by municipal tankers or there is access to public waters within 300 meters of the residence. Significant improvements have been made since the revolution. In 2012, 93.4% of households had access to drinking water, of which 73.1% through aqueduct connection, 4.4% by tanker and 15.9% otherwise. In cities, the availability is 98.4% and rural 78.3%. In 2013 there were 2,266 chlorination stations and 71 water treatment plants. 98.8% of the water delivered is treated.

About sewage, the condition is not as bright as explained in section 4.4. Sewage systems must be extended and the wastewater purified to a much greater extent. Havana's sewer system, which was built almost a century ago, has undergone thorough repairs during almost five decades and is serving over two million inhabitants, far above its projected 400,000 capacity.



Figure 4.11 Drinking water is pushed up to tanks on the roof or facade. Examples from Old Havana

4.6 CLOSING REMARKS

An adaptation to higher temperatures and drier conditions in about 60% of Latin America requires large investments in water supply systems. Water savings, advanced water treatment systems and optimization of water consumption are important measures.

Rising sea levels will affect coastal areas, but the pace and extent depends on the magnitude of emissions of greenhouse gases from the rich people in the rich countries. Cuba, however, just like any other country must start to prepare for oceans mean level rising by 1-3 meters during the next fifty years as a result of ice melting in the Arctic and rising temperature causing oceans a larger volume.

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5. ENERGY

Cuba, with its location and climate, has extremely good position to produce their entire energy using the sun, wind, water and biomass. This was the fact right until the trade with Soviet Union. Then the Cubans were helped to become the most oil-dependent country in Latin America.

After the Soviet fall and US's hardening blockade, Cuba has been forced to a survival strategy and ingenuity that should make many countries in the North jealous. On that way, Cuba has great potential to become the fossil and nuclear fuel-free alternative everyone must strive. This assumes, however, that more financial resources can be spent on expansion of renewable alternatives so that dependence on oil and gas can be broken. It also assumes that oil purchases from Venezuela continue to decline and oil supplies in the economic zone north of Cuba are allowed to rest in the earth's crust.

- En el territorio cubano, con un poco más de 110 000 km², se recibe cada día una radiación solar equivalente a la energía que pueden producir cincuenta millones de toneladas de petróleo.
- O sea, la radiación solar que recibe Cuba, **en un solo día,** es mayor, en su valor energético, que todo el petróleo que consume **durante cinco años.**

Figure 5.1 The Cuban territory, a little larger than 110,000 square meters, each day receive solar radiation equivalent to 50 million tons of oil. I.e. one day of solar radiation in Cuba is bigger than the energy value of oil consumed in five years. Luis Bériz, Cubasolar



Figure 5.2 A lot of energy is used to protect themselves from sun.

With current rate of expansion it will take a very long time to completely break the dependency on oil. But with the continuing trend towards cheaper equipment and continued economic development, Cuba could manage in 20-30 years according Cubasolar. In some parts of the country, 15 years could be enough.

4.5 WATER AND SEWAGE SUPPLY

An overall change of the entire energy supply started in 2005-06 and was named the Energy Revolution. The background was an electricity production based on large, aging, unreliable oil power plants, frequent power cuts (especially when demand peaked) and large net losses. Households were full of old, inefficient appliances and 85% cooked on kerosene or city gas. Electricity tariff obstructed savings and there was lack of economizing culture.

But actually an energy transition started already in January 1959. Here are some steps on the way toward Energy Revolution:

1960 Hydroelectric power is extended and electricity industry nationalized.

1975 A solar energy group is formed within the Academy of Sciences

1983 Construction of the nuclear power plant in Juraguá starts and the National Energy Commission is formed

In the early 80s there is a start to use sugarcane bagasse as an energy source in sugar mills

1984 A research center for solar energy starts in Santiago de Cuba

1992 The nuclear power plant construction is interrupted. After the Rio Summit, Agenda 21 is included in Cuban legislation

1993 A national electricity saving program is initiated

1994 Cubasolar is founded in connection with an international conference in Havana

1997 The first natural gas-powered combination plant is built in Matanzas province

2000 The electrification of more than 2000 rural schools and health centers is introduced with solar panels and batteries

Energy Revolution began at a time when the most important global conditions in the energy sector were:

- Peak oil is reached
- US is making war for hegemony in energy sector, particularly regarding oil (Afghanistan, Iraq) and threatening Iran, Venezuela and other countries with oil fields
- *New progressive governments in power in Latin American countries with large oil and gas sources (Venezuela, Argentina, Bolivia, Brazil and Ecuador)
- Clearer impact every day of fossil energy production and consumption on climate, air and water
- Climate change leads to rising sea levels and weather phenomena such as storms, hurricanes and droughts more intense than ever before

The concern for lack of oil was eased by the confirmation of new oil deposits in the Gulf of Mexico. These can be exploited by Cuba, Mexico and the United States. But the geostrategic situation in the Gulf of Mexico can lead to conflict. It can also expose Cuba for escalating aggression from the United States. Added to this is the risk of damage of the kind the wrecked oil rig offshore Louisiana exemplifies.

The most important aspects of the energy revolution can be summarized thus:

Decentralization of power generation

Decentralization of the production and the construction of module facilities mean that the system will be strengthened and become more stable in case of natural disasters or other types of attacks. This applies regardless of whether it is fossil or renewable energy. Mass-produced machines and turbines cost less per unit than large plants, and emissions can be reduced. These smaller units can be placed close to users in the middle of population centers. Additionally, the heat previously wasted can be recycled if they are constructed as combined plants.

Energy security

With decentralization and a diversity of sources large-scale disruptions are avoided in e.g. natural disasters, deliberate attacks or accidents. If such occurs, they will affect only small parts of the system.

Use of local and renewable energy

Decentralization eliminates losses in transmission and distribution and offers opportunity to use energy plants with smaller capacity. This makes it possible to build small plants for sugar mills, for example. Renewable alternatives based on local conditions are particularly fitting.

Scientific and technical research to develop new energy sources and energy efficiency

Research on principles for renewable energy sources and the conditions for them in the country are stimulated primarily to evaluate new projects with scientific criteria and make it possible to develop new, more adequate projects for Cuban conditions. In this way the resources and the number of people participating in programs increases, including solar and other renewable energy sources, solar heating, wind, biomass from sugar cane and forest, the study of new materials and wind mapping. A coordination group for the development of renewable energy sources is responsible for the evaluation and development of projects.



Figure 5.3 Energy Revolution main elements are savings/efficiency, increased network availability, renewable sources, increased extraction of domestic oil and gas as well as international cooperation

Modernization of transmission and distribution systems

To achieve the integration of renewable systems and avoid congestion due to changes in electricity consumption, it is necessary to profoundly consider the production and distribution. This applies to both materials and modes of application which includes cables, transformation, distribution and electricity meters. The basic structures of the system will be enforced to change along with new materials and advanced inspection methods.

Education and popular mobilization

Through a popular mobilization with pupils going from house to house to replace lamps and subsidized offers to replace older equipment such as refrigerators, stoves and fans involved all people in the changeover. The energy issue was given a place in the culture and in people's minds. Concepts such as efficiency, waste, maintenance, reduced consumption and pollution become parts of everyday life, reflected in science and technology. In addition, national education campaigns on energy saving efforts were organized.

International solidarity

Energy Revolution is a way to get out of the crisis on the country's own terms. But Cuba also offers its experiences particularly to the neighbors in the Caribbean and in Latin America via the ALBA- cooperation. Cuban technicians and experts have supported Venezuela, Bolivia, Honduras, South Africa, Mali and Lesotho with photovoltaic installations.

5.2 OIL STILL DOMINATE

Oil accounts for about 75% of total energy consumption. Renewable fuels account for 24% and there biomass from sugarcane dominates. Energy consumption has decreased slightly compared to 1990, but has increased since 2000. Sun, wind and water are developing and mean a lot for the rural areas lacking grid, but statistically they count for no more than about 4%. In 2009 about half of the oil was imported from Venezuela, but domestic production has increased and imports of oil are now below exports of petroleum products. The biomass from domestic sugar cane has declined to about one-third of the 1990 production because sugarcane cultivation has decreased significantly - in 1996, 76 sugar mills were closed.

In 2014, the total consumption of electricity was 19,366 billion kWh or 1,723 kWh per person, which means an increase of 23% since 2000. The largest consumers are households, 40% and industry 25%. Losses in networks and distribution account for 15%. According to Cubasolar 99% of the country is now electrified compared to 56% fifty years ago. 95% is reached by the national grid. Increased household access to electricity has meant that the use of firewood, kerosene and alcohol have been reduced significantly.

One of the biggest problems has been the unreliability of electricity distribution. The power is now quite reliable, but in parts of the country, the systems are still in great need of maintenance and improvements.

5.3 RENEWABLE FUELS AND TECHNOLOGIES

Biomass from bagasse is considered to have the greatest potential in short term. There are 61 sugar mills spread throughout the country with 57 turbo-generators and 67 boilers. The plans are to produce 755 MW from sugarcane bagasse, as a contribution to the national grid. This requires a modernization of the equipment. Such a venture would also contribute to a more balanced development of the whole island. The infrastructure is in place, even if it needs to be modernized and strengthened. Woody biomass has less potential. This biomass can be extracted from sawdust, wood residues, etc. Even the awkward marabu shrub spreading over fallows could be put to use. 47 MW is in sight.



Figure 5.4 Bagasse from the sugar mills provides energy for their own operations and to the grid.



Figure 5.5 So far, four wind farms are built, but there are plans for more.
Photo: Unknown

Wind energy has good prospects on the elongated island with open coast. Small wind turbines have since long time been used to drive irrigation. There are more than 8000 such turbines. Since 2006 there is a Wind Atlas of Cuba, pointing out ten areas with suitable winds mainly along the northern coast and the Isle of Youth. There are now four wind farms with 20 turbines and plans to expand to 633 MW. Moreover, there are also plans to develop the wind industry. The biggest problems with wind turbines are risks of destruction by recurrent hurricanes. However, small wind turbines are developed, folding when risk of strong winds are in danger.

The direct solar energy can mainly be used small-scale and decentralized. The sun shines strongly and evenly throughout Cuba. Solar cells have a very high efficiency and small transmission losses. They can be used everywhere, but especially in those situations where it is uneconomical to extend the grid. There are more than 9,000 solar voltaic panels installed on schools, health centers, TV lounges and similar in rural areas, mainly in the mountains and on the Isle of Youth. Furthermore, they are used in e.g. signaling. The potential for the number of units is almost infinite, while each installed unit has low output. Seven large solar parks have been built or planned for loading into the national grid. In sight are 700 MW. There is one domestic solar voltaic factory in Pinar del Rio. So far it is an assembly plant, but expansion is planned as well as the production of cells.

Solar heat is used to provide hot water to among other things tourist facilities. Currently there are about 6,500 installations. It provides opportunities to demonstrate the country's climate initiatives for more than three million tourists each year. Solar heating systems can reduce electricity consumption by 10-15%. One more field where direct solar energy is used is for drying herbs and tobacco. This is a skill being passed down through generations, coupled with development of new technologies. A factory for manufacture of solar water heaters was inaugurated in 2009.



Figure 5.6 and 5.7 to begin with, solar voltaic panels have been installed in villages without electricity grid. Example from Guamá. Photo unknown



Figure 5.8 Large photovoltaic plant connected to the national grid. Cantarrana in Cienfuegos province with an output of 2.6 MW, is one of seven new parks.



Figure 5.9 Handicraft work predominates in the solar cell factory Ernesto Che Guevara in Pinar del Rio

Hydropower is mainly developed in the form of mini and micro power plants that do not require dams and can be located close to consumption. There are now just over 170 plants producing electricity. Approximately 900 short streams, of which 38 are considered main rivers, are flowing into the sea around Cuba. There are plans for 56 MW. Turbines are domestic manufactured.

