PalArch's Journal of Archaeology of Egypt / Egyptology

ANALYSIS AND EVALUATION OF POTENTIAL FODDER AREAS SUITABLE FOR ORGANIC PRODUCTION IN THE CENTRAL ECONOMIC ZONE OF THE REPUBLIC OF SAKHA (YAKUTIA)

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Valentina V. Osipova, Nikolai E. Pavlov, Ivan I. Sleptsov, Marianna I. Petrova. Analysis And Evaluation Of Potential Fodder Areas Suitable For Organic Production In The Central Economic Zone Of The Republic Of Sakha (Yakutia)--Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(10), 2680-2697. ISSN 1567-214x

Keywords: land resources, organic products, fodder production, hayfields, pastures, cattle, recommendations for use.

ABSTRACT

Recently, introducing organic farming in agriculture has become widespread throughout the world. In Yakutia, there are scientific developments on organobiological farming using legumes and on the use of effective microorganisms and vermiculture in growing crops. Analysis and synthesis of the research results,s as well as calculations for rational land use, for environmentally friendly production and for reproducing soil organic matter will be the key argument in deciding on the transition to biologized farming technologies in the areas of the Central Economic Zone of the Republic of Sakha (Yakutia) (hereinafter CEZ).

The authors of the present research aimed to develop theoretical and practical proposals for the efficient use of forage land, focused on organic production in the CEZ. The potential of land resources for organic production was established by statistical analysis of data on areas, gross harvest and land productivity for harvesting roughage. Theoretical and practical proposals for organic agricultural production were developed based on the efficient use of fodder land in the region.

The research data showed that with the introduction of organic farming by 2030, the area under fodder can increase 3 times, and the collection of fodder units compared with 2016 will increase 6.0 times and reach 187,796 tons in the zone. As a result, the number of cattle will increase 2.9 times (from 116007 in 2017 to 333797 by 2030).

Organic farming in Yakutia is possible with the introduction of a system of perennial grasses seed production and an increase in the area of perennial grasses up to 4000 ha by 2030, of which legume crops are to occupy 1500 ha. Improving the technology of summer and winter sapropel excavation in the lakes of Central Yakutia, radical and surface amelioration of the floodplain meadows of the Tuymaada valley, the development of new and fallow lands for fodder crops, estuary irrigation in terrace lowlands by 2030 will allow bringing the share of organic biologized agriculture to 10- 15% of the total agricultural land.

Keywords:land resources, organic products, fodder production, hayfields, pastures, cattle, recommendations for use.

INTRODUCTION

The object of the study was land resources for agricultural use of the CEZ from the standpoint of organic production for livestock; the aim was to develop theoretical and practical proposals for efficient use of forage land on this matter. Accordingly, the following tasks were set:

determining the potential of land resources suitable for organic production in the CEZ;
developing scientificproposals to improve efficiency of land use in the CEZ.
The result of the work performed is practical suggestions and recommendations on introducing and increasing organic agricultural production in the CEZ.

Today, the number of ecologically cultivated areas is growing rapidly in the world, the demand for environmentally friendly food products is increasing, while the market is developing significantly, and trade in this sector is expanding. In countries with a rich food market, food quality is playing an increasingly important role. The quality of a food product can be judged by various criteria: by its appearance, packaging, etc., but the most important criteria are the taste of the product and its usefulness to human health. In this regard, organic farming products have all the advantages.

Large areas of land are already used for organic farming in the world: 5.1 million ha in Europe, 1.5 inNorth America, 4.7 inLatin America, and about 10.6 million ha in Australia. In Europe, the area of land converted to organic farming grew significantly in recent years, which was facilitated by the common European Union policy adopted in 1993 regarding the support of farmers in the first years after the transition from traditional to organic agriculture: the average land area for organic farming in the EU reached 4%, in Austria and Italy 8%, and in Sweden, which is the European leader, almost 12% (Poznyak, 2009).

Currently, Russia lags far behind in agricultural productivity. The technical equipment level is 5-7 times lower than in developed countries, andstaffing is affected, since only 23% of Russian agronomists have higher education. The weak points are the seed base and breeding; the level of implementing innovationsremains low (Pavlov, 2012).

