Result of study on developing forest seed region in Mongolia

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Abstract: In foreign countries, motor roads and railroads are usually used as borders of forest seed regions. In the case of Mongolia, this method is not suitable in view of the sparse population, large distribution area of forests and the huge territory of the country. Therefore, this study used topographical features to determine the borders of the seed regions. Satellite images in combination with Digital Elevation Model (DEM) make it possible to define rivers, streams and mountain ridges as the borders of forest seed regions. Overall, we identified 19 seed regions for Siberian larch and 12 regions for Scots pine, 9 regions for Siberian pine, 6 regions for Siberian fir and 9 seed regions for Siberian spruce forests. Due to a lack of genetic-selection studies in Mongolia, these proposed forest seed regions can be considered as a preliminary effort with an opportunity to be updated and improved based on more detailed research results. The forest seed regions and maps will play important role as fundamental material for establishing a permanent forest seed supply based on genetic-selection characteristics of the forests in different regions in Mongolia.

Keywords: Seed; Region; Pine; Larch; Siberian pine; Siberian fir; Siberian spruce;

INTRODUCTION

The forestry sector in Mongolia is rapidly changing, including reforestation and restoration activities which been broadening in all aspects. Therefore, it is vitally important to establish scientific knowledge and understanding of the hereditary and genetic characteristics of the main forest-forming tree species for certain forest regions to ensure successful reforestation and forest restoration efforts. Hence, it is vital to determine forest seed regions in order to utilize geographic difference in adaptation and productivity of trees in order to grow high productivity forests which can withstand adverse environmental factors.

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Several previous researches, including Milyutin et al., (1988) produced preliminary forest seed zoning under the framework of Mongolian-Russian Joint Biological Complex Expeditions conducted in 1981-1990 and they identified 13 seed regions for Siberian larch and 4 seed regions for Scotch pine forests respectively [13]. These studies were notable in terms of their significance in improving the quality of reforestation work, enabling experimental research to use seeds from geographically different regions, and establishing permanent seed stands based on the genetic-selection process in each district [17]. In addition, the study into internal modification of larch species in eastern Khentii along with research to identify parameters of larch seed quality have helped determined the best regions (forest seed zoning) to transplant seeds across. The joint expeditions also reported that the difference and modification in the morphological characteristics of larch populations were dependent on the growth conditions, and distribution of populations. What was new about this study was that it was able to determine the larch seed districts in the forest-vegetation zone of Khentii, where *Larix sibirica*, *L. daurica*, and *L. chekanowskii* are present [1,5,6,7,9,10,11,12].

The main objective of this study is to develop the seed region mapping of Mongolia’s coniferous forests based on genetic-selection characteristics. For this purpose, we aim to identify seed regions for coniferous trees including Siberian larch (*Larix sibirica* Ldb.), Scots pine (*Pinus sylvestris* L.); Siberian pine (*Pinus sibirica* Du Tour.); Siberian fir (*Abies sibirica* Ldb.), and Siberian spruce (*Picea obovata* Ldb.)

**MATERIALS AND METHODS**

The basic units of the seed region are the identical genetic origin and growth conditions, which differ from neighboring regions which is representative of a given provenance region in terms of altitude, climate, soil and vegetation characteristics. *Local seeds* are those that have been collected from forests within the border of the same seed region; and *seeds from other regions* refer to those that have been collected from other seed regions. The following materials, information and sources are used in developing seed regions and their mapping.

1. Digital elevation model of SRTM satellite data with 30 m accuracy
2. Satellite maps Google Earth
3. Meteorological data of study areas
4. Forest inventory reports, materials, and maps
5. Specialized maps
   - I. Topographic map
   - II. Digital elevation model
   - III. Mountain slope map
   - IV. Soil map
6. Vegetation map
7. Forest distribution map

The forest distribution map (shape file) with descriptions of 464,323 stands was developed by the Forest Research Development Center (FRDC) of the Ministry of Environment and Tourism (MET). These shape files had information on species composition, tree species, and ecological and geographical data of the forest stand and compartments. The digital elevation model, different satellite images, specialized thematic maps and field survey results on soil and vegetation characteristics have been used as additional materials.