Biogas is currently produced in a thousand small facilities where waste from agriculture is taken care of and digested. There are plans to contribute 27 megawatts to the national grid.



Figure 5.10 Biogas plants are being built for example in Sancti Spiritus

Ocean energy has so far been tested on a small scale. Cuba has a long coastline and a sea that is rarely still. A large part of the settlements are located close to the coast and the potential for bringing energy from the sea is considered very large in the longer term. The first attempt in the world to get energy from the temperature difference between warm surface water and cold bottom water was made in Matanzas bay in 1936 proving to produce electricity. No more attempts have been made in Cuba. There are plans in other countries, but few are commercially developed. There are also opportunities to utilize the energy from waves, tides and ocean currents.

5.4 FOSSIL FUELS AND TECHNOLOGIES

There are possibilities to extract oil and natural gas in- and offshore. Most are located at great depth in the Mexican Gulf north and south of western Cuba. The Cuban oil, however, is thick and rich on sulfur, and has caused some problems. Also the gas is rich on sulfur. It has proved difficult to get oil rigs to extract oil. At current prices and risks the oil better is kept in the ground.

Cuba has no coal deposits, but China has offered to build a coal plant. After careful consideration, Cuba said no thanks.

A controversial fuel is peat, which is found in significant amounts spread over the country but mainly in the Zapata swamp, Ciénaga de Zapata. Some look upon peat as renewable, comparable to wood. Others regard it as a fossil, comparable with coal and oil. The reserve is largely unused due to the environmental problems connected to digging. There is a risk of salinisation and reduction of species survival.

5.5 THE RISE AND FALL OF NUCLEAR POWER

In 1983 and 1985 Cuba started to build two nuclear reactors in Juragua, at the outfall of Cienfuegos bay into the Caribbean Sea, with Soviet support. A modern suburb was built just four kilometers from the reactors. After the Soviet collapse, the constructions stopped. In 1992 the government decided to cancel the project as the new Eastern bloc broke economic relations with Cuba and affiliated to the US blockade. The unfinished nuclear power construction, however, remains as a monument to the memory of a grandiose but failed and risky energy. Several nuclear technicians retrained to ambassadors for solar electricity. Most Cuban energy experts agree that Cuba is not going to build any nuclear plants. Those who still have not completely abandoned the idea agree that there will never be a nuclear plant in Juragua.



Figure 5.11 Monument to an unnecessary and risky technology. The reactor was never charged. Photo Eva Lundqvist

The reactor ruins could be a suggestive tourist attraction. My own idea is that it could also become center of large-scale solar power plant and research center for renewable energy. The land is dry and without trees, grid poles are already set up, and unemployment is high among the Nuclear Town's 15,000 inhabitants. Unfinished and empty houses could be completed for the new solar energy workers. Although Cubasolar's idea is a new phase of energy revolution in which every Cuban home will be a plus energy house using solar voltaic cells, there is also a demand for supply of Cienfuegos industries, including a large refinery and a cement factory and the city center.



Figure 5.12 The model of the proposed nuclear power plant exhibits in the old fort Castillo de Jagua at the entrance of Cienfuegos bay



Figure 5:13 and 5:14 To avoid or minimize air-cooling units would be the most important energy saving measure in Cuba. It may be difficult given the climate. But one could learn from history. Here are two examples from the same street in Santiago de Cuba: A “modern” office and Diego Velázquez’ house from 1522. The latter offers a pleasant climate, just through its architecture

5.6 EFFICIENCY AND SAVINGS

Increased efficiency and energy economizing with public engagement are two of the main parts of the Cuban Energy revolution. For households this has, among other things, meant:

- Replacement of all traditional bulbs to energy saving bulbs at the state's expense
- Improvement or replacement of all electrical appliances including TVs
- Old kerosene and spirit stoves are replaced with new electric or gas
- * A progressive electricity tariff which stimulate saving (see Figure 5.23)
- A comprehensive public education and education campaign

Especially about basic training and adult education, Cuba has led the way like no other country. At all levels, there has emerged an awareness of the fact that efficiencies can only be effective if there is knowledge and awareness among the population, especially the younger generations, and will to contribute.

The state-funded and popular exchange of bulbs is an example of how Cuba has been a leading country. It was quickly carried out and afterwards discussed and partially implemented in many parts of the rich world. The next stage will be switching to the even more efficient, sustainable and non-toxic LEDs.

In the industry and the energy production the energy transition is just in the beginning. There is still old Soviet equipment, and large investments are required to replace machinery and equipment. The US blockade makes the transition more difficult and expensive by threatening and punishing those foreign companies and banks trading with Cuba. Another area requiring vigorous modernization efforts is energy infrastructure, the grid. Here the efficiency potential is very great. Improved lines and backup power or alternative also leads to increased reliability.



Figure 5.15 A small bar in Central Havana copes with the heat wave, with high ceilings, crossventilating, and a couple of small fans. The kitchen is cooled behind a glass wall.

5.7 TWO FORERUNNERS - GRANMA AND GUAMA

One province and one municipality in the eastern part of Cuba are pioneers when it comes to utilize renewable alternatives. Both are carrying out solarization-projects with the aim to become Cuba's first province and municipality totally powered by renewable electricity and energy in fifteen years.

The province of Granma has a proud history, named after the boat bringing the revolutionaries to Cuba in 1956. It is dominated by the massif of Sierra Maestra where guerrilla fights started the same year. Now a new energy revolution is implemented there and well on the way. In 2013 37% of all energy consumed in Granma was renewable. Large parts of Sierra Maestra are inaccessible with the national grid.

Instead, the province and the municipality in collaboration with Cubasolar have concentrated on independent small-scale electricity supply. More than 1,600 small PV systems with batteries are providing schools, clinics, homes, museums, irrigation, etc. with electricity. Solar water heaters and plant driers are also built.

The territory of Granma is rich in small streams where 36 mini- or micro-hydro stations are built. Neither of them is connected to the grid. In addition, there are now in Granma 127 biogas plants and experiments are made to produce biodiesel for tractors.

Guamá is a small municipality in the province of Santiago de Cuba. It is beautifully jammed in between the Caribbean Sea and the Sierra Maestra. One problem is depopulation and the municipality has planned "solarization" as a social and cultural project that also will strengthen residents in their self-esteem and involve them in the municipal development with solar panels. A special adult education project will run until 2017. It will involve the whole population and the idea is to lift the municipality so that it becomes attractive to stay and live in the municipality. Cubasolar, local press, radio, TV and the school are supporting. The ambition is two-way communication and not one-sided marketing.



Figure 5.16 Small-scale solar voltaic installation in Guamá

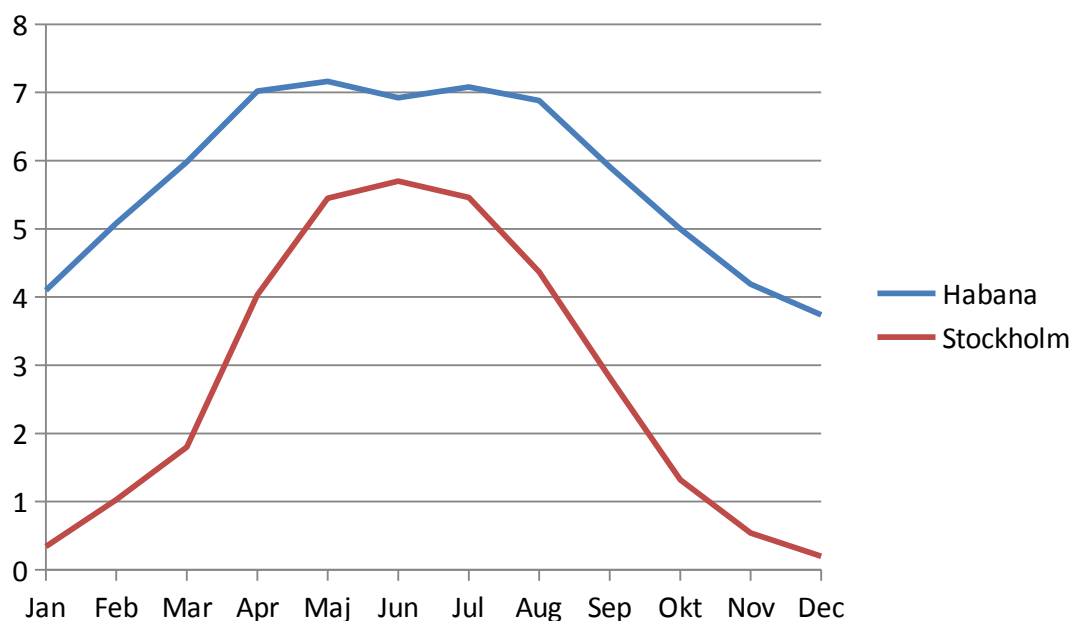


Figure 5.17 Solar radiation in Havana and Stockholm, kWh per square meter per day. The average insolation in Havana is 5.76 kWh / sqm / day, more than double the one in Stockholm, 2.80 kWh / sqm / day. Nevertheless, photovoltaics are good investments, even in Stockholm. Source: Gaisma / NASA 2002

5.8 A SECOND ENERGY REVOLUTION

Luis Bériz is leading the nonprofit organization Cubasolar. It started in 1994 and has had great significance for investments in renewable energy in the country. It organizes every two years an international conference bringing together science and practice in the energy field. Cubasolar both cooperates with and instigate the government when it comes to developing energy supply. Luis Bériz has launched the following ideas and proposals that have not yet become official government policy but is well in line with international knowledge. I would call it the energy revolution's second phase or a new second energy revolution.

The starting point is that the sun is the superior source of energy especially for Cuba, receiving 1800 times more solar energy than oil consumed per unit of time. The daily solar radiation is equivalent to 50 million tons of oil and therefore bigger than the energy value of the oil consumed during 5 years. It is only to convert parts of this solar energy into electricity and hot water. It can also be described like this: a solar panel roof over the east-west Cuban highway would cover Cuba's entire need for electricity. The technique is simple and robust. Prices of solar panels are steadily falling and the technology is suitable for small scale energy production close to consumption.

Solar radiation varies very little from place to place and over the months, with an average of 5 kWh per square meter per day. That is twice as much as for Sweden or Germany. In addition, Cuba's insolation is biggest when the need - of fans and air cooling - is biggest. In Northern Europe the solar insolation is biggest when the need - heating - is smallest.



Figure 5.18 Cubasolar's enthusiast Luis Bériz in his office/home. Here he develops his ideas theoretically and practically, and conducts vigorous public education efforts including magazine publishing, courses and campaigns



Figure 5.19 On top of the roof on one of Havana's hills, Luis Bériz installed two water heaters in the foreground and four 250 W photovoltaic panels at the laboratory shed. On the roof there are also the usual drinking water cisterns and a small solar dryer for spices (obscured)

The other renewable sources also have the sun as origin, but depend much more on location. This applies to wind, biomass and streaming water. They should of course be used where conditions exist. But according to Bériz the direct solar energy is generally the superior option and then there's no reason to put too much effort into developing other options such as ocean energy. Generally the renewable alternatives at every place also are much bigger than the needs.

Berriz indicates that a major problem - like energy security - requires one big solution, or many small. So far, the big solutions have dominated globally (e.g. German Desertec wishing to exploit the Sahara to supply Europe with electricity, my comment). Even in Cuba, the government – after the electrification of villages without connection to the national grid -has invested in seven large solar parks. But the solar panels open for the many small solutions based on local needs, even in urban areas.