Organic agriculture and biologization are the most important elements of technological integration in the world market; these are leading trends in the scientific and technological development of the agro-industrial complex of the Russian Federation for the period until 2030/ the forecast was prepared by the Higher School of Economics and approved by the Ministry of Agriculture of the Russian Federation in January 2017 based on analyzing over 200,000 information documents and working with 400 leading scientific organizations, universities, companies, and industry unions (Bagaev, 2010; Kornilov, 2011).

Increasing soil fertility is possible due introducing organic crop rotation with the legume share of up to 40% (Vasyutin, 2013). Low productivity of natural hayfields in the Republic of Sakha (Yakutia) in recent years (0.5-0.7 t/ha of hay) (Pavlov, 2012), as well as nutritional deficiencies in cattle (Abramov, 1993; Abramov, 2000; Tikhonov, 1996) require introducing leguminous crops into crop rotation (Denisov, 2000).

The analysis was based on agricultural production statistics of the Republic of Sakha (Yakutia), materials of the Agricultural System of the Republic for the period 2016-2020, and other documents.

Based on world agricultural experience, it can be argued that sustainable development of agricultural production is possible only with the optimal combination of all available resources – land, labor, and production.

METHODS.

The studies were carried out by statistical analysis of data on areas, gross yield and land productivity for harvesting roughage in the CEZ. The authors used the directory of the statistical department of the Yakut ASSR (1980), the directory of the Yakut Republican Statistics Office (1990), and the directory of the territorial body of the Federal State Statistics Service for the Republic (2016).

The calculations were carried out using the Methodological recommendations for compiling technological maps and calculating the cost of livestock products in the Republic of Sakha (Yakutia) (2004), Methodological recommendations for compiling technological maps and calculating the cost of horse breeding in the Republic (2005), and the System of Agriculture Management in the Republic (2017).

RESULTS.

An analysis of land resources in the CEZrevealed there are the necessary climatic conditions and land potential for organic production.

The largest area of hayfields is concentrated in Ust-Aldansky (57.857 ha), Churapchinsky (56.221 ha) andMegino-Kangalassky (52.154 ha) districts. The largest percentage of available grasslands use is in Megino-Kangalassky (up to 94.5%), Namsky (up to 100.0%) andTattinsky (up to 91.8%) districts. On average, the percentage of hayfields use varies from 69 to 76% (1980 to 2016) (Table 1.1).

Hay productivity in the areas of the Central Economic Zone in recent years is low – 8.0-13.0 kg/ha.

The analysis of statistical data for 1991-2016 showed that in the CEZ the number of cattle decreased from 210.042 head in 1991 to 116.007 head in 2016 (94.035 head in total). The volume of harvested roughage, in particular, of hay, in 2016 amounted to 292.436 tons on the area of 280.515 ha. Providing 116 thousand head of cattle with hay in the stall period was sufficient (Table 1.1).

By 2030, with the introduction of organic farming, the percentage of use will be 100% in all the areas of the zone. Hay productivity on the lands where organic farming will be introduced will increase to 22.4 c/ha. The volume of roughage will be 480.223 tons, which equates to 204.827 tons of feed units (Table 1.1).

The pastures area in the CEZ is 465.039 ha with the 35 c/ha average yield of green mass. The pasture supply is highest in Namsky (70.026 ha), Ust-Aldansky (78.619 ha) and Churapchinsky (68.661 ha) districts. Relatively small pastureland is available in Gorny (21.330 ha) andKobyaysky (19.768 ha) districts and in the suburbs of Yakutsk (21.087 ha). The pastures are used at 78-80% (Table 1.2).

By 2030, with the development of remote abandoned pasturelands, construction of horse breeding bases, amelioration of fertility and surface amelioration of nearby degraded pastures, green mass productivity will increase to 50 kg/ha. The collection of feed units in the CEZ as a whole will rise to 441.803 tons, which is 116.317 tons more than on natural pastures.

The area of arable land in this zone occupies 72.204 ha, of which 16.682 ha (23% of the total) were allotted for fodder crops in 2016. The largest arable land area is recorded in the Amginsky district (18.746 ha), where 3.691 ha (19.7% of the total) were occupied by fodder crops in 2016. The smallest arable land area is in Kobyaysky (358 ha) and Gorny (1029 ha) districts; in 2016, fodder crops occupied only 7.5 and 50.3% of the total arable land, respectively.

