

**Matsalu Bay Environment Management  
of Agricultural Run-Off  
Demonstration and Information Activities**

**Final report  
2001**

**from  
the Swedish and Estonian  
BEAROP  
and  
ScanAgri  
teams**

# Contents

Background .....	3
The Rägina Demonstration Watershed .....	3
Demonstration Farms .....	6
Demonstration field plot trials .....	6
Monitoring station .....	6
Education room.....	7
Presentation of the work carried out .....	7
Task A. Demonstration activities in the Matsalu Bay Catchment Area.....	7
Task B. Environmental monitoring.....	13
Task C. Preservation of wildlife and biodiversity .....	15
Task D. Information strategy, extension .....	16
Task E. Environmental and legislation activities .....	18
References.....	20

Appendix 1. Meetings and activities in the Matsalu project

Appendix 2. Task D. Information strategy, extension

Appendix 3. Conclusions from the questionnaire "Your farm and environment" – 1999

Appendix 4. Results of soil mapping on fields in the Matsalu Demonstration Watershed

## Background

The project “**The Matsalu Bay Environment Management of Agricultural Run-off, Demonstration and Information Activities**” was announced in October 1996.

After evaluation of different project proposals, the consortium JTI/ScanAgri, the Swedish Institute of Agricultural and Environmental Engineering and ScanAgri, was selected to carry out the project. A final programme for the project was delivered on May 7, 1997.

The Agreement of co-operation between the Ministry of Environment and the Ministry of Agriculture of Estonia and the Swedish University of Agricultural Sciences, SLU, was signed on March 9, 1998. The final signing by the Ministers of the two Estonian Ministries was done on August 22, 1998. The contract between SLU and the consortium JTI/ScanAgri was signed on June 11, 1998. The consortium agreement between JTI and ScanAgri was signed in June 1998.

## The Rägina Demonstration Watershed

The Rägina Demonstration Watershed is situated in the Matsalu Bay Catchment area in the Martna Municipality in the Läänemaa County. The total area of the Demonstration Watershed is 21.2 km<sup>2</sup>. It is a quite homogeneous and intensively used agricultural area taking into account conditions in the western part of Estonia. 53% (11.3 km<sup>2</sup>) of the total area is arable land and 47% (9.9 km<sup>2</sup>) forest. Most of the arable land is drained and the density of tile drainage systems is quite remarkable, 3.03 km/km<sup>2</sup>.

*Table 1. Main land use characteristics.*

Arable land		11,3
Sown area	7,6	
Grassland	3,7	
Forest		9,9
<b>Total watershed area, km<sup>2</sup></b>		<b>21,2</b>

There are 20 private farms in the Demonstration Watershed and one Agricultural Company. The cattle barn, belonging to the Agricultural Company, is in the western part of the watershed, but most of its arable land is outside the watershed.

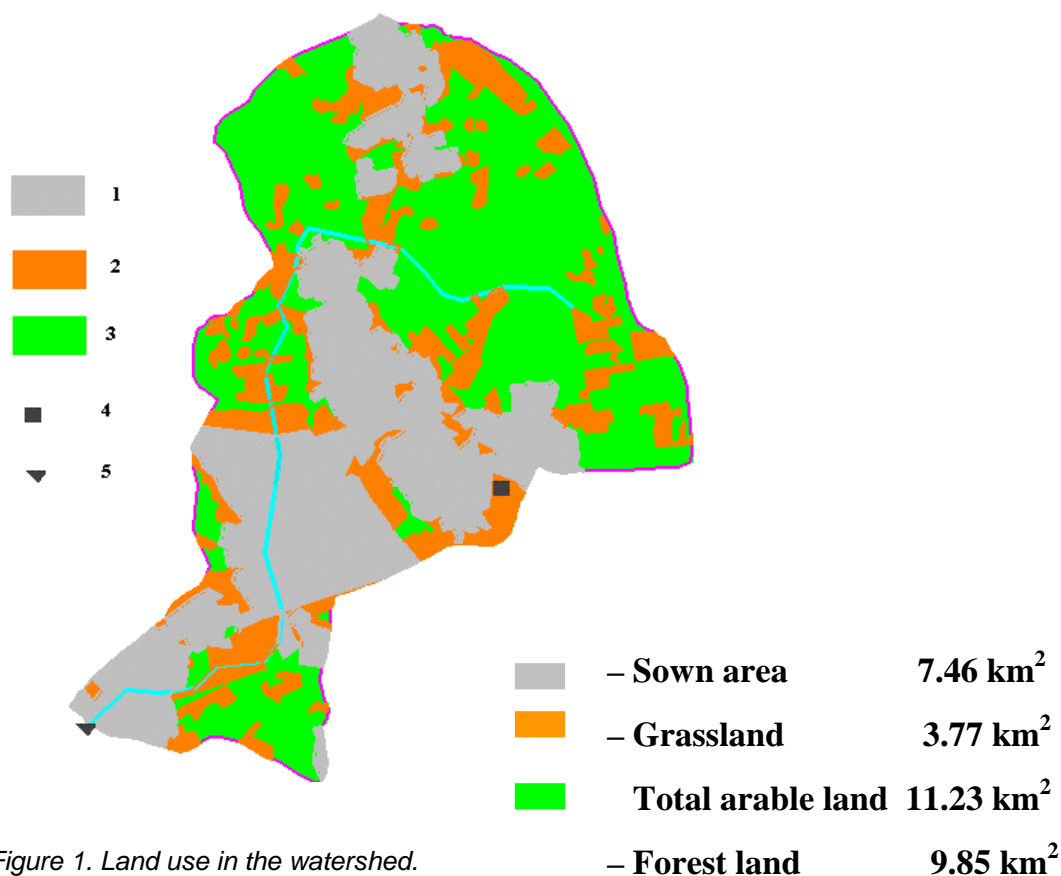


Figure 1. Land use in the watershed.