Bériz formulates the challenge as follows: Is it possible to transform every consumption site also to a production site? To transform schools, health stations, shops, small industries, housing, etc. into plus energy sites where energy production is bigger than consumption? It assumes that all these points are connected by a reliable grid that cannot be abused by more or less murky forces like in many countries in the world. With a power grid completely under government auspices Cuba has good potentials. However the grid does not reach all rural areas so they will have to continue with their local battery solutions.



Figure 5.20 A well-equipped kitchen in Central Havana with rice cooker in the center

Bérriz exemplifies with a plus-energy dwelling. The average Cuban dwelling consumes between 150 and 200 kWh per month. A well-equipped residence with fridge, TV, DVD, 3 fans, iron, washing machine, 4 fluorescent lamps, 4 low-energy bulbs, water heater, stove, rice cooker and pressure cooker consume an average of 186 kWh per month.

It is entirely possible to reduce that consumption to less than half, or 87 kWh by switching to LED lighting and more efficient refrigerators and TV sets as well as replace the electric water heater with solar heat and cook on gas.

Bérriz expect installing four solar panels of 250 W each, providing 140 kWh per month per household. The panels are linked via a converter and a special electricity meter to the grid and the surplus, in this example 53 kWh, can be sold. If consumption would increase by for example an air condition unit, the surplus will decrease or the need for additional photovoltaic capacity will increase. But the best is if the home can be designed so that the need for air cooling can be minimized.

The new equipment according to this example would cost \$ 940 and the photovoltaic installation \$ 2,000. Estimated value of energy savings is \$ 631 per year. It would take not quite 5 years to pay off the investment. Subsequently, the household basically have no electricity bills and the solar panels are expected to last for 40 years.

If every other place for electricity consumption makes the corresponding exchanges and investments, the entire village or municipality can become a plus- village or plus-municipality. A long-term sustainable development will be built from below. The pace is determined by the availability of solar panels - in terms of capital and production capacity - and this is a priority issue for the Cuban government. If companies and aid organizations from the rich world want to make a contribution to Cuba's future, the democracy-building solar cells should be prioritized.



Figure 5.21 One principle for development of renewable energy is to produce small scale energy as closely as possible to consumption. Young people demonstrated this to Cubasolar.

5.9 ENVIRONMENTAL AND HEALTH IMPLICATIONS

Biomass is primarily used for energy generation in sugar mills. The most serious environmental consequences are various particles belching out from chimneys where they have not had means to install dust collectors. The large amount of carbon dioxide emitted is no problem because the gas is reused in the next harvest through natural photosynthesis. This gas is not included in the national greenhouse gas emissions. However, there are problems with a poisonous by-product from the production of biomass from bagasse previously largely deposited in the soil at the sugar mill affecting groundwater. In several places, however, this has been cleaned for use as agricultural fertilizer.



Figure 5.22 Emissions to air and water can be significant at the sugar mill.

The traditional wood and charcoal use has earlier made great damage by ruining forests and mangrove. However, these problems are almost solved by solarization. A considerate use of dry firewood and charcoal will not damage the environment.

Oil spill from ship strikes the long coast of Cuba on a regular basis. It depends on leaks after accidents or carelessness. But it also depends on tank washing and sewage. Wildlife, fishing and tourism are particularly affected.

Hydropower environmental impacts are linked to the construction of dams but they are not urgent in Cuba. Small power plants without dams are almost completely clean. With dam construction conditions for animal and plant life alters, soils are decreased, flood risks are increased, etc. The country's lar

Urban waste has so far been problematic because it involves large amounts that leak ammonium, and catch fire now and then. Cuban cities produce nearly equal amounts of waste as Western European cities (it could also be interpreted as a measure of standard of living). Cuba's urban waste, however, contains a bigger proportion of organics, which is advantageous if the waste is used for digestion into biogas.

So far, municipalities have only just started on a small scale, but as in the case of sugar production by-products, it is twice as valuable to make fuel of waste that cannot be reused or recycled in another way. The hydro project in Toa River was stopped when construction was already started - just for environmental reasons.

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The carbon dioxide from energy combustion accounts for 95% of total greenhouse gas emissions (3.5 tons per person). Mainly, these emissions originate from electricity generation, combustion processes in industry and traffic. Carbon dioxide emissions account for the very serious environmental consequences and are also responsible for half of Cuba's ecological footprints. It is therefore of highest importance to reduce emissions of greenhouse gases. It is about reducing oil consumption and developing renewable alternatives. A second energy revolution with clean oil instead of soiled oil is necessary.

Sector Residencial. Cambio de la tarifa eléctrica.		
ANTERIOR	RANGOS DE CONSUMO	ACTUAL
0,30 ←	Mayor de 300	→ 1,30
0,20 ←	De 251 a 300	→ 0,80
0,20 ←	De 201 a 250	→ 0,60
0,20 ←	De 151 a 200	→ 0,40
0,20 ←	De 101 a 150	→ 0,30
0,09 ←	De 0 a 100	→ 0,09
PESOS POR kWh	kWh	PESOS POR kWh

Figure 5.23 The power tariff has been made strongly progressive to encourage reduced consumption. The price per kWh for consumption more than 300 has increased from 0.30 to 1.30 pesos

5:10 SOCIAL ASPECTS

In 2004, 95.5% of the households were connected to the grid. Mainly the remote mountain villages lacked electricity. Now, however, hundreds of mountain villages are equipped with solar panels - primarily to schools, television salons and health centers. Everyone has the right to a secure energy supply of good quality. The prices of fuel and electricity are designed so that anyone should afford a necessary quantity but greater consumption becomes expensive and thus energy savings are supported. Liquid gas to households, however, is rationed so that it will be enough for everyone.

Some of the most important energy-related social objectives are:

- 100% of households have access to electricity in the near future
- Continued public education regarding energy issues, especially saving and health
- Promotion of sustainable development in the country

The focus on high education and of high quality for everybody has been of great importance for social development. The electrification of rural schools contributes to an education that can reach everyone with the same high quality. All schools have computers and TV sets - even the rural schools with few students - and the public television company has two educational channels offering supplemental education up to university level. This contributes to adjust the differences between town and country.

Energy and environmental issues permeate education in schools and universities. Almost all subjects in school include energy and environmental issues, teacher training includes both and universities offer a variety of courses and degrees in energy efficiency and technology. The Ministry of Education is responsible and organizes energy festivals at provincial and national level. Mass media and social workers follow up popular education. TV channels have no commercials, but many educational programs on energy and the environment, in order to involve all the people.

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6. TRANSPORTATION



Figure 6.1 The stuffed traffic on a main road in Cienfuegos when a train is passing.

According to tourist brochures transportation in Cuba is secured by the old highway cruisers from the USA. They exist, mainly in Havana, and many Cubans have learned the art of taking care of these old jewels with scarce access to spare parts. They keep them alive but replace the engines with efficient diesels from Mercedes or from Japan.

What otherwise mainly characterizes the transport policy is minimization and improved efficiency in transports. Seen over the whole country the non-motorized transports - mainly horse carriage and bicycles – takes care of about half of all transports. The railway network was developed early but has largely been left to decay. The road network was widely expanded in the 70s and 80s but since then maintained only bit by bit. In the meantime Cuba has instead gone in for development of the whole country and the decentralization of workplaces, industry, agriculture, education, health care and governance. They are consciously limiting transport activities in the same way they are saving energy. And they streamline transportations e.g. by packing the few cars full. This is part of the explanation for Cuba's modest ecological footprints.

Hopefully Cuba can avoid having to go through the phase of mass motoring that the rich countries must now abandon. But Central Havana is beginning to feel the stress from cars with queues, noise, air pollution and parking lots.



Figure 6.2 Bikes in Cuba have about the same covering as cars in Sweden, 1.2 persons

Passengers	2010	2014
Railway	8,3	9,7
Bus	900,4	1037,4
Taxi, state-owned	45,8	60,4
Shipping	3,4	3,6
Aviation	1,2	1,3
Other	642,3	743,4
Total	1 601,4	1 855,8

Figure 6.3 Table of registered passengers in Cuba 2010 and 2014 (million passengers). All kind of transportation has increased. In bus services urban and school buses dominate. Others consist e.g. of horse carriages, rickshaws, trucks and cars. Source: ONEI 2014-15



Figure 6.4 Horses are not just a tourist attraction. They account for by far the most local passenger transports outside of Havana. A very efficient and environmentally good alternative. Photo: Eva Lundqvist

6.1 HORSES AND BIKES DOMINATE TOTALLY

Urban and interurban public transports were hard hit by the 90's economic crisis when the lack of fuel, vehicles and spare parts were difficult. Shortages hit equally hard the few who had their own cars. Bicycles and horse carriages came to rescue.

Horse-drawn carriages and bicycles are still the most important means of transport in cities, towns and villages except in Havana, where the long distances, the dense traffic and the hot sun is discouraging. When talking with Havana residents it becomes clear that the bike is associated with poverty and misery, not accepted as the modern, efficient and environment-saving transport it is. In that respect, the Cubans, however, have started taking lessons from major European cities such as Amsterdam, Berlin and Copenhagen. Bicycle trips are not included in the ONEI statistics.

To tolerably manage bus transports in Havana at the beginning of the economic crisis trucks (trailers) were rebuilt to "camels" that could take 200 passengers. They are now in Havana replaced by the new articulated buses from China. One can also see some old yellow school buses from North America and flatbed trucks with simple benches.

After the huge downturn in the early 90s the number of passengers has doubled in recent years. Bus travels pre-dominate, but other travels on the road by horse, bicycle taxis and car increases the most. Rail travel is increasing moderately as well as trips on the water.

In the bus transportation the general urban and regional buses dominate with over 1 billion travelers in 2014. The school buses had 132 million, workplace buses 60 million and tourist coaches 15 million travelers. A cooperative bus service has been established since 2013, with 13 million travelers.



Figure 6.5 Bikes dominate in terms of number of vehicles in the traffic. It's only in the capital that residents do not appreciate the bike. Cienfuegos



Figure 6.6 Bus stop in the center of Cienfuegos.

Mode of operation	2010	2013
Public bus	12.4	12.9
School bus	3.4	5.2
Working place bus	1.3	1.0
Car	1,0	1,6
Maritime (boats)	0.4	0.4
Total	18.4	21.1
Registered at collecting sites	12.9	15.3

Figure 6.7 Table of registered passengers in Cienfuegos' municipality in 2010 and 2013 (millions). City buses dominate. Horse carriages, bikes and trucks are not included. Source: ONEI 2014

Mode of operation	Units n	Pers/n	Persons n	Share %
Bike of which electrical 13	103	1.2	124	12
Motorbikes and mopeds	32	1.5	48	5
Horse carriage	56	7.0	392	37
Car of which Americans 6	42	3.5	147	14
Taxi	3	3.5	11	1
Truck	6	2.0	12	1
Bus of which truck platforms 3	10	25	250	24
Pedestrian			66	6
Total			1,050	100

Figure 6.8 Results of the authors own transport counting at the exit from central Cienfuegos on Calzada de Máximo Gómez at the Parque Villuendas April 22, 2015 at 17.05 - 17.35. Number of people per unit is roughly estimated. Horse carriages dominate, accounting for over 1/3 of the traffic on this main driveway. As for the number of vehicle units bikes are in the majority. There are twice as many e-bikes as American cars. The non-motorized transports accounts for over 50%. The state-owned transports does not exceed 25%.

During a visit to the provincial capital of Cienfuegos with 174,000 inhabitants - comparable to Uppsala - I felt that the public traffic statistics must be misleading or at least incomplete. It was so evident that the horse carriages and bicycles dominate in the quiet and clean urban transportation. I decided to make my own little traffic count. The results are presented in the table above and compared with statistics from ONEI. The dominant horse carriages are highly effective and may be wholly organic. One horsepower can transport 12 people in bicycle speed - without AC. Traffic distribution is probably representative of the 80% of Cuba that lies outside Havana.