With the introduction of organic farming, by 2030 the fodder area should increase 3 times (Table 1.3). The volume of feed units by 2030 (compared with 2016) will increase 6.0 times and reach 187.796 tons in the zone.

Table 2 shows the potential of land by 2030 in the CEZ; feed units yield will reach 834.493 tons per year. According to zootechnical standards, such volume can provide for 333.797 head of cattle.

Thus, the number of cattle will increase from 116.007 in 2017 to 333.797 by 2030 (2.9 times).

Table 1. Harvesting of roughage in the CEZ.

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
1.Amginsky	Natural hayfields, total % used	46.840 27.586 58.9	19.827	7.2	46.840 24.768 52.9	29.722	12.0	46.840 25.092 53.6	31.569	13.0	46.840 13.840 29.5	15.224	11.0
	Radical amelioration	2933	3114	10.6							9000	18.000	20.0
	Surfaceamelioration										21.000	27.300	13.0
	organic biological farming										3000	7500	25.0
	Total	**30.519**	**22.941**	**7.5**	**24.768**	**29.722**	**12.0**	**25.092**	**31.569**	**13.0**	**46.840**	**68.024**	**14.5**
2. Gorny	Natural												

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	hayfields, total % used	32.346 8265 25.5	8119	9.8				32.346 18.188 56.2	14.165	8.0	32.346 15.346 47.4	13.811	9.0
	Radical amelioration	14.378	9582	6.7							2000	3000	15.0
	Surface amelioration										14.000	15.400	11.0
	organic biological farming										1000	2000	20.0
	Total	**22.643**	**17.701**	**7.8**				**18.188**	**14.165**	**8.0**	**32.346**	**34.211**	**10.6**
3.Kobyayskiy	Natural hayfields, total % used	39.198 14.950	16.676	11.	39.198 17.372	20.847	12.0	39.198 18.275	19.69	11.0	39.198 16.502	18.152	11.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
		38.1		2	44.3			46.6	2		42.1		
	Radical amelioration										500	750	15.0
	Surface amelioration										21696	23868	11.0
	organic biological farming										500	1000	20.0
	Total	**14.950**	**16.676**	**11.2**	**17.372**	**20.847**	**12.0**	**18.275**	**19.692**	**11.0**	**39.198**	**43.770**	**11.1**
4. Megino-Kangalassky	Natural hayfields, total % used	52.154 50.846 94.5	25.970	5.1	52.154 47.091 90.2	32.964	7.0	52.154 43.690 83.8	44725	10.0	52.154 39.204 75.2	31.363	8.0
	Radical	8564	6256	7.3							5000	7500	15.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	amelioration												
	Surface amelioration										4950	4950	10.0
	organic biological farming										3000	6000	20.0
	Total	**59.410**	**32.226**	**5.4**	**47.091**	**32.964**	**7.0**	**43.690**	**44.725**	**10.0**	**52.154**	**49.813**	**9.6**
5. Namsky	Natural hayfields, total % used	32.183 36.877 114.6	30.884	8.4	32.183 43.386 134.8	39.047	9.0	32.183 27.361 85.0	29.015	11.0	32.183 22.875 71.1	20.588	9.0
	Radical amelioration	1151	1231	10.7							8000	16.000	20.0
	Surface amelioration										2000	2400	12.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	organic biological farming										3000	7500	25
	Total	**38.028**	**32.115**	**8.4**	**43.386**	**39.047**	**9.0**	**27.361**	**29.015**	**11.0**	**35.875**	**46.488**	**13.0**
6.Tattinsky	Natural hayfields, total % used				40.854 34.595 84.7	38.055	11.0	40.854 37.490 91.8	37.568	10.0	40.854 29.000 71.0	29.000	10.0
	Radical amelioration										5000	10.000	20.0
	Surface amelioration										4854	4854	10.0
	organic biological farming										2000	5000	25.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	Total	**-**	**-**	**-**	**34595**	**38055**	**11.0**	**37490**	**37568**	**10.0**	**40854**	**48854**	**12.0**
7. Ust-Aldansky	Natural hayfields, total % used	57.857 8277 14.3	3946	4.8	57.857 35.299 61.0	31.769	9.0	67.857 33.617 58.1	33.611	10.0	67.857 29.458 50.9	23.566	8.0
	Radical amelioration										4000	6000	15.0
	Surface amelioration										23.399	23.399	10.0
	organic biological farming										1000	1500	15.0
	Total	**8277**	**3946**	**4.8**	**35.299**	**31.769**	**9.0**	**33.617**	**33.611**	**10.0**	**57.857**	**54.465**	**9.4**
8.Hangalass	Natural												