A digital elevation model was used with Surpace to define aspects. Spatial overlapping analysis has been conducted to prepare and extract information from specialized maps [3,4,13,14].

Based on the experiences from other countries, motor roads and railroads are usually used as borders of the forest seed regions.
In the case of Mongolia, this method is not suitable due to the sparse population, large distribution area of forests and the large territory. Therefore, we used topographical features to determine borders of the seed regions. Topographical maps visibly denote the borders using river, stream and mountain ridges as border areas [2,8,15,16].

During the field survey, an inventory of seed stands and studies of vegetation and soil types were conducted, which enabled to produce detailed seed region maps. Digital Elevation Models with 30m resolution and Satellite Images (Google Earth, Landsat) were used in the map processing.

RESULTS AND DISCUSSION

The basic unit of the seed regions is the forest seed region, which is characterized by similar soil and vegetation characteristics, moisture condition, and index of continent to produce a population with similar genetic materials (within the distribution limit of the certain species of tree).

Mongolian forests are mountain forests with high altitudinal variation and dry growth conditions, hence, seed quality of the main tree species have been declining recently. For this reason, we did not divide seed regions into sub-regions. It is required to use seeds collected from local or neighboring regions/populations for the tree propagation and reforestation activities.

![Seed regions of Siberian larch (Larix sibirica Ldb.)](image)

The research results identified 19 seed regions for Siberian larch \((Larix sibirica\ Ldb.)\), Dahurian larch \((Larix dahurica\ Turcz.)\), and Chekanowskii larch \((Larix chekanowskii\ Szaf.)\); 12 regions for Scots pine \((Pinus sylvestris\ L.)\); 9 regions for Siberian pine \((Pinus sibirica\ Du Tour.)\); 6 regions for Siberian fir \((Abies sibirica\ Du\ Ldb.)\); and; 9 seed regions for Siberian spruce \((Picea obovata\ Ldb.)\) forests and a map with a scale of 1:1 000 000 was developed which will serve as the base material for further seed management efforts with emphasis on conservation of forest genetic resources and tree breeding.

Seeds collected from the plain (steppe) forests can be used for almost all forest regions, however, seeds collected from mountainous regions can only be used within a 200-400 m range from the original altitude. We identified 19 seed regions for Siberian larch and 12 regions for Scots pine, 9 regions for Siberian pine, 6 regions for Siberian fir and 9 seed regions for Siberian spruce forests. Each seed region is presented with information on possible regions to transfer seeds for transplanting, environment-climate conditions and regional forest characteristics, given in Tables 1-5.

Due to a lack of genetic-selection studies in Mongolia, these proposed forest seed regions can be considered a preliminary effort with the possibility to be updated and improved in the future, based on more detailed research results. These forest seed regions can be used as fundamental material for establishing a permanent forest seed supply, based on genetic-selection characteristics of the forests in different regions in Mongolia.