Figure 6.9 The ferry from Cienfuegos to Jagua ready for departure. Passenger ferries also can be found in e.g. Havana.



Figure 6.10 Rush-hour traffic at the Calzada de Máximo Gomez in Cienfuegos

6.2 RAILWAY TRADITION

Cuba has a long railway history, the longest in Latin America. Already in the 1830s, the first track was built, between Havana and Guines. During the rest of the 1800s, the railway was extended to all then provincial capitals and major ports. Moreover a fine-mesh net was laid out to take care of the sugar industry's freights. Havana and another seven cities got a tramway system that was demolished in the 50s to make way for the cars, later failing in numbers.

In 1912 Havana's Central Station was inaugurated and in 1916 the first and only electric railroad between Havana / Casablanca and Hershey-Matanzas. It was built to transport sugar but is now a commuter train with a few daily departures.



The image shows a handwritten timetable board titled "PIZARRA INFORMATIVA". It lists train schedules with columns for Train, Origin, Hour of Departure, Station, Destination, Hour of Arrival, and Observations. The board is mounted on a wall and contains handwritten entries for various routes including Havana Central, Guines, and other regional destinations.

Tren	Origen	Hora de Salida	Estación	Destino	Hora de Llegada	Observaciones
11	Hst/Central	18:13Hr	Regular	Stgo de Cuba	10:05AM	Cada 3 días
15	Hst/Central	18:53Hr	Regular	Gt. Ana. Ho	12:38PM	Cada 3 días
13	"	19:25Hr	"	BYNO/HZO	10:37/11:50AM	Cada 3 días
7	"	21:21Hr	"	Santiago de Cuba	08:33AM	Inter Diario
71	"	06:10AM	"	Pinar/Rio	13:25 Hr	Inter Diario
73	"	07:15AM	"	Cienfuegos	17:45 Hr	Cada 3 días
CH 223	"	06:35AM	"	Guines	08:35AM	Diario
CH 225	"	09:17AM	"	"	11:17AM	Diario
CH 227	"	12:10PM	"	"	14:05Hr	Diario
CH 229	"	14:38Hr	"	"	16:38Hr	Diario
CH 249	"	17:35Hr	"	Los Palos	20:21 Hr	Diario
CH 249	"	08:30AM	"	Mincedm/Bayamo	10:00AM	"
CH 243	"	13:00Hr	"	"	14:30 Hr	"
CH 243	"	17:20Hr	"	"	18:50 Hr	"

Figure 6.11 The timetable from Havana C in January 2015. Long-distance trains generally leave every three days and takes twice as long time as Viazul buses. Commuter trains run daily.



Figure 6.12 The only electric train runs from Casablanca in Havana to Hershey and Matanzas. It is a commuter train with a few daily departures.

After the Revolution, the Cubans invested in renovating the main routes - mainly Havana-Santiago de Cuba - and bought the locomotives and carriages from the Soviet Union, Britain and France.

Nowadays, most of the country's railway system needs heavy renovation. This applies e.g. bridges and signal systems. There have been many accidents and delays and travel has increased slowly. The trains run about 30 km / hour and takes twice as long time as the buses. New wagons have been bought from China and Iran, and both China and Venezuela have promised loans so that a proper renovation of the railway can be implemented.



Figure 6.12 The only electric train runs from Casablanca in Havana to Hershey and Matanzas. It is a commuter train with a few daily departures.



Figure 6.14 New double track railway between the free port of Mariel and Havana for freight and passengers is Cuba's first clear example of a major improvement. New train units are purchased from Russia and put in practice

The latest happening in the railway sector is that a totally new double track is built between Havana and the new free port of Mariel - both for freight and passengers. Here the new train units purchased from Russia will be used.

A renovation of the railway requires huge resources, but it is an essential part of a sustainable future and it seems that the Cuban government is determined to succeed.

6.3 FREIGHT MOST BY TRUCK

Truck transport dominates but rail and shipping has increased considerably.

Freight transports are distributed as follows:

Mode of operation	2010	2014
Railway	12.8	16.9
Truck	31.8	41.4
Maritime	1.9	6.9
Flight	0.01	0.009
Non-specified	34.2	35.8
Total	80.7	101.0

6.15 Table of freight transports in Cuba in 2010 and 2014 (million tons). Source: 2014-15 ONEI

The main roads cover more than 60,000 km, half of which are paved and 638 km is highway. But highways are used by all types of vehicles and non-vehicles.

Cuba has seven ports for international shipping: Cienfuegos, Havana, Manzanillo, Mariel, Matanzas, Nuevitas and Santiago de Cuba. The Cuban merchant marine shrank and was put in mothballs during the 90s crisis, and now consists of a few smaller ships.

Shipping is mainly important for international freight transports. But among the numerous cruising ships in Caribbean waters, there are very few who enter Cuban ports as a result of the US blockade.

The US has opened for some ferry services between ports in Florida and Havana. It is so far on smaller ferries without car spaces at a cost of \$ 3-400 return. The distance is no longer than from Stockholm to Finnish ports.

Cuba has no less than 170 airports, 79 of which are paved and 7 have runway exceeding 3 km. Havana, Camaguey, Ciego de Avila, Santiago de Cuba and Varadero have international traffic. All province capitals can be reached by the domestic aviation's small propeller machines.

6.4 DECENTRALISATION AND IMPROVED EFFECTIVENESS

Unlike virtually every country in the world, plans and actions since the 60's focus on the whole country to develop and live. You can see it in the school sector where nearly every child has the school in walking distance and in higher education, where university education is offered in every municipality. Almost no village is too small to have its own school, health center and TV lounge. There is depopulation of the countryside even in Cuba, but the move is mainly to provincial capitals and the population of Havana does not increase. Cuba obviously has an advantage of not being subject to an economic system driving towards concentration and large-scale.



6.16. This “yellow” ensures that the seats in the passing cars will be well utilized in morning traffic.

The scarce transportation resources after the 90s crisis have also enforced a rationalization that has no equal in the "developed" countries. It aims to increase the covering in the car traffic as far as possible, even if 100% is hard to reach. For example, in Sweden the covering is 25% or 1.2 person per car (In Cuba this is the covering for bikes) The goal is that the few rolling cars should be filled to the last seat. All state- owned cars are obliged to take in hitchhikers and private cars are considered to have a moral obligation. There is a system of meeting sites monitored by inspectors (yellows) for this small-scale public transport. From New Year 2009 car owners also are encouraged to apply for a taxi license in order to increase transport capacity.



Figure 6.17 Private-owned cars (with white P-plates) will gladly



Figure 6.18 State-owned cars (with some blue color on the plate) are obliged to make unoccupied seats available for free hiking.

6.5 ENVIRONMENTAL AND HEALTH IMPLICATIONS

Nearly all fuel used in transport sector is fossil and diesel dominate on both road and rail. There are thoughts on beginning to use biofuels, but the ethanol track is basically closed since Fidel Castro at an early stage was fore-sighted enough to point out how ethanol production was competing with food. The electrical bikes similar to EU-mopeds have got a rise - not least outside Havana.

Air pollution that bothers particularly eastern Havana is due almost entirely to the large concentration of oil refin-eries. Noise and air pollution from traffic also causes problems in some parts of the metropolitan area.

Traffic has been the cause of more than 700 deaths and 7,000 injuries per year in recent decades. The main reason is shortcoming in vehicles and roads, but alcohol consumption also plays a role. In 2013, traffic was the cause of 11,685 accidents with 687 deaths and 8,236 injured.



Figure 6.17 The number of electric bikes and mopeds are growing rapidly in the Cuban traffic.

6.6 SOCIAL ASPECTS

The car as a status symbol is a big issue in Cuba as elsewhere. But the car also has big practical significance because the transport situation is so difficult. The minority that has been able to buy or be allotted a car has a privileged situation. Meanwhile, all experts and political leaders are aware that a car-dependence like in the USA is not something worth striving for. The aim is also to develop the public transportation so that necessary travelling can be met with increasingly higher quality and at low fees. Demands are also put to those who have access to a car to share and offer the unoccupied seats. The car should be seen as a collective small-scale resource complementing the public transport. Cuba has a large common-funded sector including schools and health care. As for public transport, however, the fee has never been abolished, even if it is low, 20-40 cents of a peso in local traffic. Hitchhiking with a state car is free.

6.7 CUBA'S CHALLENGES

Cuba is in the midst of efforts to restore a worn-out infrastructure. It is about repairing acute damages to streets and roads since the 90s crisis, and even more important to repair and upgrade the railway network. Although the focus is to decentralize activities and minimize the need for transportation, the needs are bigger than what the infrastructure of today can cope with.

At the same time the country has a historic opportunity to avoid the unsustainable impasse of megacities from North and South, cities and communities adapted to mass motoring. But because many people in Cuba as well as in many other countries dream of an unlimited use of private cars, the shortcut is not easy. Cuba, however, has unique qualifications to build a sustainable transport system by means of public education, public power and planned economy. Bike and horse are unbeatable locally and railway for longer distances.



Figure 6.20 Children in Havana hopefully keep the interest in the bike throughout life. This is Cuba's chance to achieve a sustainable future.

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7. HOUSING

In the beginning of 50s more than half of the Cubans lived in cities and towns even though it was a distinctly agricultural country. And more than 20% lived in the capital.

The usual dwelling in the countryside was a traditional Bohio, a palm cottage with earthen floor - without electricity and water. In the sugar mills the seasonal workers were living in old slave barracks. The poor crowded into dilapidated colonial palaces in Old Havana and shacks in the outskirts of the city while the rich moved out to seaside villas or luxury homes in new neighborhoods.



Figure 7.1 One of the middle-class functional style buildings in Vedado, Havana

When the Liberation Army triumphed January 1, 1959, the dammed up need for housing counted over 700,000 dwellings, and the annual growth was considered to be about 30,000 new homes per year. An intense reform and construction began to lower housing costs, replacing slum areas and improve rural housing. Several large housing projects were launched, mainly in Havana. However, housing construction had to stand back for the rest of the country and for investments in economic development. During the 70's and 80's housing construction resumed by apartment blocks in cities built through a form of collective self-help, while the informal sector achieved at least as many homes through division, extension and renovation. Everything came to a halt almost completely in the beginning of the 90's economic crisis. The 2011 guidelines for the new economic policy indicates increased support for local engagement and the development of alternative forms of housing.

Dwellings may now be bought and sold, while the principle of a social housing policy remains in place. No one may own more than one permanent and one vacation accommodation. According to the Constitution, the Government shall work to ensure that no family should be without a comfortable home.

7.1 THE HOUSING POLICY OF REVOLUTION

Supported by a first Urban Reform Act 1960 the apartment buildings for renting were expropriated, the state took over and ownership of apartments was transferred to the tenants for a monthly installment of up to 10% of family income. It meant a reduction in housing cost for the households by 50%. The private ownership of urban land was limited.

The materials industry and construction companies were successively transferred to public possession and several large housing projects were launched to replace the worst slums. In Havana the building of large new neighborhoods was resumed with the same ideals as in Vällingby and Farsta in Sweden with shops, schools, day nurseries, health centers and parks. Efforts to improve farmers' homes by casting the floor, installing water, sewage and electricity, also continued. One hundred thousand poor peasant families benefitted from this.



Figure 7.2 Apartment buildings from the 60s fitted into the terrain in a new village. An example of the focus on housing for the rural population that began in the mid-60s with simple domestic prefabrication system, named after the Nicaraguan freedom leaders from the 30s, Sandino.