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
ky	hayfields, total % used	42.658 25.044 58.7	23.799	9.5	42.658 32.550 76.3	39.060	12.0	42.658 30.640 71.8	32.028	10.0	42.658 17.408 40.8	19.149	11.0
	Radical amelioration	4300	6020	14.0							9000	18.000	20.0
	Surface amelioration										13.250	13.250	10.0
	organic biological farming										3000	7500	25.0
	Total	**29.344**	**29.819**	**10.2**	**32.550**	**39.060**	**12.0**	**30.640**	**32.028**	**10.0**	**42.658**	**57.899**	**13.6**
9.Churapchinsky	Natural hayfields, total % used	56.221 46.397	31.620	6.8	56.221 32.302	25.842	8.0	56.221 37.274	38.78	10.4	56.221 33.658	30.292	9.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield,	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
		82.5			57.5			66.3	8		60.0		
	Radical amelioration	1403	1312	9.4							3000	4500	15.0
	Surface amelioration										17.563	15.807	9.0
	organic biological farming										2000	3000	15.0
	Total	**47.800**	**32.932**	**6.9**	**32.302**	**25.842**	**8.0**	**37.274**	**38.788**	**10.4**	**56.221**	**53.599**	**9.5**
10. Yakutsk	Natural hayfields, total % used	16.620 12.161 73.2	12.530	10.3	16.620 12.853 77.3	15.424	12.0	16.620 8888 53.5	11.275	12.7	16.620 9958 60.0	11.950	12.0
	Radical amelioration	203	345	17.0							800	1600	20.0

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	Surface amelioration										4362	5800	13.3
	organic biological farming										500	1250	25.0
	Total	**12.364**	**12.875**	**10.4**	**12.853**	**15.424**	**12.0**	**8888**	**11.275**	**12.7**	**14.620**	**20.600**	**13.9**
CEZ	Natural hayfields, total % used	416.931 230.403 55.3	133.636	5.8	416.931 280.216 67.2	272.730	9.7	416.931 280.515 67.3	292.436	10.4	416.931 227.249 54.5	213.095	9.4
	Radical amelioration	41209	37700	9.1							46300	85350	18.4
	Surfaceamel										127174	137028	10.8

District	Category	Traditional technologies									Organic agriculture		
		1980			1990			2016			2027-2030		
		Area, ha	Gross yield, t	Yield,	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha	Area, ha	Gross yield, t	Yield, t/ha
	ioration												
	organic biological farming										19000	42550	22.4
	Total	**271.612**	**171.336**	**6.3**	**280.216**	**272.730**	**9.7**	**280.515**	**292.436**	**10.4**	**419.623**	**477.723**	**11.4**
Feed units (FU)	Natural hayfields, total % used											**89.500**	
	Radical amelioration											**35.847**	
	Surface amelioration											**57.552**	
	organic biological farming											**20.702**	
	Total											**203.601**	

Table 2. Potential production of environmentally friendly cattle feed in the CEZ in 2030