Table 2. Specification of land use on family farms and agricultural companies in the watershed in 1999.

No	Owner	Total area, ha	Natural grass-land, ha	Arable land, ha			
				Total	Area not used	Cultural grassland	Sown area
1	Tee, L	146.4	14.3	105.7	-	58.0	47.7
2	Kuusemaa, T	137.9	5.5	123.7	-	1.7	122.0
3	Liivla, V	103.0	25.1	13.0	-	10.0	3.0
4	Rehkalt, A	86.1	8.9	40.2	-	28.4	11.8
5	Kimst, A	75.5	11.0	38.6	-	14.6	24.0
6	Kuusemaa, L	50.0	11.0	14.8	-	6.8	8.0
7	Kuusemäe, V	45.0	6.0	14.0	-	13.8	0.2
8	Ehatamm, K	41.7	15.5	7.8	-	7.5	0.3
9	Pajumaa, A	39.0	7.2	16.4	-	14.9	1.5
10	Laanemaa, A	37.2	-	35.9	-	18.9	17.0
11	Mustjatsa, K	33.2	0.4	25.7	0.4	8.8	6.5
12	Lemba, A	32.9	5.9	18.5	0.5	11.9	6.1
13	Väits, H	28.5	3.1	20.2	-	19.2	1.0
14	Üksvärav, A	27.0	6.0	8.5	-	3.3	5.2
15	Pankina, A	24.1	1.3	22.2	-	18.0	4.2
16	Kersa, I	18.8	5.6	13.1	-	11.5	1.6
17	Kaljusaar, H	18.3	0.6	0.9	-	-	0.9
18	Väits, J	17.3	2.0	0.5	-	-	0.5
19	Saska, M	13.2	1.7	3.6	-	2.3	1.3
20	Härmsalu, U	8.4	0.2	7.0	0.8	-	6.2
	OÜ "Lähtru	345.0	-	345.0	9.0	20.0	316.0
	<b>Total</b>	<b>1328.5</b>	<b>131.3</b>	<b>875.3</b>	<b>10.7</b>	<b>269.6</b>	<b>595.0</b>

Table 3. Specification of land use on family farms and agricultural companies in the watershed in 2000.

No	Owner	Total area, ha	Natural grass-land, ha	Arable land, ha			
				Total	Area not used	Cultural grassland	Sown area
1	Tee, L	146.4	14.3	108.5	-	58.0	50.5
2	Kuusemaa, T	183.0	9.3	73.3	-	1.7	71.6
3	Liivla, V	114.5	25.1	13.0	-	10.0	3.0
4	Rehkalt, A	77.5	16.8	24.5	-	14.0	10.5
5	Kimst, A	75.5	11.0	38.6	-	14.6	24.0
6	Kuusemaa, L	50.0	11.0	14.8	-	6.8	8.0
7	Kuusemäe, V	45.0	6.0	14.0	-	13.8	0.2
8	Ehatamm, K	41.7	15.5	7.8	-	7.5	0.3
9	Pajumaa, A	39.0	7.2	17.2	-	14.9	2.3
10	Laanemaa, A	47.4	1.1	43.1	-	18.9	24.2
11	Mustjatsa, K	33.2	0.4	15.7	0.4	8.8	6.5
12	Lemba, A	49.4	14.6	18.0	4.1	11.4	2.5
13	Väits, H	28.5	3.1	20.2	-	19.2	1.0
14	Üksvärav, A	27.0	6.0	7.7	-	3.3	4.4
15	Pankina, A	24.9	2.7	17.1	-	12.9	4.2
16	Kersa, I	18.8	5.6	12.3	-	11.5	0.8
17	Kaljusaar, H	18.3	0.6	0.8	-	-	0.8
18	Väits, J	17.3	2.0	0.5	-	-	0.5
19	Saska, M	24.7	11.3	5.3	-	2.3	3.0
20	Härmsalu, U	8.4	0.2	7	0.8	-	6.2
	OÜ "Lähtru"	337.0	-	337.0	-	30	307.0
	OÜ "Kirjak"	160.4	160.4	-	-	-	-
	<b>Total</b>	<b>1567.9</b>	<b>316.4</b>	<b>796.9</b>	<b>5.3</b>	<b>259.6</b>	<b>532.0</b>

Table 4. Specification of animal production on family farms and agricultural companies in the watershed in 1999.

No	Owner	Cows	Heifers 6-12 months	Heifers >12 months	Calves	Pigs	Chicken	AU/ha arable land
1	Tee, L	15	7	9	3	-	-	0.22
2	Kuusemaa, T	-	-	-	-	95	20	0.15
3	Liivla, V	-	12	-	-	-	20	0.48
4	Rehkalt, A	6	1	5	2	4	20	0.26
5	Kimst, A	2	-	18	-	-	12	0.29
6	Kuusemaa, L	12	20	20	6	-	50	2.28
7	Kuusemäe, V	1	-	-	-	-	-	0.07
8	Ehatamm, K	2	2	-	-	2	10	0.44
9	Pajumaa, A	3	1	1	-	1	20	0.27
10	Laanemaa, A	4	3	-	-	-	-	0.15
11	Lemba, A	3	2	-	-	-	-	0.22
12	Väits, H	3	2	2	1	1	-	0.27
13	Üksvärav, A	-	4	-	-	-	30	0.48*
14	Pankina, A	2	8	-	-	-	10	0.27
15	Kersa, I	4	1	-	1	-	-	0.36
16	Saska, M	1	2	-	-	-	8	0.58
	<b>Total</b>	<b>58</b>	<b>65</b>	<b>55</b>	<b>13</b>	<b>103</b>	<b>200</b>	<b>×</b>

\* 4 lambs and one horse additionally

Table 5. Specification of animal production on family farms and agricultural companies in the watershed in 2000.

