1.

Land and Productivity – Can the Baltic region feed us all?

by Malek Khalili, Bengt Bodin, Sten Ebbersten and Lars Rydén

1.1 Food – the basic challenge of sustainability

Man lives off the land. From the products of nature he finds his food, materials for building his home, and everything else that is needed for his physical well-being and a good life. In our modern society, this has had the extreme result of there being no land – or water – left that is not used for production: agricultural land, forests, meadows, waters. The entire surface of the Earth is already a resource for humans.

The use of land is at the core of the challenge of sustainable development. As will become clear, we are living far beyond the carrying capacity of our land. We are overexploiting the environmental space that our land, water and air provide. A basic requirement for sustainability is to establish a healthy long-term relationship between our society and the land and water that provides for us. How should this be done?

Some very fundamental changes are necessary in the long run. We are faced today with agriculture, forestry and fishing that have large and mostly negative environmental impacts. They are all dependent on non-renewable resources and have drastic negative consequences for the protection and conservation of nature.

On a global scale, the use of land is critical. The Earth's population is predicted to increase from today's 5.6 billion to some 10 billion inhabitants by the middle of the next century. It makes us doubt whether the land actually can feed us all. It is particularly worrying that the productivity of a great deal of land is declining due to improper use. Erosion, desertification and pollution are all ongoing processes in many parts of the world and result in declining land productivity. In fact, the area of cultivated land on the Earth has declined steadily since the late 1970s. Nevertheless, the average amount of food available for all of us living on this globe has increased by 15 per cent during the last 30 years. However, this increasing trend in land productivity is likely to end very soon.

The Baltic region is different from the world average, and that is for the better. We live in a corner of the world that is not densely populated and that does not experience any dramatic population increase. We also live in an area that is richly gifted with productive fields, forests and sea. The Baltic region may clearly become sustainable if wisely used.

1.2 The land in the region and how it is used

The Baltic basin consists of the Baltic Sea itself and the land area that drains into the Baltic Sea. Its land area includes wholly or partly the territory of altogether 14 nations with some 85 million inhabitants. Even countries like Norway and the Czech Republic contribute to the water in rivers running through Sweden and Poland.

The whole drainage basin covers 1,745,000 km^2. If the Baltic Sea itself is included, the area extends to 2,250,000 km^2. This is about 15 per cent of all Europe.

The nature in the Baltic basin is characterized by boreal forests in the north, agricultural areas in the south and an abundance of lakes, some of them the largest in Europe, like Lake Ladoga, Lake Onega and Lake Vänern. There are high mountains both in the north-west and the south. Big rivers are the Neva, the Vistula, the Daugava, the Kemijoki and the Luleälv among many others.

The area is described on the maps on pages 6–7.