District	***Hay***			***Succulent feed***			***Pasture feed***			***Total***			***Cattle, head***
	Area, ha	***Gross yield, t***	***FU, t***	***Area, ha***	***Gross yield, t***	***FU, t***	***Area, ha***	***Gross yield, t***	***FU, t***	***Area, ha***	***Gross yield, t***	***FU, t***	
Amginsky	3000	7500	**3675**	14.809	207.326	**51.832**	7979	39.895	**9974**	25.788	254.721	65.481	26.192
Gorny	1000	2000	**980**	972	13.608	**3402**	4266	21.330	**5332**	6238	36.938	9714	3886
Kobyaysky	500	1000	**490**	36	504	**126**	3954	19.770	**4942**	4490	21.274	5558	2223
Megino-Kangalassky	3000	6000	**2940**	7091	99.274	**24.818**	10.852	54.260	**13.565**	20.943	159.534	41.323	16.529
Namsky	3000	7500	**3675**	4028	56.392	**14.098**	14.052	70.260	**17.565**	21.080	134.152	35.338	14.135
Tattinsky	2000	5000	**2450**	3413	47.782	**11.946**	7611	38.055	**9514**	13.024	90.837	23.910	9564
Ust-Aldansky	1000	1500	**735**	6046	84.644	**21.161**	15.723	78.615	**19.654**	22.769	164.759	41.550	16.620
Hangalassky	3000	7500	**3675**	5817	81.438	**20.360**	10.668	53.340	**13.335**	19.485	142.278	37.370	14.948
Churapchinsky	2000	3000	**1470**	7350	102.900	**25.725**	13.732	68.660	**17.165**	23.082	174.560	44.360	17.744
Yakutsk	500	1250	**612**	4089	57.246	**14.312**	4217	21.085	**5271**	8806	79.581	20.195	8078
Total	**19.000**	**42.250**	**20.702**	**53.651**	**751.114**	**187.780**	**93.054**	**465.270**	**116.317**	**165.705**	**1.258.634**	**324.799**	**129.919**

DISCUSSION.

It can be stated that by 2030, complete refusal of chemical fertilizers and plant protection chemicals, and introduction of organic crop rotation will increase the share of organic bio-cultivated agriculture to 10-15% of the total area of agricultural land.

The data of the authors' studies are consistent with the results of other scientists (Bazdyrev, Loshakov et al., 2008; Dobrovolsky, 2001; Kiryushin, 1996, 2011; Tarhanov, Tarhanova, 1997; Tarhanov, 1999; Tarhanov, Tarhanova, etc., 2000; Tarhanov, 2010; Tarkhanov, 2014) in the fact that using a closed cycle (crop production – feed; cattle breeding – fertilizers) and creating a feed base through radical and surface ameliorationby 2030 will ensure organic feed production in the amount of 477,723 tons of roughage or 203601t feed units in the CEZ.

The land resources for agricultural use of the CEZ were examined from the standpoint of organic production for livestock farming; the potential of land resources for organic production in the CEZ was determined; scientificproposals were made for improving the efficiency of land use in the CEZ.

CONCLUSION.

The methods of transition to organic farming are as follows:

1. Complete refusal of chemicals to protect plants from pests and diseases, of herbicides, chemical (artificial) fertilizers and antibiotics; further actions to improve and restore soil fertility;
2. Use of animal and plant waste as fertilizers;
3. Use of crop rotation to restore soil;
4. Planar soil cultivation as an alternative to deep plowing - the soil is loosened to the depth of not more than 5 cm;
5. Use of beneficial soil bacteria (effective microorganisms) as part of biological preparations;
6. Treatment of agricultural crops seeds with biological products without chemical dressing before sowing. Seeds of high sowing conditions of zoned varieties are used; the sowing direction is north-south for better conditions for plant photosynthesis. The minimum seeding rate to create the best conditions for plant nutrition and to increase the seed productivity of plants;
7. Use of the closed 'agriculture-livestock' cycle (crop production – feed, cattle breeding– fertilizers);

Refusal of year-round stall maintenance; compulsory grazing; no synthetic feed additives and hormones, banned preventive use of antibiotics are recommended in cattle breeding with organic farming.

To increase organic agricultural production,the board of the Ministry of Agriculture of the Republic of Sakha (Yakutia) needs to develop and approve a seed-growing system for perennial herbs.By 2030, the areas of perennial herbs are to occupy 4000 ha, of which legume crops are to occupy 1500 ha. By 2023, it is necessary to bring the area of lucerne seed plants to 1,500 ha with the seed yield of 1.0 kg/ha, and the area of sweet clover to 500 ha with the seed yield of 3-4 kg/ha. From 2024, it is possible to sow cereal-leguminous grass mixtures on 1,500-2,000 ha annually, which will allow cultivating 20.000 ha of high-yielding hayfields with organic biologized farming. The most favorable conditions for seed

production of lucerne and sweet clover are created in the former Mendiginskyexperimental production facilities of Yakutsk Research Institute of Agriculture in the Amginsky district.

