

SNV Macedonia



Piloting on Agro-forestry and renewable energy possibilities

-Biomass production-



Prepared by SNV Skopje office

2011

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ACRONYMS

RE	Renewable energy
FO	Forest owner
NAPFO	National Association of Private Forest Owners
PFO's	Private Forest Owners
EU	European Union
RD	Rural Development

Background

Biomass produced from wood is increasingly used for energy, especially heating. Currently in Macedonia, Balkan region however mainly firewood (wood logs traditional system) is used. Modern production of wood chips and/or pellets is limited used. This market is increasing rapidly. Fast growing wood species offers a good option for production of biomass for energy.


In Macedonia many agricultural lands are not or marginal used. Some of these lands are not very suitable for agricultural farming, but can be used well for fast growing trees species, producing biomass. Such trees can also be integrated in existing farm land on borders, windshields, over corners. Besides the production of biomass from the trees, tree belts also fulfilling other functions as wind protection reducing water inundation in wet areas, improvement of micro climate conditions or erosion control of river banks.

**PLANT SALIX EXPRESS
ENERGY WILLOW!**


Three reasons for choosing SALIX
EXPRESS to plant:

- *This willow has proved to be the most successful of all eligible energy willows in Hungary. [The tree adapts to extreme site conditions and is the fastest grower].*
- *The first year yield was 23 tons/ha [by 10,000 pcs/ha planting network].*
- *As a forest plant, this willow grows an excellent stem, and it is not susceptible to disease, plus it has a long yearly vegetation period.*

Please ask for a quotation:
Attila Hegedűs
hegedus@forcons.hu,
www.salixenergia.hu
www.greenovacio.hu



One year old primary
stoolbed for cutting
production
(Kapuvár - Földvár, 2009)



In Europe several fast growing species are introduced and used for producing biomass. These are not used yet in Macedonia and its region. In Hungary trees are propagated for improving their production. One of the varieties is (White Willow)

Salix alba, a fast-growing **variety Express**, used for plantation growing and production of biomass for energy in Hungary.



Three year old Salix alba variety Express

Above the growth difference are shown for a regular *Salix alba* at three years growth and an improved fast growing *Salix alba* express as well at three years.

Biomass production in Macedonia

Since the agro-forestry concept is new in Macedonia it was a challenge to plant the fast growing species on agriculture land. In 2010 this species is introduced on some pilot schemes at limited scale, but gives good results in growth and potential. A total of 10 different sites are used in Macedonia with different conditions. Besides *Salix alba* also some *Acacia* (*Robinia pseudo acacia*) were used. *Salix* is used preferably on the moist, wet sites, while *Robinia* can be used well on dry lands.



Selection of plantation sites

Process of information collection, consultation and explanation was conducted among farmers. The pilot focused on small scale farmers using their land. Sites were selected in consultation with the farmers. Farmers indicated small plots not in use, marginal land, along side agricultural land for protection (erosion control from river, wind etc), while at the same time producing biomass. Important factor for best results is the willingness, dedication and understanding of the farmer. In the final results owners were satisfied agreeing that this should have been done long time ago.

“When these trees grow up and the other land owners see what we have done, I hope that they will understand the meaning of agro forestry and the idea of biomass production”.

Biomass cultivation data

The pilots are in the villages Amzibegovo, Mustafino and Meckuevci located close to Sveti Nikole (East Macedonia) and in Taor near to Skopje (North Macedonia).

Sites in the village of Amzibegovo have been grouped on four locations:

- Site 1, located along the river out of the village, owned by one farmer
- Site 2, located on the right side in side the village, 10 m higher than the level of the river along it side owned by 2 owners
- Site 3, located along the river, on the left side of the village owned by 2 owners
- Site 4, located along the river, on the left side of the village owned by 1 owner. Parcel had big possibility for spread of reed.

In the village of Mustafino all sites have been grouped as one location due to very similar growing conditions.

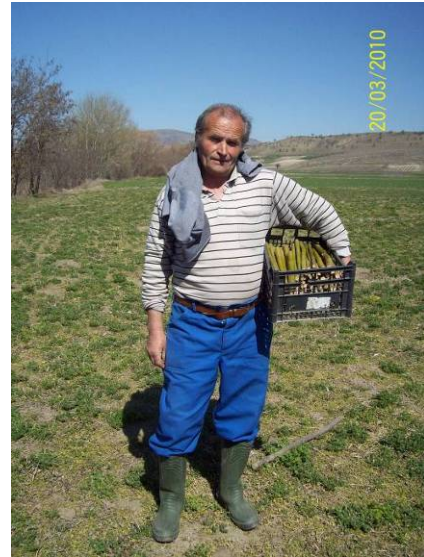
Village of Mechuevci has only one planting site, of which one parcel is planted with Salix and one with Robinia.

In the village of Taor there are four different sites, of which three parcels are planted with Salix and one with Robinia.