1.3. Weather and water

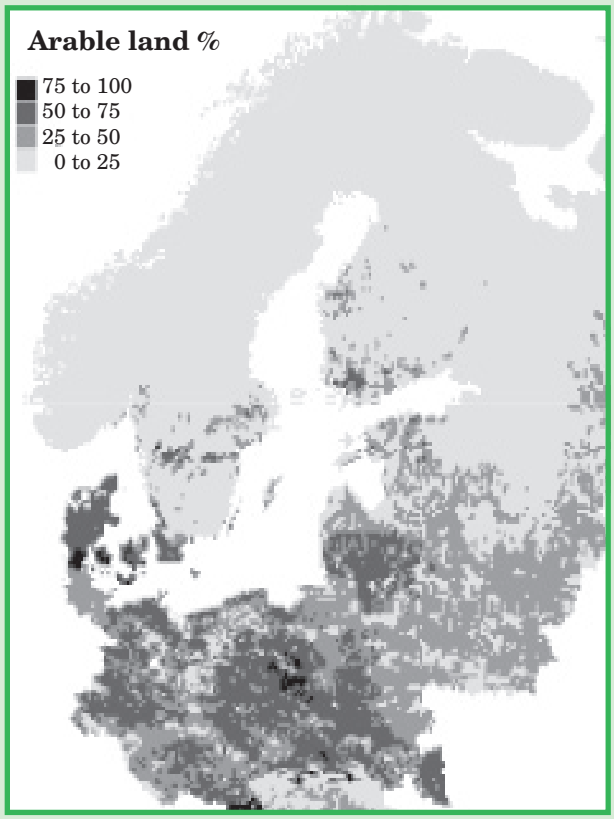
by Sten Bergström

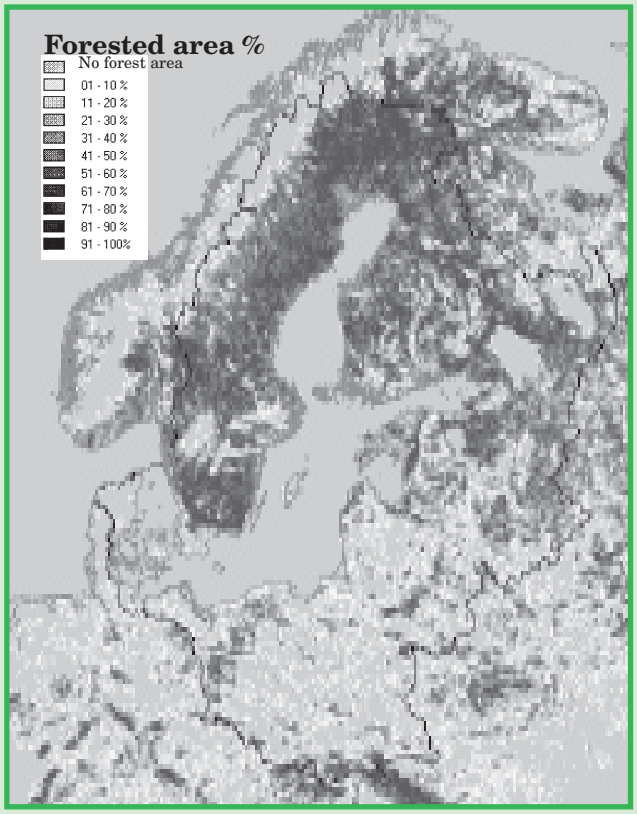
The Baltic basin covers a range of climates. Long, cold winters dominate in the north while there are more variable conditions in the south. Precipitation has its

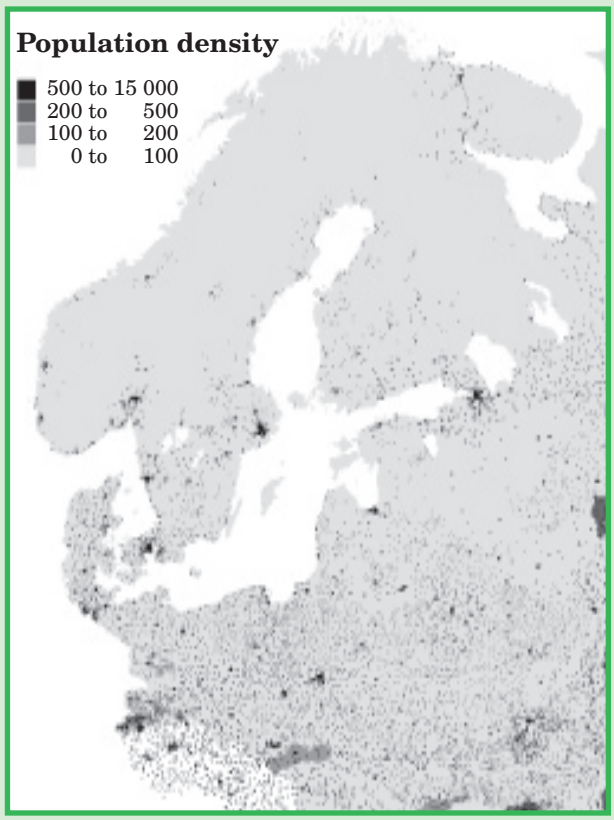
Table 1.1 Land cover in the Baltic drainage basin. Area in km^2 , and as a percentage of the total. (J. Sweitzer et al.,1996).