No	Owner	Cows	Heifers 6-12 months	Heifers >12 months	Calves	Pigs	Chicken	AU/ha arable land
1.	Tee, L	16	5	11	1	-	-	0.22
2.	Kuusemaa, T	-	-	-	-	55	-	0.15
3.	Liivla, V	3	2	6	1	-	10	0.56
4.	Rehkalt, A	7	1	8	-	5	30	0.51
5.	Kimst, A	2	4	2	-	18	11	0.26
6.	Kuusemaa, L	12	30	15	12	-	50	2.49
7.	Kuusemäe, V	1	-	1	-	-	-	0.11
8.	Ehatamm, K	2	2	2	-	-	-	0.51
9.	Pajumaa, A	4	1	-	-	2	14	0.29
10.	Laanemaa, A	-	12	-	-	-	10	0.14
11.	Lemba, A	4	1	2	2	-	-	0.33
12.	Väits, H	2	2	2	-	-	5	0.20
13.	Üksvärav, A	1	-	1	-	2	30	0.40*
14.	Pankina, A	2	-	2	-	-	10	0.18
15.	Kersa, I	4	1	1	-	-	-	0.41
16.	Saska, M	2	1	-	1	-	9	0.53
	<b>Total</b>	<b>62</b>	<b>62</b>	<b>53</b>	<b>17</b>	<b>82</b>	<b>129</b>	<b>x</b>

\* 4 lambs and one horse additionally

## Demonstration Farms

### *Liitmäe farm*

Liitmäe farm is situated in the Demonstration Watershed. This farm was evaluated as suitable for demonstration purposes, even though the newly constructed barn did not offer quite acceptable animal welfare and working conditions for the farmer.

### *Jüri farm*

Jüri farm is situated in the Matsalu Nature Reserve Area close to the Matsalu Bay and on very valuable alluvial meadow of the Kasari river (famous bird nesting area), but outside the Demonstration Watershed. This farm is appointed by the Matsalu Nature Reserve Area administration and also evaluated as suitable for demonstration purposes.

## Demonstration field plot trials

The demonstration field plot trials are established at the Liitmäe farm. The field plot trials show the yield quantity and quality of produced crops when manure, fertilisers and pesticides are used in accordance with GAP.

## Monitoring station

The monitoring station was constructed on the river Rägina in 1999 and was equipped with automatic data-logger for discharge measurements, flow-proportional water sampling and some weather parameters.

## Education room

A meeting room in the Martna Municipality building is used as an education room according to an agreement with the head of the municipality. All lectures for the farmers are now carried out in this room. The room has been equipped with an overhead projector, a projection screen, poster-boards and some furniture (chairs).

## Presentation of the work carried out

### Task A. Demonstration activities in the Matsalu Bay Catchment Area

#### Sustainable agricultural management

##### *Objectives*

The Rägina Demonstration Watershed was selected to introduce and demonstrate sustainable agricultural management practices in the Matsalu Bay catchment area. The main emphasis was put on minimising nutrient leakage and run-off, from family and joint-stock company farms, by showing how nutrients can be retained and used at farm level.

##### *Actions*

- One of the farms in the selected watershed will be appointed as a Demonstration Farm. This farm will be equipped with an education room.

*Activities performed:* The Liitmäe farm has been appointed as Demonstration Farm. The education room for seminars, exhibitions, etc. was equipped in the nearby municipality building in Martna because there was not proper facilities on the farm.

- Nutrient balances on animal level, on the Demonstration Farm, and on all farms field and farm level. A balance will be made for the entire watershed. All balances will be made yearly.

*Activities performed:* Interviews for making nutrient balances on farm and animal levels were proceeded according to the plans. Compilations of the collected data were used for calculation of the yearly nutrient balances for the entire Demonstration Watershed and the separate farms. These nutrient balances, together with measures to improve the nutrient management, have been presented and demonstrated in the lectures for the farmers in the Demonstration Watershed. Lectures and discussions with the farmers have been carried out also outside the Demonstration Watershed in Matsalu Bay task area.

Nutrient balances for all main producers (21), including agricultural company, were calculated. Balances for the fields and for the whole catchment area were calculated for the year 2000. At the seminars in June and October 2000, the results of calculated nutrient balances were presented and measures were proposed for improvement of nutrient management. Nutrient balance for agricultural companies on farm level is slightly positive, but for small private farms it is still negative, especially for nitrogen. This indicates that nutrient surplus in the soil is decreasing.

- Large-scale demonstration field trials in co-operation with and managed by Jäneda Training and Advisory Centre are implemented on the Demonstration Farm or a nearby farm.
- A demonstration field plot trial is implemented according to the model developed in Kabala. A new plant analysis method for nitrogen will be introduced.
- Water monitoring on field trial level.

*Activities performed:* Large-scale field trials on 36 plots, with 12 different treatment levels and three replacements have been carried out on the Demonstration Farm. The plots were treated in spring and autumn spreading with animal manure, solid manure and slurry but also mineral fertilisers. The Jäneda Training and Advisory Centre in co-operation with Tartu Agricultural University have performed a demonstration field plot trial for potatoes. This was done to gain experience for the large-scale demonstration field trials.