It is necessary to improve the summer/winter sapropel excavation technology in the lakes of Central Yakutia, and by 2030, to bring the share of organic biologized agriculture to 10-15% of the total agricultural land. Moreover, it is necessary to create a forage base by radical and surface amelioration of the floodplain meadows of the Tuymaada valley, by developing new and fallow lands for fodder crops, and by estuary irrigation in the near-river lowland terraces

REFERENCES

Abramov A.F., Androsov N.E., Barashkova N.V. The composition and nutritional value of feed in Yakutia. Novosibirsk, 1993. 122 p.

Abramov A.F. Environmental and biochemical principles of feed production and rational use of pastures in Yakutia. Novosibirsk, 2000. 208 p.

Bagaev G.V. When tomorrow comes. Republic of Bashkortostan, No. 139.

Bazdyrev G.I., Loshakov V.G. et al. Agriculture. Moscow: Kolos S, 2008. 567 p.

Vasyutin S.A., Filonenko V.A. Biologization of agriculture and improvement of the ecological condition of agricultural land. Problems of Phytosanitary. Moscow: 2013. P.15-17.

Denisov G.V., Streltsova V. S. Lucerne in Yakutia. Novosibirsk: Nauka, 2000. 201 p.

Dobrovolsky G.V. The role and importance of soils in the past and future of mankind. Ecology and soil. Selected Lectures of the X All-Russian School. Vol. IV. Pushchino. 2001.

Kiryushin V.I. Ecological basis of agriculture. Moscow: Kolos S, 1996. 367 p.

Kiryushin, V.I. The theory of adaptive landscape farming and the design of agrolandscapes. Moscow: Kolos S, 2011. 443 p.

Kornilov V.I. Bashkir experience of soil fertility reproduction and food security. Agrarian Bulletin of the Urals, No. 5, 2011.

Guidelines for compiling technological maps and calculating the cost of crop production in the Republic of Sakha (Yakutia) (grain, potatoes, cabbage, hay, silage and haylage). Ministry of Agriculture of the Republic of Sakha (Yakutia), Yakutsk, 2004. 67 p.

Guidelines for compiling technological maps and calculating the cost of livestock production in the Republic of Sakha (Yakutia). Ministry of Agriculture of the Republic of Sakha (Yakutia), Yakutsk, 2004.104 p.

Guidelines for compiling technological maps and calculating the cost of herd horse breeing in the Republic of Sakha (Yakutia). Ministry of Agriculture of the Republic of Sakha (Yakutia), Yakutsk, 2005. 162 p.

Osipova V.V. Activity of sickle-shaped lucerne nodule bacteria under cryolithozone conditions. Fertility. 2009. No. 6. P. 27-28.

Tikhonov N.N. Northern village. Novosibirsk: Nauka, 1996. 384 p.

The agricultural system in the Republic of Sakha (Yakutia) for the period 2016-2020: Methodological manuals. Ministry of Agriculture of the Republic of Sakha (Yakutia). Yakutsk, 2017.415 p.

Pavlov N.E. Seed and varietal studies of perennial herbs in Yakutia. Yakutsk: Tuymaada, 2012. 111 p.

Poznyak, S. S.,Romanovsky Ch. A. Ecological agriculture. Minsk: Minsk State University of Economics, 2009. 327 p.

The directory of the statistical office of the Yakut Autonomous Soviet Socialist

Republic. Yakutsk, 1980. 66 p.
The directory of the Yakut Republican Statistics Office. Yakutsk, 1990. 72 p.
The directory of the territorial body of the Federal State Statistics Service for the Republic of Sakha (Yakutia). Yakutsk, 2016. 60 p.
Tarhanov O.V., Tarhanova L.S., Valeev V.M., Popova S.I. Organic and mineral fertilizers based on freshly preserved organics. Soil, life, well-being. Penza, 2000.
Tarhanov O.V., Tarhanova L.S. Manure can bring income. Volga-business, 1997. P.37.
Tarhanov O.V. Organic matter in agrocenosis. Ufa, Bashkir Scientific and Engineering Center for Organic Processing Technology, 1999.
Tarhanov O.V. Agricultural Economics Management. National Interests: Priorities and Security, No. 36 (86), 2010.
Tarhanov O.V. Why sideration does not help the farmer. Agriculture of Russia, http://selhozrf.ru/node/4672, 2014.
Tarhanov O.V. Plant nutrition concepts and society. National Security and Strategic Planning. No. 3 (7). 2014.