Land cover type	*Total area in BDB, km^2*	*% of total area*
Forest	835 936	47.9
Arable land	352 936	20.2
Pasture	104 030	6.0
Non-productive open land	298 121	17.1
Unclassified land	33 633	1.9
Populated area	13 105	0.8
Inland water	106 849	6.1
Glacier	526	0.0
Total	**1.745.136**	**100.0**

The Baltic







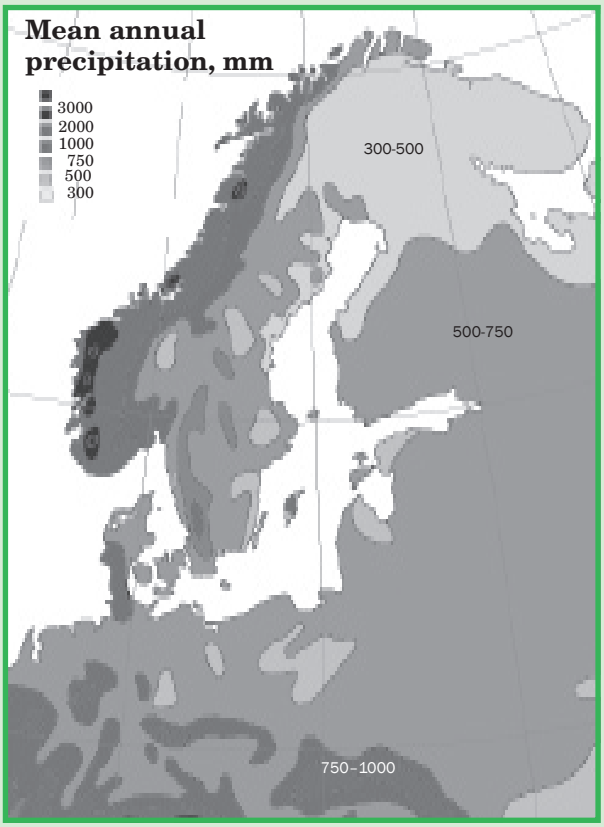
THE LAND

Forests cover the whole northern part of the region. Although the forests account for 48 per cent of the total drainage basin, only three countries dominate: Sweden has 35 per cent, Finland 25 per cent, and north-western Russia 19 per cent of the forested area.

In these three countries we also find the major proportion of the lakes. Finland, the country of thousand lakes, accounts for 24 per cent of inland water, NW Russia, due to its large lakes Ladoga and Onega, contributes with 36 per cent, while Sweden with its almost 100,000 lakes contributes with 28 per cent. This is a total of 90 per cent of the inland water area in the region. This difference between the north and the south is mainly explained by the last glaciation.

As opposed to the northern mountains and forest, we find large plains in the south. Arable lands, which account for one-fifth of the drainage area, dominate here. Poland has 41 per cent of all the arable land in the basin. The south also has the highest population density. Poland alone, with its 40 million inhabitants, has close to half of the population in the drainage basin.