These projects created jobs and reduced the enormous unemployment, but later the building of dwellings had to back to other investments needed for economic development. Priority was given to health care and education. By developing agriculture the aim was to get resources for industrialization. By investing in rural areas and raise the standard of living the contradiction between urban and rural should be bridged. (See also Chapter 6 and 8)

In the 70s, extensive construction of apartments started in suburban areas, mainly with so-called micro-brigades, a kind of collective self-help building, where employees at a work place get together to build homes for themselves, their workmates and the municipal housing queue. The micro-brigadiers were released from their normal duties but received their usual salary. Colleagues had to do their usual work overtime. The micro-brigade signed an agreement with the municipality, which accounted for building materials, technical advisors, management and training of brigadiers. Micro brigades not only built homes but also buildings and premises for social and commercial service, i.e. schools, health centers, shops, etc. Some of it was built by traditional methods, but some also with Soviet and Cuban prefabrication systems with room-sized concrete elements. Housing areas were built in the international style, the same as the Swedish million-program, but with lower material standard and without traffic separation.

The new apartment buildings were allotted with tenancy, but through a second urban reform law 1984, these dwellings also were transferred to the tenants' ownership with mortgage payments not more than 10% of family income like in 1960. Most Cuban households have now paid off their homes and what remains is the cost of reparations and maintenance.

During the 70s and 80s the construction of dwellings reached levels that could have led to the elimination of the housing scarcity within 10-20 years. 40,000 new apartments were added to the municipal housing in 1989, 17,000 in private small houses and 6000 in agricultural cooperatives. The overall standard of the new construction was a 3 room and kitchen apartments, equivalent to 12-15 square meters per person.

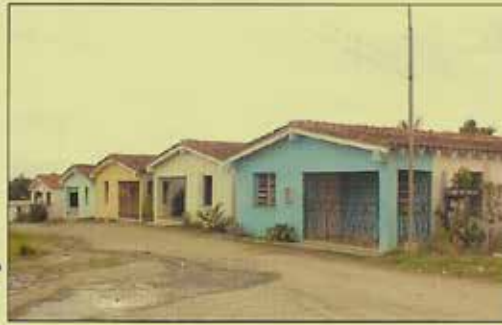


Figure 7.3 A street in the Nuclear Town of Jagua next to the nuclear power plant ruin in Cienfuegos from the late 70s. Notice the simple lift devices on the roofs like in old cities.

With the deep economic crisis that was the result of the total cessation in the early 90s of the trade with the former Soviet bloc, virtually all construction ended. There was neither energy to produce cement nor fuel for transporting it - although there was labor.

Then the same idea as in agriculture and other sectors was born also in housing, to go back to traditional methods, find energy-saving, resource-efficient and sustainable ways to build homes with self-help. The ideas began to be realized by non-profit organizations like Habitat Cuba. Habitat Cuba tried to merge the traditional strategy of housing with the residents' own initiative. The municipality architects who helped people to rebuild and enlarge their own homes, was a key feature that quickly spread throughout the country. Understanding of other problems with the European style large-scale housing constructions also grew. And a discussion on what type of housing and construction that suited Cuba's situation took off. Help to self-help in both architecture and housing construction opened a new path attracting interest from other countries in the South.

SHIFT IN HOUSING POLICY



The housing system had to change: a shift from industrialized production & construction of houses to a decentralized, small scale system to build houses with appropriate technologies...

Figure 7.4 Housing shifted from industrial large scale to handicraft small scale

7.2 CURRENT SITUATION

Housing shortages and neglected maintenance are the biggest problems when it comes to Cubans material living standards. But virtually no Cubans are homeless.

The number of dwellings increases according ONEI and totaled according to the census from 2012 to 3.88 million. But the three hurricanes in 2008 damaged some 450,000 homes and completely destroyed two annual productions or 65,000. In the hardest hit province, Pinar del Rio, 50% of all dwellings were seriously damaged.



Figure 7.5 Hurricane Sandy in 2012 caused considerable damage in Santiago de Cuba

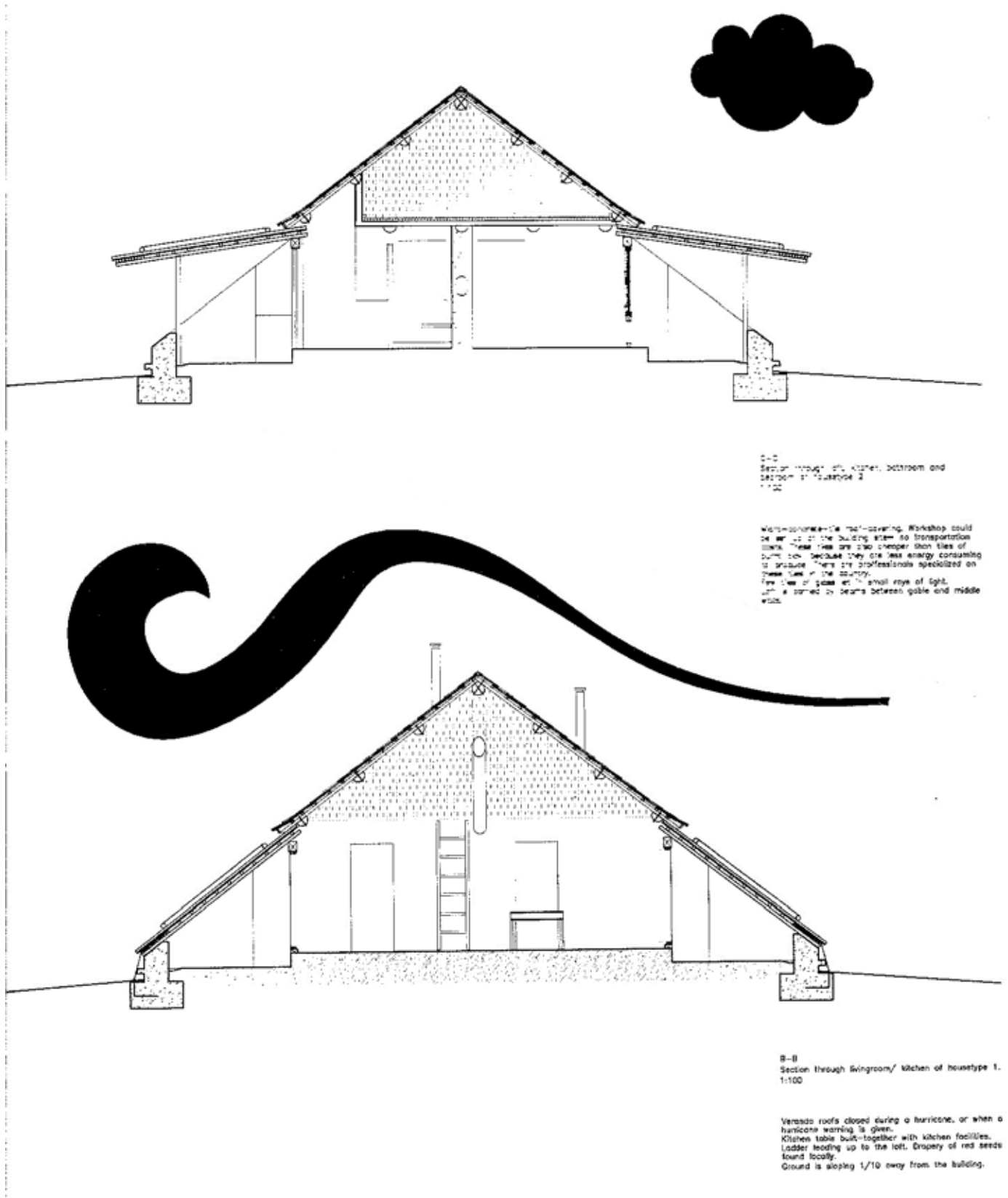


Figure 7.6 Draft model house for the village Puerta de Golpe in Pinar del Rio by Swedish architect Teres Selberg, KTH. Several projects and guides with practical solutions have been implemented by the Cuban architects. There is a standard requirement that at least one room in each apartment must provide hurricane protection

The latest, Sandy in November 2012, was damaging about 250,000 homes in Santiago de Cuba. Reconstruction and repairing strains hard the country's resources and reduces new construction.

In the early 60's, the birth rate rose strongly, then falling concurrently with education, female economic activity and gender policies. Since the pace of population growth fell from 2% in 1960 to a slight decrease in recent years. This decline could help ease the housing shortage in coming years, but an aging population creates social problems.

Population density varies widely among Cuba's 11.238 million inhabitants. On average there are 102 inhabitants per square km. But in Havana province there are 2914 and on Isla de la Juventud 35 inhabitants per square km.

In 2006, with a record pace of investment 111,373 dwellings were built, of which 29,692 with state funding and the remaining 81,681 privately or cooperatively. The goal has been to build 100,000 new homes each year, but in 2007 it was 52,607 and in 2014 the number of completed dwellings dropped to 25,037, half of which in state or cooperative owned and half private. Approximately 80% of the country's homes have, however, been built after 1959.

A remarkable reduction occurred in the index for average number of residents per dwelling. According to the census of 2012 it was only 3.0 residents per unit. In 1970 it was 4.5 and in 1981 4.2. The predominant household counts 2-3 persons and the dominant apartment size is 4-5 room units.

Already the first Urban Reform Act of 1960 transferred the ownership of existing tenant housing to households with regulated right to sale and exchange. This transformed dwelling characteristics from commodity to social right and confirmed the new social principles that have guided the housing policy. The second Urban Reform Act 1984 transferred even the state-built dwellings to the same principle of ownership by instalments.

In 2007, 87% of households are owners of their homes - most of the others were rented dwellings attached to the job. Now, 99.9% of all dwellings are owned by their households. There is no property tax and most people have paid off their homes. Others pay up to 10% of family income until the dwelling is completely paid - at a heavily subsidized price.

According to the decision of the National Assembly the society has to satisfy the needs of housing and suitable living environments for the population. It should be consistent with the central guidelines of the UN Habitat II and the stated intentions are:

- * Gradually reduce the housing shortage and achieve an appropriate balance between need and availability.
- * Renovate existing housing.
- * Broaden the use of appropriate materials, components and construction methods
- * Improve and rationalize technology and design systems by applying scientific and technological advances.
- * Provide equipment and infrastructure for new and upgraded neighborhoods.

The National Housing Institute, previously responsible for support and control of housing, is closed down following accusations of corruption and bureaucracy and the Institute for Physical Planning is now responsible of housing issues.

7.3 BUILDING TECHNIQS AND MATERIALS

Ceilings constitute the main problem when it comes to houses in poor condition while the walls may be improved with relatively simple reinforcement. Building Ministry Micons has developed a technology for roof construction. After densely occurring hurricanes have destroyed many buildings, often simple and light elements are replaced with heavy and durable.

In 1992 a program to reduce construction costs, consumption of materials and energy was implemented. The program was supported by UN-Habitat and the aim was also to reduce dependence on oil and foreign currency as well as to develop local materials and methods with a strengthened public influence. The result is that more and more eco- material is introduced. Experiment buildings have been constructed with various new materials added to classic, e.g. glass waste, in order to improve thermal and acoustic quality of panels and beams. Other examples are bamboo, soil cement, geotextiles and fiber cement in interior panels.

At the University of Villa Clara you find CIDEM, Centro de Investigación de Estructuras y Materiales since 1991. Led by the real enthusiast Fernando Martirena local techniques for energy-saving production of building materials together with population and local authorities are developed. It makes it easier for co-operatives and self-help builders, and has been particularly important during repairing and reconstruction after the ravages of hurricanes.



Figure 7.7 At the Revolution Museum in Havana “organic” concrete blocks are waiting to benefit. The fence is decorated with a symbolic image of the revolutionary “Granma”

Martirena has recently focused on development of "eco-cement" which is important given that demand for cement will grow by 70% over the next 2-3 years and it provides large carbon dioxide emissions. The new cement reduces carbon dioxide emissions by 30% and costs by 10-25% while providing a concrete 3-10 times as durable as concrete from ordinary Portland cement by reducing the clinker proportion of 40%.