In consultation with the Hungarian institute and experts from the Faculty of Forestry in Skopje, a model for planting the fast growing willow was developed.

- Planting of 10.000 stumps/ha

- Planting is done with tree stumps/cuttings of 20-30 cm length and diameter of 1.5-3 cm. The stumps need to have several buds from where the tree will sprout.



Salix alba variety Express stumps

- Soil preparation was done mechanical, plowing the soil up to 25-30 cm deep.



Soil preparation

- Cuttings are made at the end of the winter, immediately prior to planting. This is done in March before the growing season starts. Since this variety is not yet available in Macedonia stumps were imported from Hungary. The costs come to around 0.2 euro/stump. With an average of 10.000 pc/ha



Planting

- Planting (striking) of cutting is done by hand. It can however also be done by machine in large scale plantings. The stumps need to be pushed vertical and tightly in the soil, leaving only 2 cm above the surface. On suggestion of the Hungarian producer while visit in 2011, the planting need to be done pushing the stumps completely under the soil (1-2 cm) to protect them from evaporation. This way of planting is giving better success rates.



Tending

Biomass planting data															
			Salix alba Express									Total	Robinia pseudo		Total
Planting site			v. Amzibegovo site 1	v. Amzibegovo site 2	v. Amzibegovo site 3	v. Amzibegovo site 4	v. Mustafino	v. Meckuevci	v. Taor site 1 kamenica	v. Taor site 2	v. Taor site 3		v. Meckuevci	v. Taor	
baseline	description	soil type	moist sandy clay	stony clay	moist clay	moist clay	moist clay	stony clay	stony clay	moist clay	moist clay		moist clay	clay	
		slope	no	no	no	no	no	1%	5%	no	no		5%	2%	
		exposition	none	none	none	none	none	north-east	south-west	none	none			north-east	
		water level	high	very low	high	high	medium	low	high	high	high		very low	very low	
		inudated in months	0	0	1	1	0	0	0	2-3	1		0	0	
		text	along river	10 m higher and along river	along river	along river mixed with reed	small parcels in the yards	remote place higher and along river	stony soil	best site for biomass production/ high rate of deseases	best site for biomass production/ high rate of deseases		remote place / poor surownding vegetation	abonded agricultural land, exposed to erosion	
	number		1400	1900	600	350	570	700	150	1150	100	6920	550	450	1000
	size of parcel		1400 m2	1900 m2	430 m2	700 m	400	500 m2	150 m2	800 m2	100m2	6380m2	600 m2	450 m2	1050m2
	planting scheme/ in row x between rows x length in m		1 x 1	1 x 1	0,7 x 1	1 x 2	0,7 x 1	0,7 x 1	1 x 1	0,7 x 1	1 x 1		1 x 1 x 150	1 x 1	
	purpose of the owner		erosion/ wind control / fuel wood	erosion protection / fuel wood	erosion and flooding control / fuel wood	erosion and flooding control / fuel wood	flooding control / fuel wood	erosion and wind protection / biodiversity / fuel wood	wind protection / biodiversity / fuel wood	flooding control / fuel wood	fuel wood		wind protection / biodiversity / fuel wood	flooding and wind control / fuel wood	
piloting	time		5 days	6 days	3 days	2 days	3 days	4 days	1 day	4 days	1 day	29days	4 days	3 days	7days
	costs	soil preparation	900	1,200	350	400	500	no	100	500	200	4.150mkd	1600	350	1.950mkd
		planting	3,200	4,000	1,200	800	1,200	3200	800	2,400	400	17.200mkd	1600	1600	3.200mkd
		weeding	no	no	no	no	no	no	no	no	no		no	no	
	activities	soil preparation	one ploughing	one ploughing	one ploughing	one ploughing	one ploughing	holes	one ploughing	one ploughing	one ploughing		holes	one ploughing	
		planting	by hand	by hand	by hand	by hand	by hand	by hand	by hand	by hand	by hand		by hand	by hand	
weeding		no	yes	no	no	no	no	no	no	no		no	no		

- Planting schemes is done on average of 10.000 species/ha in the pilot. Planting schemes can vary and also depending on harvest method. If mechanical harvesting is done via harvester or trailed chipper spacing in plantations should be fit for the machinery. In the small scale pilots, where willow is planted closer, manual harvesting is foreseen. The following planting schemes were used:

	Single row technology		
Spacing in row/between rows (in m)	1 x 2	1 x 1	0.7 x 1
Amount of cuttings (pc)	10.000	10.000	10.000
Rotation (yrs)	2-3 years	2-3 years	2-3 years

- Tending: After planting manual weed control was done 1-2 times to avoid overgrowing by weeds. Chemical weed control can be done, but was not practiced in the pilots and appeared not necessary. In case of a dry spring irrigation might be needed, but was not applied in the pilots. However a favorable spring was experienced. Second year mechanical tending might be needed.
- Harvest can be done in 2-3 cycles. At least 6-8 cycles can be made having a lifespan of 12 – 25 years minimum.
- After harvest the remaining stumps may be sprayed with Vegesol eReS 4-5 l/ha. A basic treatment to increase protection of the stumps from fungal and bacterial infection and increase the life cycle and yield of the plantation. Pest control is under normal field conditions not needed. Nutrients supply is sufficient from the remaining (mulching) after the harvest. To stimulate growth in the second year 80-100 kg of nitrogen per ha at each two years', before the stems start to shoot can be applied. In the Macedonia pilots however only mechanical weeding is applied when needed, to reduce cost and make it applicable for farmers.