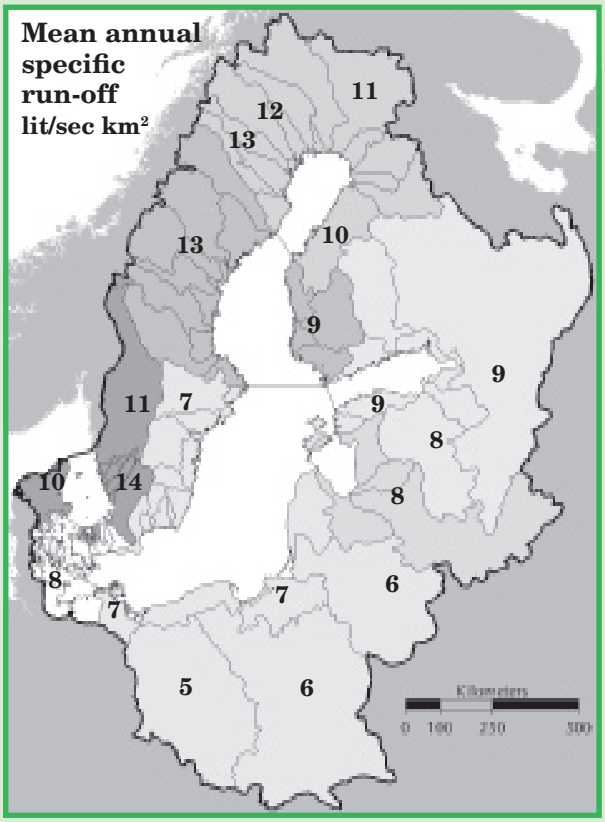
Drainage Basin



THE WATER

The mean annual volume of fresh water run-off from the land areas of the entire Baltic basin amounts to approximately 450 km^3. This corresponds to a flow of 14,150 m^3/s which means that the run-off from the land area of the Baltic basin is only slightly less than that of the Mississippi river. There is a considerable inter-annual variability in this flow.

450 km^3 is a tremendous volume of water which, in theory, is available for the population in the basin. Evenly spread out over the surface of the Baltic Sea, it corresponds to a depth of 1.2 meters. Over the land, it would be about 40 cm. Due to the high precipitation and low evapotranspiration of the north, the available water resources are much greater in the north than in the south and particularly great in the north-west. This is in strong contrast to the population density, which is greatest in the south and very low in the northern parts of the area. Regional water availability, described by run-off generation per unit area (specific run-off), is limiting for large parts of agriculture in Poland.



Source for maps: J. Sweitzer et al 1996 and Ballerina data base at http://www.baltic-region.net/prog/norbal/ballerin/index.htm

maximum in the north-west and the highest evapotranspiration occurs in the southern parts of the basin. The interaction of the storage of water and the dynamics of climate creates a complex run-off pattern of the available water resources. In the northern parts of the Baltic basin, more than half of the precipitation may be accumulated as snow in winter and released during melting in spring while, in the south, the run-off peaks in winter (see p. 7).

1.4 Agriculture in the region – development of industrial farming

(1.4–1.5 by Sten Ebbersten)

In all countries of the Baltic region, agriculture is of great economic and social importance. In the south, especially in Poland, it is a major sector which, until recently, accounted for a large share of both the work-force and the economy in the country. The size of the agricultural sector more recently is given in Table 1.2.

Table 1.2 Relative importance of agriculture in some countries the Baltic region.

Country	*Share of Employed population, %*		*Share of GDP, %*	
	Agriculture 1990	*Industry 1990*	*Agriculture 1993*	*Industry 1993*
Belarus	20	40	17	54
Czech	11	45	6	40
Denmark	6	28	4	27
Estonia	14	41	8	29
Finland	8	31	5	31
Germany	1	38	4	38
Latvia	16	40	15	32
Lithuania	18	41	21	41
Norway	6	25	3	35
Poland	27	36	6	39
Russia	14	42	9	51
Slovakia	12	33	7	44
Sweden	4	30	2	31
Ukraine	20	40	35	47

Sources: Human development report 1996 . UNDP. New York 229 pp.
Percentage of labour force are calculated on the basis of data from ILO 1995.

Since the 1950s, agriculture in the region has undergone large structural changes. The purpose of the changes has been to increase productivity and efficiency and thereby decrease production costs. Continuously fewer people are working in the agricultural sector although the degree of the change varies with the countries. In the west, some 2 – 5 per cent of the population is today employed in agriculture. In addition, production is maintained with the same or even a decreasing area of agricultural land.

For more than three decades, the western countries have aimed to develop agricultural production that does not more than occasionally pass the level of self-sufficiency. Various political and economic tools and regulations are used to reach this goal. In some countries, for example Denmark, a large surplus of agricultural products such as cereals, meat, and dairy products are produced. This production is very strictly regulated through negotiated quotas which are sold within the European Union. When exported outside the Union it is, for political reasons, sold below world market prices using tax subsidies.