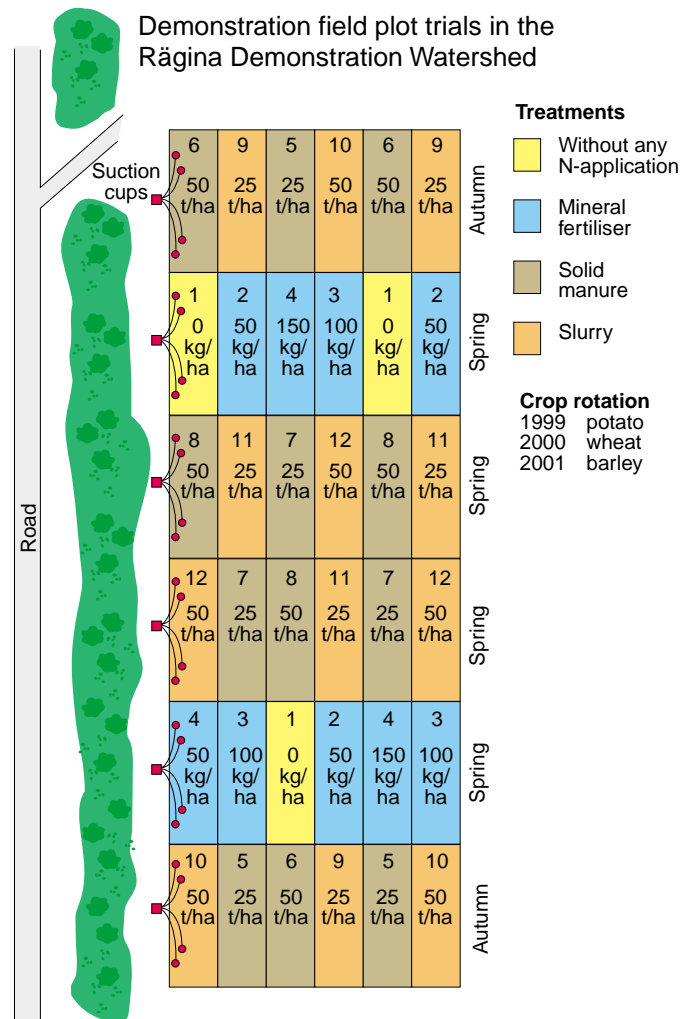


Figure 2. The layout of the demonstration field plot trials at the Liitmäe Demonstration Farm in the Rägina watershed.

In 1999, experiments were carried out with potato and in 2000, summer wheat was used as part of the crop rotation system. All necessary work with the experiment was carried out together with Jäneda Training and Advisory Centre. Soil water samples were collected systematically for evaluation of nitrogen losses through root zone. Altogether 244 soil water samples were collected and analysed. Also 108 soil samples from field plots were analysed.

The nitrogen leaching through the root zone in the demonstration field trials is measured using suction cups. The soils are naturally drained by the underlying lime rock, rich in cracks and do not allow any other method.

Water samples were collected from four points in every representative plot with different treatment levels. The results are extremely interesting from a management and an environmental protection point of view. After the harvesting period during the autumn, leaching of nitrate through root zone can be high. The concentration of nitrate nitrogen in soil water is up to 30-50 mg/l. This exceeds remarkably values gathered from the reference areas with zero treatment.

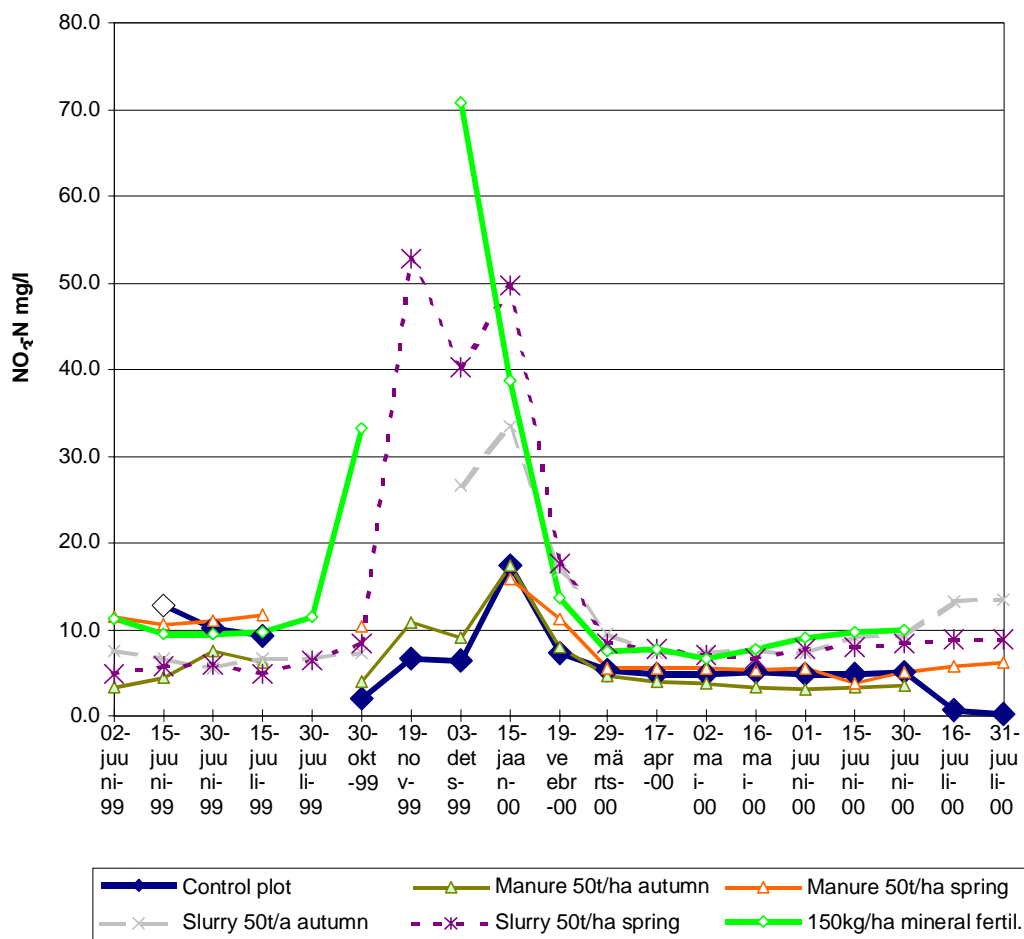


Figure 3. The concentration of nitrates in soil water in the depth of 90 cm (mean values for different fertilisation rates).