The development work is done with Swiss support and can produce big effects if there's an international impact.

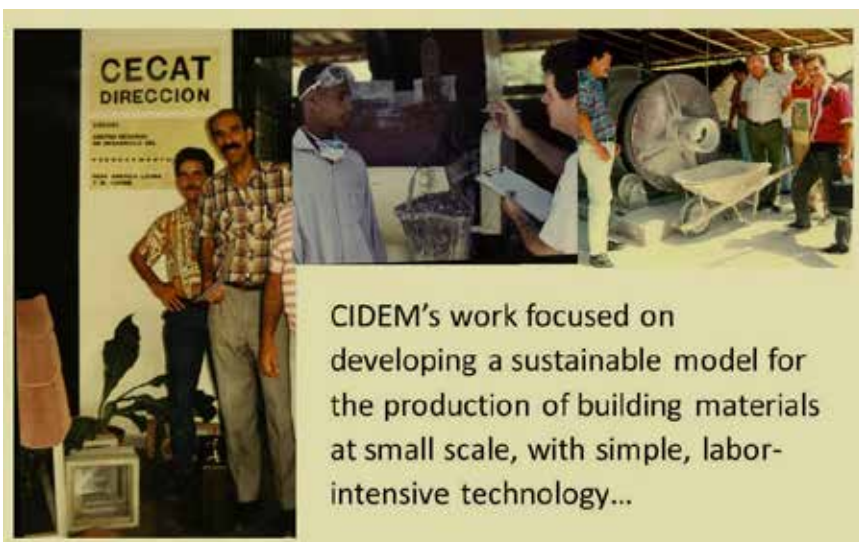


Figure 7.8 From a presentation by Fernando Martirena



Figure 7.9 Large amounts of cement are used in new buildings and facilities. Like here at the entrance of Cienfuegos



Figure 7.10 One example of pure functionalism. And there are more left in Havana than in many other cities of the buildings from the 30s, 40s and 50s

7.4 HAVANA

Havana had before the 90's crisis, a fairly well-developed public transport by bus. Like so much else it was hard affected, by shortages of fuel and spare parts. It has been rebuilt since the early 2000s but is still insufficient.

In Havana there is since 1988 the group GDIC, Group for the capital's integral development. This group includes architects, planners and social scientists. They have been advisers to the municipal government, as well as initiators and advisors in a number of urban renewal projects around Havana. The mission is to develop a model for sustainable urban renewal with participatory democracy where citizens are subjects rather than objects. The group has built and manages the large model of the city at a scale of 1: 1000, located next to its office acting as a central documentation and information center.



Figure 7.11 Residential palaces from the early 1900s in Old Havana are grand but battered.

7.5 HOUSING AS SOCIAL RIGHT

Housing is regarded a social civil right, not subject to profit or market speculation. Eviction due to a family's inability to pay the rent became illegal in 1959. Dwellings could be changed and the difference in value should be paid according to fixed rules, but there was also a black market. Since 2012 it has become possible to buy and sell homes. Nowadays, everybody own their home but no one can own more than one primary residence and one vacation home.

Some of the key elements in the Cuban housing policy - reaffirming the social nature - are as follows:

- Housing costs are subsidized so that the homeowner's installment do not relate to the whole production cost. The distribution of new apartments is decided partly by workplace employees if they are built by micro-brigades, partly by the municipality. In both cases the principle of needs and merits is applied. In this way, even families with special needs and small assets can get housing.
- Families are offered credit lines for payment of the subsidized production costs. Interest rates are 2-3%, and the loans must be repaid in 15-20 years. The monthly payments should amount to no more than 10% of family income, and loans may be extended.
- Bank credits are offered for the purchase of building materials with interest at 9% and for the preservation and improvement of 3% interest for building in-house. Subsidies are also available for this purpose.
- Families whose houses have been affected by natural disasters are assigned the necessary materials to repair the damage or rebuild - at subsidized prices. These family's workers also get off from work. They may keep jobs and wages until they have finished the reconstruction of their dwellings.

7.6 WHAT ABOUT THE FUTURE?

The housing developing in Cuba today has as basic principle a combination of social housing and household-based self-help building, both in terms of refurbishment, repair and new construction. The self-help is done with the support of co-workers, neighbors and friends. Before the 90's economic crisis the government was responsible for a large-scale housing production but the informal sector produced as many homes.

A legislative amendment 1 November 2012 opens for buying and selling homes and renting out those who would otherwise stand empty. Both buyers and sellers have to pay 4% tax on the purchase price. You can also change and bequeath homes. But still the rule is valid that no one may hold more than one primary residence and one vacation house or apartment. Hence the aim is to avoid the speculation that characterizes the rest of the world. If successful, it is magnificent.

At the same time, the need for new and refurbished dwellings is so big that the country's economy is far from sufficient to implement the government's plans. With the new focus the possibility to meet the housing needs of Cubans is increasing. It has led to local cooperatives for construction and production of building materials, local markets for materials and freelance artisans. Families get new loans and subsidies increasing demand and results in a sharp rise of private management and self-help.

Architect Dania Gonzalez will conclude with a summary statement of intent that is still relevant (from the magazine Cuba 1/2009):

- We need to develop sustainable technologies to utilize local materials, for low energy solutions in both production and use, designing the dwellings for both self-ventilation and resistance to hurricanes and torrential rain. And to take care of daylight. For local, clean and renewable energy there are already proven solutions.
- We also need to decentralize and develop participatory planning forms, engage local people, build on local cultures, but also efficiently use the land, build dense - which does not mean high - both to reduce transport needs and to preserve agricultural land and forest.



Figure 7.12 Traditional atrium providing shade, ventilation, community and greenery is a model to develop for the future of housing building. See also Figure 5.14

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8. WHAT CAN THE NORTH LEARN FROM CUBA?

It is time to summarize what we can learn from the Cuban experience, but also what Cuba can learn from the North and the challenges Cuba faces.

In Chapter 2, I report about Cuba's ecological footprints and that half is caused by carbon dioxide emissions from a far too big dependence on oil. Meanwhile, the Cuban carbon footprint is only 41% of Danish, 27% of Swedish and 18% of the US-American. When Cuba manages to convert to an energy supply through solar, wind and biomass, other consumption may nearly be doubled - in the context of one globe. I reproduce here the summary table from Chapter 2 (Figure 8.1)

	INDIA	CUBA	CHINA	WORLD	SWE	US	DEN
Cropland	0,20	0,27	0,31	0,32	0,50	0,60	1,48
Grazing land	0,01	0,12	0,08	0,12	0,32	0,18	0,50
Forest prod	0,07	0,05	0,09	0,14	0,83	0,40	0,63
Fishing gr	0,01	0,02	0,06	0,06	0,11	0,05	0,35
Built-up land	0,03	0,01	0,06	0,03	0,11	0,04	0,14
Carbon	0,20	0,50	0,64	0,83	1,85	2,70	1,20
Total EF	0,52	0,97	1,25	1,50	3,72	3,97	4,29
New Carbon	0,15	0,15	0,15	0,15	0,15	0,15	0,15
New total EF	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Space +/-	+ 0,53	+ 0,38	+ 0,24	+ 0,18	-1,02	-0,42	-2,24

Figure 8.1 (same as 2.10) The Figure 2.9 supplemented with carbon emissions within about 1 ton (0,15 globes) and the total ecological footprint within the earth's biocapacity (1,0 globe). The results are in terms of increased or reduced space for remaining consumption. With a small reduction in carbon dioxide emissions people in India can on average more than double their remaining consumption within one globe. Cuba and China must make more carbon reductions but get considerable space for more consumption. The countries of the North must reduce considerably both emissions and remaining consumption. All data are converted to number of globes per capita.

The countries of the North have a much tougher situation. They will not only have to reduce their large carbon emissions to almost zero. They also have to reduce their consumption of inter alia cropland, pasture and forest products. For Sweden it is particularly difficult when it comes to forests (0.83 globes) and for Denmark when it comes to cultivated land (1.48 globes). All rich countries will find it difficult to combine such large consumption reductions with the economic growth that a capitalist economy requires. But sustainable development must aim not to exceed the resources of the only habitable planet we possess! At the same time, we must be aware that consumption in the North is very unevenly distributed. The poor in Sweden, Denmark and the United States do not have bigger ecological footprint than the middle income person in Cuba.



Figure 8.2 Traces from the Afro-Cuban Santería religion may appearing in an organopónico.

Alamar in Havana

8.1 WHAT CAN THE NORTH LEARN?

It is possible to combine a very high socio-economic development with consumption within planetary boundaries



Change from chemically intensive monoculture to diversified organic smallholdings through interaction between science and practice

Produce vegetables, fruits, spices and medicines for urban populations in urban, suburban and family farms

Reduce food consumption, particularly of meat and dairy products

Save energy and replace oil with small-scale solar, wind, water and biomass

Develop local transport without motor. Go in for bikes

Stimulate hitchhiking as a way to socialize and rationalize car use

Decentralize society functions and housing, so that the whole country can develop

Transfer the dwellings to the residents within the framework of a social housing policy, free from speculation

Go in for democracy, popular education and general civil and military service

Figure 8.3 Summary of lessons from Cuba

The most common perspective held by representatives of the North is to talk about what we in the rich and developed countries can teach the developing countries. After my studies of Cuba it becomes increasingly apparent that there are many reasons to turn this around and ask what we in the North can learn from Cuba.

The important basic lesson is that it is possible to combine a very high socio-economic development with a consumption within the planet Earth's limits. Cuba is indeed the only country that can do this according to the latest available data but many other countries in Latin America are close to sustainability. India and China have sustainability within reach. For Scandinavians and North Americans who are so deeply enmeshed in a consumption economy, it is a troubling lesson that requires an open mind for new ideas.

Lessons from the agricultural sector include the necessity of interaction between science and practice, to change from chemically intensive monoculture to diversified organic smallholding. It is fully in line with the message from the global movement of poor peasants, Via Campesina. It is not fully implemented in Cuba but the ambition and the knowledge is there. This applies not least to the knowledge of how to replace chemical fertilizers with natural materials and how different combinations of plants and insects can replace chemical pesticides.

Next lesson in the area of agriculture (and urban planning) is that most of the vegetables, fruits, spices and medicinal plants that urban population needs, can be produced and sold from urban and suburban farms and family farms within short distances from consumers. This also includes knowledge about soil improvement practices with worm culture and composting etc. The countries of the North do certainly not have Cuba's potential for several harvests per year, but on the other hand they generally have much more land, especially when most of the cars disappear.

Regarding the food issue, it is evident that the Cubans consume less but climatically better food than we in the North.

From the figures for cultivated land and pasture, we can deduce that Cubans consume half as much as Swedes and a quarter of what the Danes consume. The lesson will be to review the eating habits and food wastage and to reduce consumption, particularly of meat and dairy products.

In the energy sector everybody can learn from the Cuban energy revolution, in particular as regards savings and efficiency. What above all says something about energy consumption are the carbon dioxide emissions, ie, the use of fossil fuels. Cuba's relatively small but anyhow too big carbon footprint derives from the production of electricity while the North's relatively large or giant footprint comes mainly from transport. The heating of buildings in Northern weighs about as heavy as the cooling in the South. Cuba has a long way to go when it comes to switch from oil to renewable but we can learn from their energy revolution and the ambitions to refrain from nuclear power and replace fossil fuels with solar, wind and biomass primarily by small-scale solutions. This will be achieved with the support of popular education and mobilization that also can lead to additional savings.