The background to this system of regulation is the continued biological and technological progress that has resulted in an agricultural sector characterized by specialization and increased production. This entire change is often called the 'industrialization of agriculture'. It has resulted in abundant and cheaper food of often better quality using less work and has released the work-force for other tasks in society. However, industrialized agriculture has extensive negative effects. These include the mismanagement of natural resources and the environment; it has also led to incalculable psycho-social effects, such as stress, loneliness and isolation, among the rural population.

The modern specialized crop cultivation methods, which were gradually developed during the 1950s, were dependent on increased use of fertilizers as well as large-scale use of pesticides. The two are in fact interdependent. Increased fertilization leads to increased risk for fungal diseases on the crop. The monotonous cultivation of closely selected species over several years in a row and over large areas increases the risk of insect infestation and makes the control of weeds more difficult.

Rationalization and specialization led to larger farms. The majority of them were concerned with crop production. Animal production, in the beginning pigs, eggs and broilers, but also milk and cattle, then became concentrated in rather few but large farms with only a single kind of animal, or even a single production line. Similar specialization has occurred in crop production. As a consequence, some areas became almost void of animal farms while others have dense concentrations of them. This structure of agricultural production has very negative environmental consequences and poses considerable demands on the infrastructure of society to handle daily and large transportation of goods and other products to and from the farms, as well as large demands on the food industry, such as dairies, slaughterhouses, mills, fodder production units, fertilizer factories, etc.

The described changes are characteristic in the West. The development towards large and specialized units was, however, in principle similar in the Soviet Union, although the economic mechanisms were very different.

Carrying capacity and the Baltic region

THE AGRICULTURAL REVOLUTION

The introduction of agriculture into society increased the capacity to feed a population by some 50 times. As a consequence, the need to move to new places to feed a group diminished. Man became stationary; in addition not all members of society needed to take part in the production of food. These general tendencies, which were introduced into this region about 5000 years ago, are in fact still continuing to this day.

Figure 1.1 How farming has improved. Painting by Jan Eric Rehn, Petrus Strandberg, 1749.

THE MAJOR TECHNICAL INNOVATIONS

The capacity of the region to support its human population has expanded enormously through the development of agriculture. Estimations of this 'carrying capacity' from a hunters' society up to our present industrialized agriculture are given below. The major steps in development that need to be mentioned are:

1 bringing land into cultivation by burn-beating and reclamation;
2 use of draught animals and tilling techniques;
3 development of crop rotation and plant nutrient management, introduction of breeding and development of new varieties of crops and new breeds of animals;
4 use of chemical fertilizers and pesticides and
5 use of fossil fuels, mechanization and structure rationalization.

The use of land for exergy production or to feed draughthorses for transportation was replaced by imported mineral fuels after the Second World War and new areas became available for food production. The area released is approximately the same as must be used for the production of vegetable oil to meet present agricultural needs for fuel.

WHICH FACTOR IS MOST IMPORTANT?

Obviously the figures are very approximate and vary with the character of the landscape. The estimates refer to the northern part of the region (lower bound) and the most fertile plains (upper bound). In fact today, for production in the very best conditions, 0.1 ha is enough to feed one person. What is the impacts of the factors soil, water, temperature, fertilizers, tilling, plant breeding, pesticides, etc? In fact, the importance of the factors differ widely for different systems. In poor soils fertilizers are essential. For some crops, such as oil seed and potatoe, pesticides are very important. Winter crops may not be cultivated north of 60° N, and so on.

SUSTAINABLE AGRICULTURE

The most recently introduced techniques, such as high input of mineral fertilizers, use of pesticides - chemical agriculture – and fossil fuels will not be retained in a sustainable regime. The question of the productive capacity of the land in a sustainable regime will be discussed in chapter 6.