From a scientific point of view, it is interesting that nitrogen losses from small agricultural catchments were extremely low, only 6,7 kg/ha. It indicates that transformation of nutrients in river systems and self-purification processes are important for reduction of nitrogen load from point and non-point sources of agriculture. These processes need more attention also from a management point of view.

The quality and quantity of harvested plants were also investigated. The content of nitrate has been measured for potato yields from each plot. The results show that there are remarkable differences in yields and in the quality of potato on different fertilisation levels. The budget of nutrients in potato fields in 1999 is shown in Table 6. These results have been introduced to the farmers during the field day and at the seminars. The results are extremely interesting, because these were the first such experiments with potatoes. Ongoing experiments were introduced to many visitors from Estonia and abroad.

*Table 6. The nutrient (NPK) budget of the potato field in 1999 with different fertilisation rates (kg/ha).*

Variant no	Usable nutrients into the soil			Removed nutrients with yield			Active budget of nutrients		
	N	P	K	N	P	K	N	P	K
1	-	-	-	54.1	5.6	50.9	-54.1	-5.6	-50.9
2	50.0	-	-	73.5	7.7	75.2	-23.5	-7.7	-75.2
3	100.0	-	-	92.5	8.1	86.0	7.5	-8.1	-86.0
4	150.0	-	-	105.6	9.2	105.4	44.4	-9.2	-105.4
5	18.1	10.0	66.0	68.3	6.5	94.2	-39.3	3.5	-28.2
6	36.3	20.0	132.0	80.1	8.4	93.1	-22.1	11.6	38.9
7	20.0	11.3	82.0	73.7	8.3	84.9	-41.7	2.9	-2.9
8	40.0	22.5	164.0	75.2	7.5	84.8	-11.2	15.0	79.2
9	64.5	9.0	31.5	93.2	8.7	95.3	-28.7	0.3	-63.8
10	129.0	18.0	63.0	106.7	8.9	104.1	22.3	9.1	-41.1
11	54.0	10.0	30.0	99.8	8.9	94.9	-45.8	1.1	-64.9
12	108.0	20.0	60.0	101.0	8.7	86.4	7.0	11.3	-26.4

*Table 7. The nutrients (NPK) budget of the summer wheat field in 2000 with different fertilisation rates (kg/ha).*

Variant no	Usable nutrients into the soil			Removed nutrients with yield			Active budget of nutrients		
	N	P	K	N	P	K	N	P	K
1	0	-	-	37	7.5	8.4	-37	-7.5	-8.4
2	40	-	-	57	9.7	11.0	-17	-9.7	-11.0
3	80	-	-	75	11.4	13.0	5	-11.4	-13.0
4	120	-	-	76	11.0	12.7	44	-11.0	-12.7
5	80 + 9	5.0	8.2	72	11.1	12.4	17	-6.1	-4.2
6	80 + 18	10.0	16.5	70	11.0	12.1	28	-1.0	4.4
7	80 + 10	5.6	10.2	69	10.8	11.9	21	-5.2	-1.7
8	80 + 20	11.2	20.5	67	10.7	12.0	33	0.5	8.5
9	80 + 11	4.5	10.5	69	10.4	10.9	22	-5.9	-0.4
10	80 + 22	9.0	21.0	68	10.6	11.7	34	-1.6	9.3
11	80 + 9	5.0	10.0	68	10.8	12.2	21	-5.8	-2.2
12	80 + 18	10.0	20.0	69	10.8	11.6	29	-0.8	8.4

## Technical support

### *Objectives*

- To disseminate knowledge of manure handling techniques, capacity, advantages and disadvantages, economy, nutrient utilisation and environmental impact.

*Activities performed:* Lectures on manure handling at seminars for the farmers in the Demonstration Watershed. Farmers do not have enough experience in the field of testing and controlling of agricultural machinery. Therefore, project experts have been consulted how to handle and test different types of machinery (solid manure and pesticide spreaders, harvesters, sowing machine).

- To introduce and demonstrate manure handling systems, including manure storage and spreading. Manure handling systems should be based on Good Agricultural Practice (GAP).

*Activities performed:* Test of the spreading performance of the JF 12 solid manure spreader, supported by SIDA funding. The spreader will also be used in field demonstrations.

### *Actions*

- Investigation of today's system and propose implementation of suitable measures concerning handling technique for storage and spreading of manure at the Demonstration Farms Jüri farm owned by Eino Jõemaa, and Liitmäe farm owned by Liidia Tee.

*Activities performed:* The manure handling systems at the Jüri and Liitmäe farms have been evaluated to fulfil the Estonian regulations and an action programme has been worked out and implemented. A solid manure spreader has been delivered and is in use at the Jüri farm. The spreader may also be used on the other farms in the Demonstration Watershed. So far, no spreader for urine and slurry has been bought for the Demonstration Watershed.

The costs for reconstruction of manure and urine storages have been underestimated. Therefore, we have to plan for a less expensive spreader for slurry and urine. An investigation of background data for buying such a spreader has been carried out. There are two alternatives:

1. To investigate the possibility of using the tanker at the Liitmäe Farm for mixing pesticides (this tanker is owned by the local municipality). Gennadi Bogun has examined this tanker and given his point of view together with calculated costs for a reconstruction to a urine spreader with a splash-plate.
  2. To buy a second-hand slurry spreader with splash-plate, which later could be equipped with a spreading boom.
- Investigation of today's system and propose needs for suitable measures concerning handling technique for storage and spreading of manure on the other farms in the Demonstration Watershed.

*Activities performed:* Investigation of today's manure handling system has only been carried out on four of the other farms in the Demonstration Watershed. At all farms with more than 10 animal units, the manure handling systems have been investigated. An action programme, to fulfil the measures recommended by

Estonian regulations, will be worked out. Information and data about animal production, manure handling systems and manure utilisation are presented in Appendix 3.

- Calculation of the need for storage capacity based on the number of animals, legislation and surface run-off at the Jüri and Liitmäe Demonstration Farms.