In transport, there are two important lessons. Local transport in cities outside the capital goes mainly without motor. The main mode of transportation is horse carriage which accounts for 1/3 of all transport of persons and a part of the freight. It is an extremely efficient form which means that one horse pulls up to 12 persons in good bike speed. The fuel consists of cereals and water. Compare that with the car in the North, where about 150 oil-guzzling horses pull 1.2 persons in roughly the same speed if there is not too much queuing. In quantity of vehicles the bike dominates in Cuba and the car accounts for a very small proportion of trips. The important thing North can learn from this is that local traffic does not need the car, and that non-motorized travel should be a priority. Horse carriage in the South translates to bike in the North.

As for somewhat longer passenger transport and travel within the metropolitan area, Cuba has solved the shortage of buses and trains in a way that is very memorable - though it would require a cultural revolution in the North. The idea is the same as for all travel businesses: in increasing the covering so that all seats are used. In Cuba this also concerns cars. Since the state owned cars are a common property (about half of the fleet) they should take in everyone who wants to go along - free of charge. For private cars (without blue plate) it is not mandatory, but common. Private car owners can also register as a taxi, take some pay and pay taxes on income. To stimulate hitchhiking is a way to socialize and streamline the use of cars that the North could absorb as a simple and non-bureaucratic form of carpooling. It can save the building of many motorways and car parks.

Decentralization of society functions and housing is something that saves both transport and energy. It is almost impossible in the North with an economic system that instigates economic and geographic concentration. Through its planned economy Cuba has been able to develop the whole country.



Figure 8.4 Waste management issues are not discussed here. But the image recalls the importance of recycling

Cuba already in the early 60's established an institute for regional planning in order to plan an equal development of the whole country and reduce Havana's dominance. By investing in rural areas and smaller cities the differences between city and country would be bridged. Industries were built where there were raw materials and labor. During the 60's one hundred new villages were built that broke the pattern of scattered settlements. They now constitute the cores of the larger agricultural and forestry areas.

Primary schools are set up in villages even where there are only few students, as well as health centers available everywhere. New secondary schools began as boarding schools in the late 60's. Recently the students have returned to schools in the cities and towns. University education is available in every municipality. Housing policy has given priority to rural areas and small towns. Provincial capitals grows while Havana decreases. For example, in Sweden those in power say that the entire country should live, but regional policy is abolished. Sparsely populated communities muddle through with the help of immigrants that are not welcome in development projects. The difficult lesson is to decentralize, to plan and manage development so that housing, public services and businesses can be developed in the entire country so that large a few cities do not absorb everything.

When it comes to housing and housing administration, Cuba has made a long journey that began much like in the North with large-scale construction of apartment building neighbourhoods. Step by step, the building and management of homes has been decentralized in small-scale private cooperatives or companies.. This has been achieved within the framework of a social housing policy that prevents speculation and regulates the cost for households in relation to income. Subsidies according to needs instead of property taxes. This is another difficult but important lesson for the North. To implement a social housing policy with emphasis on self-help with the ownership and management transferred to the residents.



Figure 8.5 Dance and music are important in Cuban culture. Tango at Prado in Havana. Photo: Eva Lundqvist

The ambition in the implementation of the various environmental and energy projects in Cuba is that this must be done together with the concerned population that also has been prepared by a solid education. The education is there throughout the school system but also for adults, for example, through two educational television channels.



Figure 8.6 All young men and most of the women do community service, military and/or civilian. It stabilizes the Cuban social structure

An important basis is the civilian and military community service that almost all young people participate in. It can be likened to a three year nationwide training camp where almost everybody participate in order to become useful players in the Cuba team. Young men do 1-2 years of mandatory military service. Those who go on to higher education make one year military and 2 years in civilian activities related to his education and interests. Young women can make one year's voluntary military service and then two years of community service after higher education. Without the military, it will be three years civil service. During the community service they get accommodation, food and a minimal salary. The lesson is that popular support, that is democracy, is a prerequisite for successful sustainability efforts. Cuba's system of school education, adult education and general community service is something that many people could be inspired by.



Figure 8.7 and 8.8 There is a lack of knowledge in the North of Cuba's parliamentary and electoral systems. Elections are general, secret and without parties. Suffrage from 16 years. With 2½-years intervals, there is election to the City Council. Nominations are made in open meetings in small neighbourhoods. Each constituency can elect one, their representative. Every five years there are elections to provincial and national assemblies. Social movements and trade unions make proposals to the City Council that nominates candidates, but only one for each elective place. The government and the head of state is elected by the National Assembly.

8.2 WHAT CAN CUBA LEARN FROM NORTH?

Given that the North has distanced itself so much from a sustainable development it is mostly the North's mistakes that can be lessons for Cuba. The most serious mistake made by the North is the undemocratic economic system that is instigated by capital growth and self-interest rather than the public good. The results of this system should convince Cuba to maintain and develop its alternative. But in the technical field the North has knowledge and development that Cuba can benefit from.

In agriculture the lesson is the deforestation, water degradation, seed monopolies, genetic engineering, chemical pesticides and fertilizers in the North that are the major threats to the climate, nature and humanity. Knowledge of this should be sufficiently propagated. Urban agriculture has begun to develop also in the North. It is positive but Cuba is way ahead.

The energy situation in the North is still dominated by fossil fuels, nuclear power, large-scale privatization and over-consumption. Nothing to emulate for the Cuban part.

Transports in the North are still based on the 50's mass motoring. It has destroyed many cities and towns and furthermore the climate in general. There is a demand for more cars in Cuba and I hope that the Cubans are wise enough to avoid this dead end for any development towards a sustainable future. Keep the happy few museum cars but learn from the European cities that have invested most in the bicycle as Amsterdam, Copenhagen and Berlin. And learn from expanding and maintaining railway systems that some countries in the North have been capable of.

North's mistake in housing policy is instructive in a dissuasive way. Homes and properties are completely subordinated to speculation and commercial forces. The elements of social housing that previously existed in for example Sweden is almost gone now.

8.3 CUBA'S CHALLENGES

In the early nineties Cuba went through an economic crisis that was even worse than the one Greece is undergoing in 2015. But Cuba retained its autonomy and its democratic society building. Based on its own innovation capabilities and in cooperation with progressive governments in Latin America Cuba lifted the country to what it is today: the only country in the world that is sustainable.

There is a concern that the giant in the north will start pumping in tourist dollars, cars and fertilizers. That the Cuban social model will be sabotaged. My opinion is that the Cuban social structure is so well-organized and stable that it will be able to resist these new attacks. Cuba is worth further studies.

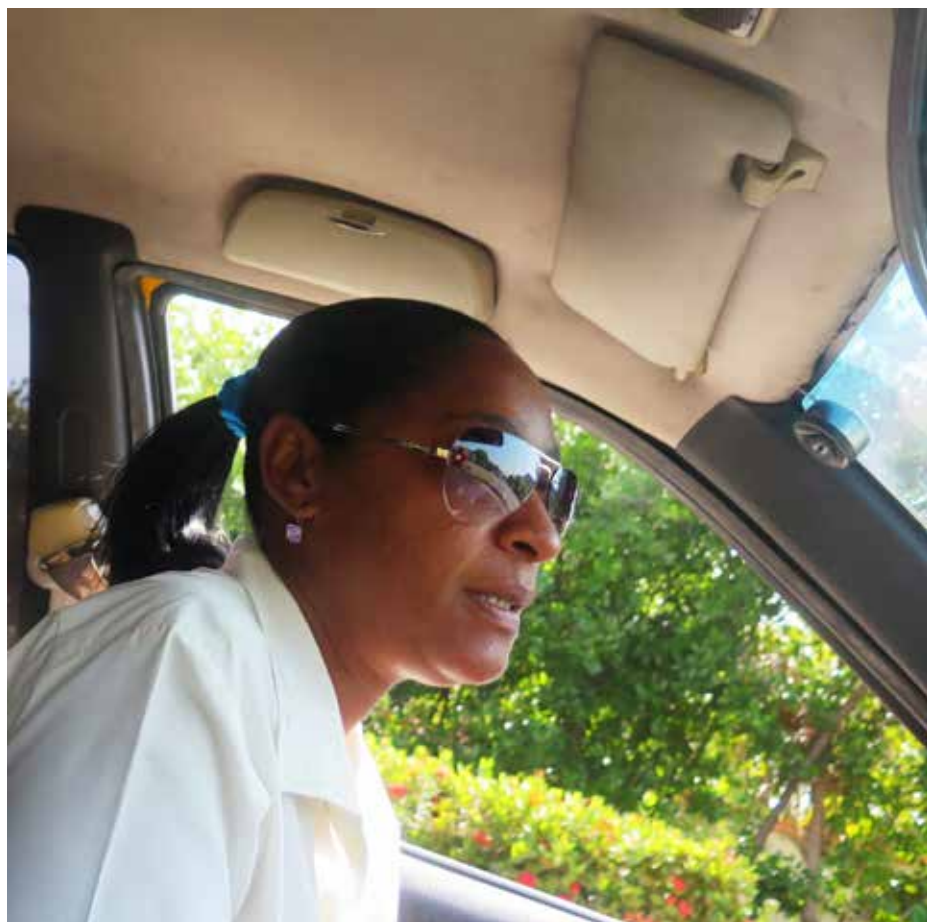


Figure 8.9 Gender equality has come a long way in most areas in Cuba. But among taxi drivers, women are still unusual

APPENDIX

A HISTORICAL BACKGROUND UP TO 2015

Some important dates, with especial regard to sustainable development.

Cuba was discovered about 5000 years BC by peoples from Latin America.

In the fourth century, the island was populated by Tainoes, a people from Ecuador, via Venezuela. Siboneys and Guanatajabeys also got there. They were collectors and hunters, but also farmers. They amounted to more than one hundred thousand in Cuba in the beginning of 15th century.

1492 Christopher Columbus "discover" Cuba, disembarking in Baracoa on north-eastern coast, starting the Spanish colonization.

1512 The first city, Baracoa, is founded by Diego de Velásquez and the Taino chief Hatuey was burned alive.

1512 Sugarcane cultivation is introduced. Slave imports from Africa starts and begins to replace the natives that with time will be exterminated.

1533 The Taino rebellion in the mountains was defeated

1533 The first slave uprising in Cuba.

1791 Slave uprising in Haiti. French sugar and coffee landlords flee to Cuba. The import of slaves from Africa become massive.

1796 Steam engines are used for the first time to operate the sugar mill in Seybabo.

1837 The first railway is built.

1845 Gas lighting is introduced on Salud street in Havana.

1868 The first war of independence against Spain is initiated by Carlos Manuel de Cespedes, releasing and arming his slaves.

1877 The electricity is introduced.

1878 In the Baragua protest the Liberation Army General Antonio Maceo condemn the peace agreement that the big landowners signed with Spain.

1879 Several armed uprisings follow. The phone is introduced.

1886 Slavery is outlawed, last in the American continent.

1889 The first electricity grids are being built in Cardenas and Havana.

1892 José Martí founds the Cuban Revolutionary Party for Independence from Spain.

1895 The second war of independence starts. José Martí is killed in battle May 19

1898 United States detonate their battleship "US State of Maine" in Havana harbor as a pretext for invasion.

1898 US starts a war against Spain, occupy Cuba and disarm the Cuban freedom fighters.

1898 A peace agreement between Spain and the United States in Paris on December 10. US annexation of Cuba, opening for US companies to take control of the country's economy. The first cars show up in Havana.

1899 US military governor enacts a new Constitution for Cuba, giving the US the right to intervene militarily when their interests are threatened.

1900 School of architects and engineers is created at Havana University.

1901 First electric tramway.

1902 Cuba gets formal independence from the United States with a "Platt supplement" in the constitution, giving the US the right to intervene militarily etc. US Citizen Tomás Estrada Palma is appointed president.

