RENEWABLE BIOMASS PRODUCTION ON THE BASE OF INTRODUCTION OF FAST GROWING TREES PLANTATIONS AS A DIRECTION OF GREEN ECONOMY

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Conception of green economy may be used in different branches: industry, agriculture, energy and others. It tightly connected with nature protection because of decreasing of environmental pressure. Environmental benefit may be realized by different way. Introduction of bioenergy enable decreasing of greenhouse gas emission, saving of nature resources as a minimum, but it may also have some not so evidence profit.

The perspective direction of bioenergy is introduction of agroforestry based on short rotation coppice plantations of trees, like willow, poplar and others. Introduction of plantations of fast-growing trees in Belarus provided by National Programme of development local and renewable energy sources for 2011-2015. From economy and ecological point of view special interest has introduction of willow plantations, which require of selection varieties adapted for environmental conditions of country.

For Belarus conditions more interesting is introduction of plantation of willow. The yield of willow biomass crops may achieve 10-15 tons of dried wood or 5-6 toe per hectare. Willow biomass cropping systems simultaneously produce not only power and economic, but also environmental and social benefits. These include reduced SO2 and NOx emission, no extraction of additional CO2 to the atmosphere, reduced soil erosion and pollution from non-point source of agricultural lands, and enhanced agricultural landscape diversity. Willow plants may be successfully grown on different types of lands and also have the potential in reclamation of degraded and polluted soils.

As a result of the Chernobyl disaster the area of radionuclide contaminated agricultural soils in Belarus is about 1.3 million ha, including 0.8 million ha of arable lands. The optimal system of cultivation of this type of soils on contaminated area is a serious problem, because traditional crops such as grass and cereals may accumulate extra radionuclide. Our field study experiments (2007-2010) were conducted at Krichev district of Mogilev region in eastern Belarus, close to the Russian border. This region characterized by high level of Cs-137 contamination as well as high level of heavy metals pollution. The radioactive contamination in the region has been conditioned by precipitating from clouds after the Chernobyl accident. As a result, local cesium “spots” appeared. The level of contamination in the place of our experiment varied from 185 to 370 kBq/m.2 In the first stage of our experiments the concentration of cesium-137 in different parts of willow biomass had been measured and transfer factor calculated. The measuring had been done for leaves, roots and wood. The same experiments fulfilled because of different ways of utilizations these components. The leaves go back to the soil every year, wood is using for energy in every 3 year and roots leave in the soils as far as plantation of willow used. We admitted it for 21 year. To control cesium-137 accumulation in willow biomass we apply different types (nitrogen N, phosphorus P and potassium K) and dose of fertilizer.

The experiments show that potassium mineral fertilizer is the key factor for radionuclide accumulation control. The optimal dose of potassium is 90 kg per hectare. On the base of experimental results the model of cesium-137 accumulation in the wood for a 21 year has been developed. In accordance with calculation to the end of willow cultivation (21 year) concentration of cesium-137 in wood will not be higher than permitted even with the level of cesium-137 contamination in the soil 1480 kBq/m2 (maximum 140 кБк/м2 with permitted level for firewood is 740 Bq/kg.). The concentration of cesium-137 in the roots increases gradually and get maximum in 21 year (3000 кБк/м2).

Our results confirm that in the sum about 0.8 million hectares of radionuclide polluted arable lands partly excluded from agricultural practice in Belarus could be used for willow biomass production.

One more benefit of fast growing willow production is reclamation of post-mining peaty degraded areas. The area of such lands in Belarus is thousands hectares. The problem is absence of adequate technology of willow production for the degraded peaty soils. This type of soils is very heterogenic, poorly drained, with massive structure and poor contents of nutrients. A field study was conducted at Lida region, in western Belarus. The willow clones were planted on peaty soils of post-mining landscape. The degraded peaty soil conditions are not favorable for successful plant cultivation. As the result after completion of peat mining it is impossible to grow any cultural plants for some years. The peaty soils after post-mining activity are very heterogenic. It refers to contents of nutrient, water supplying, and the depth of peaty layer, level of decomposition and so on. Apparently it is necessary to use different method of cultivation for successful growing willow on concrete site.

Our experiments shown, that it is possible to successful cultivation of fast-growing willow on degraded areas. Of course, this approach required the introduction of adequate special adopted technology. The questionable problem is the selection of special forms of willow, more suitable for the degraded post-mining peaty soils. The yield of willow biomass was on 20-30% lower than in mineral soils, but renewable wood production has big environmental benefit.

So, our experiments with willow cultivated in different environmental conditions show, that it is possible to get adequate yield of willow wood on post-mining peat lands, and plants do not accumulate extra quantity of radionuclide 137Cs and some heavy metals. Minimization of environmental impact at the result of willow biomass production may be also realized on the base of erosion and water pollution control and reclamation of contaminated areas. Other issue is economic efficiency. Our experiments let us develop special model to assess the emission of greenhouse gases, cost of willow production in nearest in further perspective, financial benefit at the result biomass using. At the result of calculation the cost of willow wood production from one hectare per year is about 600-800 $. The annual yield of wood consists near 50 ton per hectare. In accordance with metering of calorific value of wood energy equivalent biomass is 4,4 toe or 3850 м3 of natural gas/hectare. The price of gas for Belarus is about 230 $ per 1000 м3. It means that changing of gas for wood may have financial profit as for Belarus so and other countries. Additional profit is utilization of willow wood as a biofuel. It enables to get additionally 3500 – 3700 euro per hectare for all period of plantation existing. It will be possible at the result of saving greenhouse gases in accordance with Kyoto Protocol.

The results of real experiments presented in this publication enable to conclude that fast growing trees production for renewable biomass has multiply environmental so and economic effect. This way totally corresponds to the conception and contents of green economy.