*Activities performed:* These calculations have been made:

At the *Liitmäe Farm*, calculations of the storage capacity for farmyard manure and urine and the leakage from the farmyard have been carried out. The following measures are proposed.

1. Landscape planning and maintenance was finalized in the Demonstration Farm Liitmäe inside the demonstration area in aim to collect storm water and to predict discharge of water to the barn and manure storage. The rainwater from the roofs of the cowshed and the rainwater and melted snow water collecting and leading system through ditches and constructed pond was planned and constructed. Also necessary landscape maintenance and planting work were done to increase aesthetic value and biodiversity of the farm.
2. Increased storage capacity for urine. Two new urine pits are constructed.
3. Construction of a septic tank for the water from the water toilet in the dwelling house.
4. Construction of a septic tank for cleaning water from the milking parlour.
5. There is an urgent need to ventilate the cowshed. Even if no money is allocated for such measures, we will invest a small amount of money to make the stable climate acceptable for the animals and the farmer.

At the *Jüri farm*, calculations of the storage capacity for farmyard manure and urine and the leakage from the farmyard have been carried out. The following measures are proposed.

1. The size of the area for storage of farmyard manure is large enough, but the walls on two sides are not long enough. These two walls will be reconstructed during the year 2001.
2. There are no storage facilities for urine on the farm and all urine and leakage water from the manure storage goes directly to the groundwater. Plans and drawings for construction of a pit for urine and surface water run-off from the manure storage are prepared. The construction work will start during 2001.

- Testing of spreading performance and durability for the manure spreaders.

*Activities performed:* This has been done for the solid manure spreader. The spreading performance is already demonstrated and documented. The spreader has also been used for demonstrations in field days.

- Demonstration activities, field days.

*Activities performed:* Pesticide sprayers, used on the farms in the Demonstration Watershed, have been controlled and demonstrated in a field day in 2001. The spreading performance for two solid manure spreaders has also been evaluated and demonstrated in a field day. On this field day, the manure spreader, supported

by the BAAP project, was compared to a traditional Russian spreader. According to plans, these machines will also be used in demonstrations in 2001.

- Machinery ring

*Activities performed:* No contract has been signed. A contract will be worked out concerning the use of and responsibilities for the solid manure spreader bought by BAAP funding.

## Task B. Environmental monitoring

### *Objectives*

- To estimate non-point load from agriculture
- To establish a modern automatic water monitoring station
- To demonstrate activities concerning nutrient load reduction
- To involve small catchment monitoring with the national monitoring system

### *Actions*

Design, construct and run a new monitoring station in the Rägina main ditch in order to investigate the run-off from the Rägina Demonstration Watershed.

*Activities performed:*

**Monitoring station.** A monitoring station with a Crump weir and hut for the measuring equipment has been constructed in 1999 in the Rägina River close to the "upper" road, about 1.8 km south-west of Kirna, Figure 4.

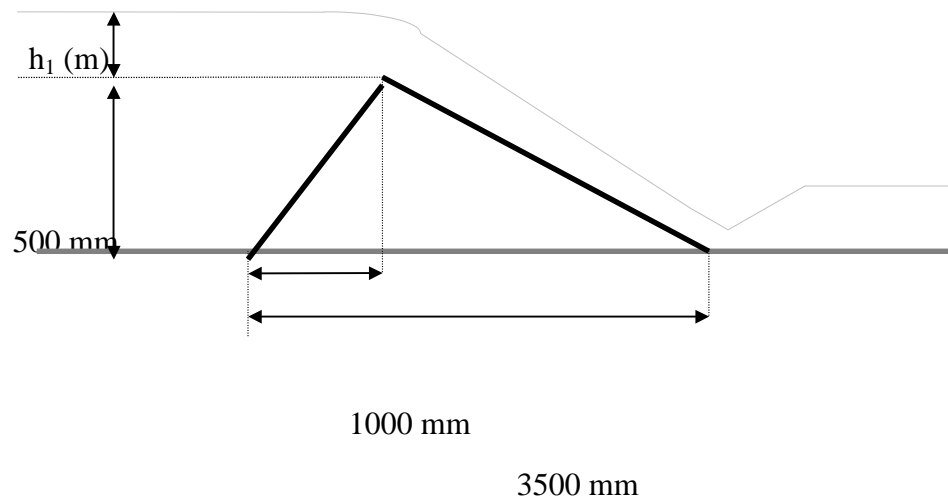


Figure 4. Principal scheme of the Crump weir.

The monitoring station is equipped with a data-logger for automatic registration of water flow and some weather parameters, e.g., air temperature and soil temperature in three layers, wind speed and precipitation, both rain and snow. The station is also equipped with a device for flow-proportional water sampling for chemical analyses. The landscape surrounding the monitoring station has been

maintained, different species of trees and bushes planted to fulfil high landscape quality goals, Figure 5. Therefore, many visitors were interested to see the site. The small agricultural catchment monitoring in the Rägina river is a part of the national groundwater monitoring system.



*Figure 5. The Rägina water monitoring station.*

The monitoring manager has been trained to compile the data collected and evaluate the results. Water samples from the monitoring station were usually collected every second week and analysed in the laboratory of the Tallinn Technical University. In addition, monthly water samples were collected from two other stations (the mouth of the river Rägina and the river Rannamõisa) since 1997. This work started already during the preparation phase of the project to evaluate agricultural impact to the Matsalu Bay. Chemical analyses were made for 15 parameters. Also 24 drinking water samples were collected and analysed from the wells of the Demonstration Farms. Collection and analyses of drinking water samples for Demonstration Farms were carried out every month.

According to the investigations, the concentrations of total nitrogen and total phosphorus in the river Rägina were low. The mean total nitrogen concentration in 1998-2000 was only 2.2 mg N/l, minimum concentration 0.6 mg N/l and maximum concentration 5.4 mg N/l. The average concentration of total phosphorus was 0.045 mg P/l and maximum concentration reached only up to 0.11 mg P/l.