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Vegetation period, day</th>
<th>Average annual air temperature, °C</th>
<th>Sum of the temperature above 5°C</th>
<th>Total annual precipitation, mm</th>
<th>Moisture coefficient</th>
<th>Average air temperature, °C [Conrad’s index of continentally, %]</th>
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</thead>
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<td>1</td>
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<td>131</td>
<td>-0.34</td>
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<td>0.65</td>
<td>-21.4 (17.3). [89]</td>
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<td>1719.5</td>
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<td>1934.8</td>
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<td>305.9</td>
<td>1.63</td>
<td>-23.7 (17.6). [79]</td>
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<td>-22.9 (15.4). [69]</td>
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<td>Tsagaannuur, Renchynkhumbe, Ulaan Uul, Bayanzurkh, Tsagaan Uul, Tsetserleg soums, Khovsgol aimag;</td>
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<td>Renchynkhumbe, Khankh, Khatgal, Arbulag, Alag Erdene soums, Khovsgol aimag;</td>
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<td>Chamdmani - Ondor</td>
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<td>Tsagaan Uur, Erdenebulgan soums, Khovsgol aimag; Teshig, Selenge soums, Bulgan aimag; Tushig, Tsagaan Nuur soums, Selenge aimag</td>
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</tr>
<tr>
<td>8</td>
<td>Sogoot</td>
<td>Tsetserleg, Tsagaan Uul, Burentogtokh, Tomorbulag, Shine Ider soums, Khovsgol aimag; Ikh Uul, Telmen soums, Zavkhan aimag;</td>
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<td></td>
</tr>
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<td>9</td>
<td>Chandmani - Uul</td>
<td>Tunel, Erdenebulgan, Tosontsengel, Ikh Uul, Taryal soums, Khovsgol aimag; Khutag Ondor soums, Bulgan aimag;</td>
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Southern Khangai
Yaruu, Ider, Tosontsengel, Ikh Uul, Tsagaan Khairhan, soums, Zavkhan aimag; Jargalan, Galt soums, Khovsgol aimag; Tsakhir, Taryat, Jargalan, Khangai, Chuluut, Ikhtamir, Erdenemandal, Tovshruulekh, Tsenkher, Bulgan, Tsetserleg, Khotont soums, Arkhangai aimag; Chuluut, Erdenetsogt soums, Bayankhongor aimag; Bat Olziit, Khujirt, Kharkhorin, Uyanga, Zuunbayan Ulaan soums, Bayankhongor aimag.

Eastern Khangai
Rashaant soum, Khovsgol aimag; Tsetserleg, Erdenemandal, Khairkhan, Battsengel, Olziit soums, Arkhangai aimag; Bayan Agt, Khutag Ondor, Bugat, Saikhan, Mogod, Khishig Ondor, Burug Khangai, Orkhon, Khangai soums, Bulgan aimag; Bayan Ondor, Jargalan soums, Orkhon aimag; Baruubüren, Khushaat, Sant soums, Selenge aimag.

Selenge
Shaamar, Altanbulag, Khuder, Yűroo soums, Selenge aimag.

Yuroo - Khuder
Yuroo, Khuder, Bugant, Bayangol, Mandal soums, Selenge aimag; Khongor, Shariin Gol soums, Darkhan Uul aimag; Jargalan, Bornuur, Bayan-chandmani, Batsumber soums, Tov aimag.

Kharaa - Minj
Ulaanbaatar, Erdene, Mongonmorti soums, Tov aimag; Batshireet soum, Khentii aimag.

Central Khentii
Erdene, Mongonmorti, Bayandelger soums, Tov aimag.

Eastern Khentii
Tsenkhermandal, Omnodelger, Batshireet soums, Khentii aimag.

Checanovski
Omnodelger, Binder, Bayan Adarga, Norovlin, Dadal soums, Khentii aimag; Bayan Uul, Tsagaan Ovoo soums, Dornod aimag.

Daguir
Bayan Uul, Bayandun soums, Dornod aimag.

Gobi - Altai
Jargalan, Khaliun, Togrog soums, Gobi - Altai aimag.