1903 United States occupy Guantanamo Bay to build a naval base under Platt supplement.

1906 United States intervenes militarily against an uprising and appoints their own military governor.

1912 The Independent Party of Blacks revolts. United States intervene militarily. 3000 freedom fighters are killed.

1913 Hydro power plants are being built in Mataguá, Cienfuegos.

1917 US military intervene against an uprising

1920-33 Sugar prices drop. US companies buy bankrupt sugar mills. Alcohol prohibition in the United States fattens Bacardi and mafia-controlled gambling and brothels invade Havana.

1922 Radio broadcasting is introduced.

1925 General Machado is elected president. The Communist Party is founded.

1930 Communist Party leader Julio Antonio Mella is assassinated by Machado's terror regime.

1933 A general strike overthrows the Machado regim. Batista leads an officer rebellion.

1933 A new government, supported by the trade unions, nationalizes the electricity companies.

1934 Supported by the US, Batista stages a military coup and outlaws the trade unions and the Communist Party.

1935 A general strike was crushed by the Batista regime that also murders labor leader Antonio Guiteras.

1938 The US initiate the Good Neighbour Policy. Trade unions and the Communist Party are legalized.

1940 A new constitution is adopted by the constituent assembly. Batista is elected president.

1944 The Communist Party is banned.

1950 Television broadcasting is introduced.

1952 Batista stages a US-backed coup again, dissolves the Congress and scraps the Constitution.

1953 Fidel Castro leads an attack on the Moncada military barracks in Santiago de Cuba on July 26. The attack fails and Castro is captivated and sentenced to prison.

1955 Fidel Castro is released, starts to organize an armed liberation war, meet with Che Guevara in Mexico.

1956 The boat Granma carries 82 freedom fighters to eastern Cuba, barely 20 manage to reunite in the mountains.

1958 The guerrilla war extends from the Sierra Maestra to central Cuba.

1959 Liberation Forces triumph on the 1 January. Revolution begins with a land reform, limiting land tenure, benefitting tenants and crofters. US launch economic sanctions and sabotage. Civil Defense is organized.

1960 US interrupts sugar imports from Cuba, US-owned property is nationalized, including oil and electricity industry. Hydro power is developed. Cuba adopts an Urban Reform law, nationalizing tenement houses, transferring dwelling ownership to the residents. Soviet Union buys sugar. The Revolutionary Defense Committees, CDR, and the Women's Association, FMC, are formed.

1961 Literacy Campaign. Cuba becomes the first country in the Americas without illiteracy. US break relations and organize the failed invasion attempt in the Bay of Pigs. Small-scale farmer's Association, ANAP, is formed. Legislation on Agricultural Cooperatives.

1962 Soviet supplies Cuba with weapons, delivery of tactical nuclear weapons is stopped by US naval blockade and threat of nuclear attack. The US apply the law on trading with the enemy against Cuba. The Academy of Sciences is founded. Comprehensive trade agreements with the Soviet Union, sugar for oil. Rationing of food and clothing are introduced.

1963 Hurricane Flora is causing enormous damage in the Oriente (Eastern Cuba). Soviet donate prefabrication industry for housing.

1963 The electrification of the whole country begins with Che Guevara as industry minister. Second Land Reform Act. Che opens the debate on economic policy.

1964 Economic policy is changed. Investments in agriculture, both food and increased sugar production and industrial development. Modern new villages are planned in rural areas.

1965 The leading July 26 Movement, together with the other insurgent movements, founds the new Communist Party and Fidel Castro is elected Secretary-General.

1966 Extensive trade agreements with the Soviet Union, favorable price relationship between sugar and oil, increased import of technical equipment.

1967 Che Guevara is murdered in Bolivia. Increased construction of new rural villages.

1968 100 000 young people in Camaguey are mobilized to cultivate the entire province. All private trade nationalized. The cultivation of the Havana Green Belt starts.

1969 Secondary and high schools for study and work are introduced in rural areas.

1970 10 million tons of sugar were to be produced, but the result is 8.5. Biological attack from the USA, swine fever.

1971 Micro Brigades are organized at workplaces to build dwellings.

1973 The national electrical grid is being expanded across the country.

1975 The Communist Party's first congress. A Solar Energy Group is formed in the Academy of Sciences. The Family Law is adopted with gender equality enshrined.

1976 A New Constitution is adopted by referendum. General direct local elections. Indirect elections to Provincial and National assemblies.

1977 A new administrative division of the country, fewer municipalities, more provinces. A new financial steering system is introduced, following the Soviet model.

1980 Parallel to the state market a free farmer's market is introduced. Pest attacks on agriculture. Cuba accuses the US of biological warfare. The National Assembly adopts an environmental act.

1981 A reorganization of defense begins for decentralized self-sufficiency and survival under attack and naval blockade. Development of organic farming is introduced.

1982 An environmental group is formed at the Ministry of construction. UNESCO appoints Old Havana as World Heritage Site.

1983 The construction of the nuclear power plant in Juraguá begins. The National Energy Commission is established. WHO holds its congress in Havana, Cuba's healthcare is highlighted as example.

1984 The Family Physician system is introduced. The household's ownership of the flat in new apartment buildings is legislated. A research center for solar energy opens in Santiago de Cuba. A new law paves the way for foreign investments.

1985 Criticism of the Soviet economy system, return to Fidel's and Che's ideas on socialism centered to the human being. Campaign to correct errors.

1986 Party Congress. Renewal and rejuvenation, new party program. Micro Brigade movement is regenerated.

1989 The Berlin Wall falls.

1990 Economical emergency state, Special period starts.

1991 The collapse of the Soviet Union. Comecon is dissolved. Export to Cuba of oil, fertilizer, spare parts, etc. ceases. Organic urban agriculture develops. Tourism investments in joint venture with foreign capital.

1992 Direct elections to provincial and national assemblies are introduced. Introduction of town district committees.

1992 The Torricelli Act for tighter Cuba Blockade is signed by US President Bill Clinton.

1993 The building of the nuclear power is interrupted. Many sugar mills are closed, sugar plantations are divided and transferred to rural workers' cooperative for organic food cultivation. Free farmer's markets are set up. Acute crisis in electricity supply and transportation.

1994 Cubasolar is founded. International conference in Havana. Electrical savings program starts.

1996 The Helms Burton Act is passed in the United States. Intensified internationalized blockade and substantial increase in support for subversion in Cuba. Cuba starts oil and gas exploration from the Gulf of Mexico.

1997 The first gas-powered electricity plant is built in Matanzas province.

1998 Drought in Camagüey, Ciego de Avila, Las Tunas and Holguin.

1999 The UN Desert Saving Prize for environmental work in Guantanamo. Social workers education is initiated.

2000 More than 2000 rural schools electrified by solar cells. TV University starts.

2008 Three hurricanes completely destroy 65,000 homes

2011 New social and economic policies are approved for decentralization, local autonomy, increased entrepreneurship and cooperatives as well as market conditions in certain trade and services.

2012 Hurricane Sandy destroys more than 300 000 dwellings.

2012 A new law allows purchase and sale of the own dwelling.

2014 After Latin American pressure, the US recognizes Cuba and negotiations on normalization of relations are initiated.

2015 After the United States has removed Cuba from its terrorist list, the Cuba Embassy opens in Washington and the US in Havana.

B GEOGRAPHY

The Republic of Cuba includes an archipelago of over 1,600 islands and islets. The Island of Cuba is the largest. The archipelago consists of four major island groups: Los Colorados, Sabana- Camagüey (Jardines del Rey), Jardines de la Reina and Los Canarreos. The latter contains the republic's second largest island, The Isle of Youth.

The capital is Havana, the language is Spanish and the currency is the peso (MN, Moneda Nacional). But since 2004 there is also a convertible currency for tourism and foreign trade (CUC). One CUC is equivalent to one US dollar and is worth 24 pesos (MN) in 2015.

The archipelago's land area is 109,866 km², the Island of Cuba is 104,556 km² and the Isle of Youth 2,204 km². Cuba Island is 1,256.2 km in length, from Cape San Antonio in Pinar del Rio to Punta de Maisi in Guantanamo. The widest part is 191 km, from Tararaco Beach north of Camagüey to Camarón Grande Point, south of Granma.

Cuba is divided into 15 provinces - Pinar del Rio, Artemisa, La Habana, Mayabeque, Matanzas, Villa Clara, Cienfuegos, Sancti Spiritus, Ciego de Avila, Camagüey, Las Tunas, Holguin, Granma, Santiago de Cuba and Guantanamo. There are 169 municipalities, including the special municipality of Isle of Youth.

The Island of Cuba and the Isle of Youth are inhabited, the rest of the archipelago is virtually uninhabited except for the tourist establishments and Coast Guard.

The geology is complicated with rocks from the Jurassic and Cretaceous periods, especially in mountain areas, and from Paleogene to Quaternary period in the rest of the country. The topography consists of mountains, highlands and flat land in 70% of the territory.

The main mountain massifs are the Sierra de los Organos (Guanico), Sierra de Escambray (Guamuhaya), Sierra de Nipe-Sagua-Baracoa and Sierra Maestra, where the highest peaks are. The highest is the Pico Turquino, 1,974 meters above sea level. On Isla de la Juventud the highest point is the Sierra de la Cañada, 303 meters above sea level. The soil is characterized by limestone in mountains and ferriferous clay in flat land.

On Isla de la Juventud there are very old rocks from the Jurassic and Cretaceous periods and in the north are rare marble formations.

A ridge runs across the Island of Cuba, sharing it on one slope facing north and one facing south, making the rivers short. The longest rivers are the Cauto, Sagua la Grande, Zaza, Caonao and San Pedro. The largest river is the Toa located in Holguin and Guantanamo. Most rivers are dammed for drinking water supply and irrigation. The largest dams are Zaza, Alacranes and Cauto-el Paso in Sancti Spiritus, Villa Clara and Granma.

Cuba Island has approximately 3,500 km irregular coastline with geographic details such as steep cliffs, sandy beaches, extensive low marshes, coral reefs, marine terraces, caves and estuaries and bays providing excellent harbors. The most important major ports are Havana, Mariel, Santiago de Cuba, Nipe, Cienfuegos, Manzanillo, Matanzas, Nuevitas and Guantánamo. The latter is since 1903 partly occupied by the United States as a naval base and prison camp.

C CLIMATE

The climate is subtropical with summer rains and characterized by sea breezes. In the higher parts of main mountain chains and the southeast coast of Guantanamo and Santiago de Cuba, the climate is dry.

Cuba is located at the Tropic of Cancer, leading to extensive solar radiation throughout the year and warm climate. Between November and April northerly winds now and then enter with rain and thunder.

The tropical location and the Gulf Stream ensure that temperature never drops below freezing. Winters are characterized by high temperatures when there lies a dominant high pressure over the sea. In the Sierra Maestra region there is a great difference between the climate in the northern and southern slopes. There are intense tropical areas in the north and desert or partly desert in Guantanamo in the south.

The average year round temperature is 25.5 ° C. The warmest month is July, with temperatures ranging between 26 ° C and 28 ° C, the coldest month is January with an average temperature between 20 ° C and 22 ° C. The maximum temperature may sometimes – recently more frequent - be as high as 35 or 36 ° C in the east. In the west, the temperature can go down to 5 °, but temperatures below 0 ° C have never been reported. The average rainfall is 1,375 mm and the average relative humidity is 78%.

A hurricane season affects the population and the country's economy with heavy winds and rains almost every year, between June and December. Each region has its specific climatic conditions but historically the western parts are more adversely affected by hurricanes, while the eastern have higher temperatures and more rain. The presence of hurricanes causes that the climate will be an important part of Cuban culture and resource planning with warning and education systems for possible evacuations.

Regarding future climate changes, two extremes are predicted. One is the intense tropical rainfall (like in Central America's rain forests) and the other is a prolonged drought and desertification. Extensive studies have been carried out to respond to and mitigate climate change impacts and to develop sustainable agriculture, finance and shipping.