Continuous calculations of nutrient losses from agricultural area have been carried out in Rägina-Kirna station since October 1999. Nutrient losses in the year 2000 were low, only 6.7 kg N/ha and 0.21 kg P/ha. It can be explained by low level of fertilisation but also with grasslands prevailing in land use. Also conditions for denitrification are favourable because of macrophytes and bushes in the ditches.

The results of the groundwater analyses show that water from 11 wells did not fulfil the demands set up by the Estonian Drinking Water Quality Standards by one or more indicators, Table 8.

Table 8. The number of probes exceeding the Estonian drinking water quality standard.

	NO <sub>3</sub> <sup>-</sup>	NO <sub>2</sub> <sup>-</sup>	NO <sub>4</sub> <sup>+</sup>	Fe <sub>tot</sub>	F <sup>++</sup>
Number of probes	4	1	0	5	2
%	17	4	0	21	8

## Task C. Preservation of wildlife and biodiversity

### *Objectives*

The goal of the task is to maintain existing high biodiversity in the Matsalu area and to increase public understanding for protection and preservation of wildlife and biodiversity.

### *Special remarks*

Activities in this area were monitored by the MoE and involved the direct participation of representatives of the Matsalu Nature Reserve to assure the co-ordination.

### *Actions*

An overview about biodiversity of coastal meadows and Kasari river flood plain in 2000 was compiled using microorganisms and worms as test communities. These experimental investigations using bioindicators were done by the Institute of Environmental Protection of Agricultural University led by professor Kalev Sepp.

- Improve farmers' knowledge of biodiversity and wildlife.

*Activities performed:* One lecture on activities on wildlife and biodiversity for the farmers in the Demonstration Watershed has been carried out in 1999.

- Together with the farmers, identify valuable elements for wildlife and biodiversity on farm level.

*Activities performed:* During the seminar, information was given how to identify valuable elements for wildlife and biodiversity on each farm in the Rägina Demonstration Watershed.

- Promote grass harvesting in meadows.

*Activities performed:* Two small 2-wheel mowers suitable to cut grass on wooded meadows have been bought. The need for maintenance of unique wooded meadows and coastal meadows to preserve high biodiversity has been explained during the seminars.

## **Task D. Information strategy, extension**

### *Objectives*

The basis of the information and extension strategy is the creation of co-operation groups consisting of farmers, rural residents and public officials working in a given watershed area and getting them to work together to reduce plant nutrient leakage. This can lead to more cost-effective, flexible and locally adapted solutions to reduce the negative environmental impact. This working model includes a comprehensive transfer of know-how, training and counselling as key elements. Enhanced know-how and insight will provide the foundation for long-term, sustainable solutions.

### *Activities*

As start of the project a questionnaire was sent to 365 farmers in the area. About 50% of the farmers answered. Through this material we got a picture of the farming in the Matsalu area. Detailed results from the questionnaire are presented in Appendix 3. Based on the results, we decided to create three groups for seminars in Raikküla, Vigala and Lihula. In a second phase, a group in Laukna was started.

### *Advisory service*

In Rapla, a local advisory centre has been established in the ETKL office. Andrei Mitt has been full-time employed as project co-ordinator and advisor. A lot of farmers have visited the office to discuss their problems and to ask questions. Farmers have also contacted the advisory centre by telephone. Examples of subjects for advise:

- information about the Matsalu project
- organic farming and recommendation for improvement of organic farming
- plant nutrient balance on the farm
- soil analyses and calculation of fertilisers needed
- crop rotation and selection of crops considering soil type
- cultivation and sowing
- grassland management
- information about good manure handling, building of storage
- plant protection and how to use pesticides without negative impact on the environment and people
- forest management
- business development
- introduction to new ecological law and Code of Code Agricultural Practice
- introduction to “ Checklist for your farm“ (actionplan for the farm)
- short introduction of the latest results from water monitoring in the Rägina Demonstration Watershed
- introduction of the results from the demonstration field plot trials at the Liitmäe farm
- information about SAPARD (Special Assistance Programme for Agriculture and Rural Development)

During this period, it became evident how important these subjects are for the farmers in Matsalu area.

Besides the work in the office, the advisor has visited a lot of farmers. Many of the visits to farmers has been initiated on the seminars. During the project period, 36 different farms have been visited, often more than once. In Appendix 3, a detailed list of the visits to the farms are presented. One very important subject when visiting the farms is soil sampling. Altogether 21 farms have taken soil samples. This has been the base for further discussions around fertiliser needs, manure handling and environmental questions. The results from the soil samples are as mean figures: pH 6,7, P-AI 4,6 and K-AI 10,2. The results of the soil analyses are presented in Appendix 4.

***Seminars for farmers (including homeland owners), advisers and joint-stock companies.*** Seminars have mainly been made for farmers in the three regions; Raikküla, Vigala and Lihula. In these places, eight seminars have been held. Lectures have been given by Estonian and Swedish experts. The seminars have given the farmers a basic knowledge of crop production, manure handling, and environmental aspects. The farmers have also been able to influence the subjects of the seminars. At the seminars, the farmers have been working with their own farms concerning crop production plan, plant nutrient balance, “Checklist for your farm“. Details about seminars are presented in Appendix 3. The project co-ordinator has also made seminars together with the BEAROP team in Martna.

***Agricultural field days for farmers and homeland owners.*** Field days have been held in Martna on the Demonstration Farm together with the BEAROP team. In the “seminar regions“ there were field days in the different regions in 2000 and in 2001. We made a trip for all the farmers to the Demonstration Farm in Martna and the Matsalu Nature Reserve.