Table 3. Seed regions of Scotch pine forests

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Vegetation period, day</th>
<th>Average annual air temperature, °C</th>
<th>Sum of the temperature above 5°C, mm</th>
<th>Total annual precipitation, mm</th>
<th>Moisture coefficient</th>
<th>Average air temperature, °C [Conrad’s index of continentally, %]</th>
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<td>Tsagaan - Uur</td>
<td>132</td>
<td>-3.9</td>
<td>1848.6</td>
<td>250.7</td>
<td>2.54</td>
<td>-30.1 (16.4). [89]</td>
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<tr>
<td>2</td>
<td>Jid</td>
<td>143</td>
<td>0.16</td>
<td>2119.9</td>
<td>309.6</td>
<td>1.46</td>
<td>-23.3 (19.4). [79]</td>
</tr>
<tr>
<td>3</td>
<td>Burengiin Nuruu</td>
<td>149</td>
<td>-0.01</td>
<td>1997.1</td>
<td>318.0</td>
<td>1.61</td>
<td>-22.5 (19.3). [79]</td>
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<td>Bayan - Khan uul</td>
<td>151</td>
<td>0.52</td>
<td>1718.0</td>
<td>275.8</td>
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<td>Yuroo - Khuder</td>
<td>133</td>
<td>-1.01</td>
<td>1565.0</td>
<td>334.3</td>
<td>1.55</td>
<td>-26.8 (19.4). [91]</td>
</tr>
<tr>
<td>6</td>
<td>Kharaa Minj</td>
<td>146</td>
<td>-0.34</td>
<td>2050.5</td>
<td>292.2</td>
<td>1.45</td>
<td>-23.2 (19.1). [81]</td>
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<td>9</td>
<td>Bayanchandmani</td>
<td>Tsagaan - Uur soum, Khovsgol aimag</td>
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<td>10</td>
<td>Eastern Khentii</td>
<td>Khutag-Ondor, Selenge, Khilgant soums, Bulgan aimag; Tushig, Tsagaannuur soums, Selenge aimag.</td>
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<tr>
<td>11</td>
<td>Ereenii Nuruu</td>
<td>Bugat, Saikhan, Khilgant soums, Bulgan aimag; Bayan Ondor, Jar-galant soum, Orkhon aimag; Baruunburen, Sant, Khushaat, Zuunburen soums, Selenge aimag.</td>
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<td>12</td>
<td>Khalkh Gol</td>
<td>Shaamar, Altanbulag soums, Selenge aimag.</td>
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<td></td>
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</tr>
</tbody>
</table>

*Source: Meteorological and Environmental Monitoring Agency*


Table 4. Scots pine (Pinus sylvestris L.) seed region covers the following soums in certain aimag territory
Yuroo - Khuder, Mandal soum, Selenge aimag; Batsumber soum, Tov aimag; Batshireet soum, Khentii aimag;

Kharaa - Minj, Jargalant, Yeruu, Bugant, Bayangol soums, Selenge aimag; Khongor, Shariin Gol soums, Darkhan aimag;

Shariin Gol, Jargalant, Yeruu, Bugant, Bayangol soums, Selenge aimag; Khongor, Shariin Gol soums, Darkhan aimag;

Jargalant, Jargalant, Bornuur, Chandmani, Batsumber soums, Tov aimag;

Bogdkhan Uul, Bogdkhan uul, Ulaanbaatar

Bayan- Adarga, Batshireet, Omnodelger, Bayan Adarga, Dadal soums, Khentii aimag;

Yuroonii nuruu, Binder, Bayan Adarga, Norovlin, Dadal soums, Khentii aimag; Bayan Uul, Bayandun soums, Dornod aimag;

Sumiin Khooloi, Khalkh Gol soum, Dornod aimag;

Table 5. Seed regions of Siberian pine

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Vegetation period, day</th>
<th>Average annual air temperature, °C</th>
<th>Sum of the temperature above 5°C</th>
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<th>Moisture coefficient</th>
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<td>-21.4 (17.3). [89]</td>
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<td>Khan Khokhii - Khyargas lake</td>
<td>137</td>
<td>-1.75</td>
<td>2641.6</td>
<td>140.9</td>
<td>0.60</td>
<td>-30.8 (21.2). [89]</td>
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<td>3</td>
<td>Ulaan taiga</td>
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<td>1962.8</td>
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<td>Baga Khentii</td>
<td>132</td>
<td>-1.31</td>
<td>1929.0</td>
<td>312.6</td>
<td>1.94</td>
<td>-22.8 (16.8). [76]</td>
</tr>
</tbody>
</table>

*Source: Meteorological and Environmental Monitoring Agency*

Table 6. Siberian pine (Pinus sibirica Du Tour.) seed region covers the following soums in certain aimag territory