Biomass production data

Since this is a pilot in Macedonia the real field data are only available from coming year onwards.

However, almost all sites showed a survival rate of over 90% of the plants. All sites showed a very good growth reaching in the first growing season a height of 1,5 to over 2 meter. The best sites were those having a high water table with moist clay soils. With very limited tending and no additional costs for irrigation, fungal, bacterial or pest control and nutrients supply, it is estimated that in the first year of growth the planting site of 1ha could give 3.8 m3 of biomass.

1 willow = 0,000377 m3 (high = 2 m, d = 3 cm) x 10.000 pieces = 3.8 m3/ha



Picture beginning, mid and end season 2010



Based on the production experience in Hungary, a biomass production of 23 ton/ha in the first year was achieved. This would lead to at least 65 ton/ha on a three year cycle. Higher production even since growth in second and third year is expected to be higher.

Based on the initial experiences this practice could be implemented on a large scale economic basis.

			Salix alba Express									Average	Robinia pseudo		Average	
			v. Amzibegovo site 1	v. Amzibegovo site 2	v. Amzibegovo site 3	v. Amzibegovo site 4	v. Mustafino	v. Meckuevci	v. Taor site 1	v. Taor site 2	v. Taor site 3		v. Meckuevci	v. Taor		
Growth rate in the first year	29.04.2010	Top high	10 cm	10 cm	10 cm	10 cm	10 cm	5 cm	8 cm	10 cm	/	8,5 cm	30 cm	30 cm		
		Stump diameter	0,3 cm	0,3 cm	0,3 cm	0,3 cm	0,3 cm	0,2 cm	0,3 cm	0,3 cm	/	0,3 cm	0,5 cm	0,5 cm		
		Sprouts	4-5	2-3	3-5	2-3	4-5	2-3	2-3	4-5	3-4		/	/		
		disaster rate	human factor	no	2%	no	no	no	2%	no	no	/	no	no	no	
			biotic factor	no	no	5%	20%	no	no	5%	no	/	4%	1%	1%	
		success rate	100%	98%	95%	80%	100%	97-98%	95%	100%	/		99%	99%		
	03.06.2010	Top high	40 cm	40 cm	40 cm	30 cm	40 cm	20 cm	20cm	60cm	50cm		30 cm	30 cm		
		Stump diameter	0,5 cm	0,5 cm	0,5 cm	0,5 cm	0,5 cm	0,5cm	0,3cm	0,8cm	0,5cm		0,5 cm	0,5 cm		
		Sprouts	4-5	2-3	3-5	2-3	4-5	2-3	2-3	4-5	3-4	3,00	/	/		
		disaster rate	human factor	2%	2%	5%	40%	5%	70%	10%	no	no		no	no	
			biotic factor	3%	3%	5%	no	no	15%	30%	no	20%		3%	3%	
		success rate	95%	93%	90%	60%	95%	15%	60%	100%	80%		97%	97%		
	10.10.2010	Top high	190 cm	200 cm	190 cm	/	190 cm	no	40cm	200cm	200cm		35 cm	35 cm		
		Stump diameter	0,8 cm	0,9 cm	0,8 cm	/	0,8 cm	no	0,5cm	1,2cm	1,5cm		0,7 cm	0,8 cm		
		Sprouts	4-5	2-3	3-5	/	4-5	2-3	2-3	4-5	3-4		/	/		
		disaster rate	human factor	2%	20%	10%	Overgrew by reed	30%	70%	10%	no	10%		no	15% fire	
			biotic factor	3%	5%	0,10	no	no	30%	85%	no	20%		7%	5%	
		success rate	95%	75%	80%	No data; acces not possible	70%	0%	5%	100%	70%		93%	80%		

Conclusions and recommendations

Based on the experiences and results gained from piloting of planting fast growing species, there is opportunity for the land owners to improve the income for their households. Planting fast growing species provides opportunity to land owners to supply itself with that important resource for the household. Planting fast growing species on the corners of the land that is not maintained or as a windbreak belts also contributes to very different aspects such as wind protection and evaporation control, erosion control on the river banks, improvement of biodiversity etc. All these activities are related to the measures of EU Rural Development policy: agro-forestry, a forestation on agriculture land, diversification of economy etc.

The result from the pilot sites will be used to present, aware and promote support for activities related to plant fast growing species on small scale farming with inclusion of national Rural Development program.