Society/Production system	Carrying capacity cap/km² (100 ha)	Techniques	Time for introduction
Hunter	0.001–0.1	spear, traps, bow	
Collector	0.01–0.6	simple digging tools	7000
Nomadic	0.9–1.6	cattle (reindeer)	5000
Burn-beating agriculture	2–40	fire	3000 BC
Shifting cultivation	2–80	plough, oxen, horse	800 AD
Crop rotation	3–100	crop sequence effects	1800
Systematic breeding	4–150	selection, line breeding, genetics	1900
Mechanized agriculture	5–300	tractor, fossil fuel, mineral fertilizer	1950
Industrialized agriculture	10–600	specialization, pesticides	1960

1.5 The challenge of sustainable agri-culture

There are several serious environmental effects connected with industrialized agriculture. The leakage of nutrients has devasta-ting effects on surface waters and consequently on the Baltic Sea, and our drinking water. Pesticides influence fauna and flora, including outside the farm land, in often unpredictable ways. Residues of pesticides are found in the atmosphere, in water and in food. Also, the rationalization of agriculture has led to a decreased variation in wild flora and fauna. The traditional mosaic landscape with small patches of trees, edges, open ditches, small watercourses, etc. has been changed, leading to less variation in biotopes and plant life.

All these effects can be counteracted if so wished. The tools for doing so include varying crop rotation, integration of animal and crop production and more efficient recirculation of nutrients both within agriculture and between urban and rural areas.

It is easy to perceive agriculture as an essentially local activity. However, very few sectors are so dependent on global political, economic and biophysical structures. Modern industrial agriculture is very productive, but at the same time makes extensive demands on its surroundings. It needs large shadow areas, that is, additional land for production of input resources, in particular fuels – often fossil fuels – minerals and fodder. The Baltic Sea countries, where industrialized agriculture dominates, are thus, strictly speaking, not self-sufficient when it comes to food. The food is only partly the result of using solar energy and local resources. At the same time, the importation of fossil fuels during the past hundred years has proportionally decreased the cutting of wood for energy purposes. As a consequence, local forests and fields have gone through a period of recovery.

On the global level, three alarming tendencies are now occurring in parallel: the emerging threat to the environment; the broadening divide between the rich and the poor and increasing unemployment. Of the global population, only some 20 per cent has a generous standard of living. These 20 per cent use some 80 per cent of the world's resources. At the same time, about 1 billion people live below the poverty line, with an income of less than one US dollar a day. Because of poverty, almost 800 million people receive less than the necessary minimal amount of food daily and are not able to lead a decent life, in spite of the fact that there is enough food for all of us. The old ghost of starvation, a companion of humankind from time immemorial, has not been wiped out by modern industrialized agriculture. Instead, it now has a companion: the ghost of non-sustain-ability.

There are two targets on the global scale to be reached within a short time. Firstly, food production should double during the next 30 years, as required by the increase in population. Secondly, the impact on the environment and natural resources should dramatically decrease from the level produced by present modern agriculture. The Baltic region's agriculture has the potential to become an important resource in this respect. The region has plenty of productive land and an awareness among its people that leads to responsibility. What we need to develop is an agricultural ecosystem sufficiently productive for the needs of society and which at the same time reinforces the life-supporting properties of the biosphere. However, it is not enough to carry out technical and economic reforms. As global citizens we also need to reflect and agree on the ethical and spiritual foundations for creating a long-term sustainable global society.

Table 1.3 The challenges of sustainable agriculture

Topic / system	*Pre-industrialized farming*	*Industrialized farming*	*Sustainable farming*
Nutrient management	Manure and low input of mineral fertilizers	High input of mineral fertilizers	Nutrient circulation
Pest and weed control	Crop rotation and mechanical methods	Biocides and mechanical methods	Crop rotation and mechanical methods
Energy management of fossil fuel	Horses, little input fossil fuel	Large input of and methane (biogas)	Plant fat, motor alcohol
Energy efficiency	High output/input quotient	Low output/input quotient	Very high output/input quotient
Biodiversity	High	Low	High
Society support	Low	High	Agriculture as a main supporter of societal needs