***Information and study material.*** Information material produced and adapted to Estonian farming conditions.

Andrei Mitt	Short introduction to the Matsalu project
Per Stahl, Andrei Mitt	Questionnaire “Your farm and environment“
Per Stahl, Andrei Mitt	Results from the questionnaire “Your farm and environment“
Per Stahl, Andrei Mitt	Map over the whole farm. Comments
Andrei Mitt	Introduction to soil analyses
Magnus Bergström/Andrei Mitt	What is biodiversity?
Per Stahl, Andrei Mitt	Organic farming
Per Stahl	Plants nutrient balance in farm. Comments

Study material (produced at Jäneda Training and Advisory Centre) was distributed to the farmers during the seminar period.

***Articles.*** During the project period time a total of 12 articles were written for a local daily newspaper in Rapla: “Nädaline“.

The issues have been: The Matsalu project; sustainable agriculture; ecological farming in Matsalu area and reports from seminars/field days and other meetings.

**Course Evaluation (January 2001).** At the end of the seminars, farmers filled in a questionnaire. The total average points of the questions were 4,4 (maximum 5). Details are presented in Appendix 3.

### **Conclusions**

The creation of groups in the region where activities have been close to the farmers have been very important. Throughout the project time, almost the same farmers have returned to visit all seminars. This has created a feeling of membership of a group. The farmers have started to talk and co-operate with each other. Also, the groups have been meeting for discussions. These groups will probably continue to function after the project is finished. The farmers have been aware of the importance of knowledge. They have got a package of information through the seminars that will be useful in the future.

The local advisor has been an important factor of success. It has been possible for the farmer to continue the discussions after the seminars at their own farm. Many contacts for visits of the advisor to the farms have been made at the seminars.

## **Task E. Environmental and legislation activities**

### **Objectives**

We propose to improve and implement the current Estonian legislation on agriculture and environment in the Matsalu Bay catchment area. The area will be used as a case study and demonstration area showing how general reinforcement of the legislation could take place.

### **Actions**

The project team was involved in the process of improving the Estonian agri-environmental legislation. Gathered information and experience helped to work out the GAP and other legislative acts (e.g., for nitrate sensitive areas, nitrate directive, etc.).

During the project implementation period, two reports (an intermediate report in 2000, and a final report in 2001, 106 pages) were prepared in Estonian and presented to the interested authorities. The recommendations and proposals for reduction of agricultural pollution load and improvement of water quality were worked out taking into account the water basin management approach and using experience and knowledge from different countries. The recommendations were delivered to the Ministry of Environment and Ministry of Agriculture.

**Legislation.** According to Estonian legislation (Restrictions on Fertilisation proceeding from Environmental Requirements, Reg. No. 23, 04.07.1994) there are restrictions regarding the permitted animal load and manure storage. There have been difficulties in reinforcing this legislation on family farms in Estonia, there is a need for some actions. We propose first of all to have a thorough look at the law and to develop a more appropriate legislation and implementation. We also propose to reinforce this legislation in the Matsalu catchment area. To do this, it is necessary to develop a complete action programme.

**Activities performed:** Discussions between representatives from the Ministries of Environment and Agriculture have resulted in a programme to implement envi-

ronmental and agricultural legislation on the farms in the Demonstration Watershed. This work has also included activities to support the Estonian experts in the preparation of the Estonian Code of Good Agricultural Practice, GAP. Implementation of the Estonian environmental and agricultural legislation and GAP on the farms in the Demonstration Watershed has started and will be continued throughout the project.

**Information.** The farmers in the area, the agricultural advisors and the agricultural schools must learn the principles of plant nutrient circulation. Important parts are how to utilise the nutrients in manure in the best way. Legislation is therefore necessary to make this possible. Animal density, regulations on manure storage and spreading of manure are important. Not only regulation, but also good advice on how to use the nutrients that the farmers have already paid for, as fodder, in the best way after they have been transformed to manure. We have to create a positive understanding and acceptance of the legislation to achieve this goal.

Written information, pamphlets and articles in the daily press and in magazines will be produced. They should be rather short and full of interesting information for the farmers and will describe "Good Agricultural Practice". Information on new techniques and also ways of calculating with manure and spreading advice will be disseminated. Also ways of building manure storage, mucking out systems and other necessary agricultural subjects will be part of the information.

*Activities performed:* Lectures in introduction to the Estonian environmental and agricultural legislation and GAP have been given to the farmers in the Demonstration Watershed and to teachers at the local school in Martna. Aspects on environmental and agricultural legislation and GAP are included in all lessons in crop and animal production, especially in lessons in manure handling, nutrient management and nutrient balances. The programme is demonstrated in the Demonstration Watershed and spread from there to the entire Matsalu catchment area. These aspects are also demonstrated in the demonstration field plot trial.

When GAP is accepted, we will together with the ScanAgri/ETKL team prepare a leaflet for farmers on GAP.

**Advisory service.** The farmers must have the possibility to find good advice on all agricultural subjects relevant to the environment. Seminars and courses must be given, and also field days and demonstrations should be commonplace. Possibilities for both individual and group extension services must be given.

*Activities performed:* All results from the Demonstration Watershed and the two Demonstration Farms are given to the ScanAgri/ETKL team. This team is also free to use all facilities in the education room and in the Demonstration Watershed.

**Subsidies or financial support.** Some type of financial support to family farms will be necessary to make the building of manure storages possible. Different solutions, such as subsidies, financial loans with low interest and other solutions must be studied. To preserve open landscapes, there is a need for special management with low economic outcome for farmers. Therefore, in a long perspective, farmers have to be subsidised for this work.

*Activities performed:* Up to now, measures have been taken to propose guidance for subsidise investments for an improved environment. This work cannot start

until the rules and GAP have been accepted. We plan to take up this subject at the end of the project.

## References

Näidisvesikond ja näidistegevus Rägina põllumajanduslikul valgalal ja Matsalu looduskaitsealal 1999-2000. Lõpparuanne. BEAROP projekt Eestis (in Estonian). Tallinn, 2000, 104 p.