<table>
<thead>
<tr>
<th>No</th>
<th>Seed region name</th>
<th>Seed region includes the following territory of soums</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mongol-Altai</td>
<td>Tsengel soum, Bayan-Olgii aimag;</td>
</tr>
<tr>
<td>2</td>
<td>Khan Khokhii - Khyargas Nuur</td>
<td>Tsagaan Khairhan, Ondorkhangai, Zuunkhangai soums, Uvs aimag; Tes soum, Zavkhakan aimag;</td>
</tr>
<tr>
<td>3</td>
<td>Ulaantaiga</td>
<td>Tsagaanuur, Renchinkhumb, Ulaan Uul, Bayanzurkh, Tsetserleg soums, Khovsgol aimag;</td>
</tr>
<tr>
<td>4</td>
<td>Jid</td>
<td>Tsagaanuur, Chandmani Ondor, Erdenebulgan, Taryalan soums Khovsgol aimag; Tesig soum, Bulgan aimag;</td>
</tr>
<tr>
<td>5</td>
<td>Jid - Burengiin Nuruu</td>
<td>Bayan Agt, Saikhan, Khutag Ondor, Selenge, Tesig soums, Bulgan aimag; Barunburen, Tushig, Tsagaanuur soums, Selenge aimag;</td>
</tr>
<tr>
<td>6</td>
<td>Khangai</td>
<td>Tosontsengel soum, Zavkhakan aimag; Jargalan, Galt soums Khovsgol aimag; Tsakhir, Taryat, Khangai, Chuluut, Ikh Tamir, Jargalan, Bulgan, Tsenkher, Tovshruulek soums, Arkhangai aimag; Bat Olziit, Khujirt, Uyanga soums, Ovorkhangai aimag;</td>
</tr>
<tr>
<td>7</td>
<td>Yuroo - Khuder</td>
<td>Yuroo, Khuder soums, Selenge aimag;</td>
</tr>
<tr>
<td>8</td>
<td>Zakhar - Minj</td>
<td>Mongonmorti soum, Töv aimag; Tsenkhermandal, Batshireet, Binder soums, Khentii aimag;</td>
</tr>
<tr>
<td>9</td>
<td>Baga Khentii</td>
<td>Ulaanbaatar, Erdene, Bayandelger soums, Tov aimag;</td>
</tr>
</tbody>
</table>
Table 7. Seed regions of Siberian fir forests

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Vegetation period, day</th>
<th>Average annual air temperature, °C</th>
<th>Sum of the temperature above 5°C</th>
<th>Total annual precipitation, mm</th>
<th>Moisture coefficient</th>
<th>Average air temperature, °C [Conrad’s index of continentally, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tsagaan Taiga</td>
<td>121</td>
<td>-6.67</td>
<td>1536.3</td>
<td>218.3</td>
<td>1.58</td>
<td>-34.4 (15.7). [97]</td>
</tr>
<tr>
<td>2</td>
<td>Ulaan Taiga</td>
<td>123</td>
<td>-5.37</td>
<td>1592.4</td>
<td>272.2</td>
<td>1.96</td>
<td>-30.1 (15.2). [87]</td>
</tr>
<tr>
<td>3</td>
<td>Jid</td>
<td>143</td>
<td>0.16</td>
<td>2119.9</td>
<td>309.6</td>
<td>1.46</td>
<td>-23.3 (19.4). [79]</td>
</tr>
<tr>
<td>4</td>
<td>Zakhar Minj</td>
<td>133</td>
<td>-1.01</td>
<td>1565.0</td>
<td>334.3</td>
<td>1.55</td>
<td>-26.8 (19.4). [91]</td>
</tr>
<tr>
<td>5</td>
<td>Yüroo - Khuder</td>
<td>146</td>
<td>-0.34</td>
<td>2050.5</td>
<td>292.2</td>
<td>1.45</td>
<td>-23.2 (19.1). [81]</td>
</tr>
<tr>
<td>6</td>
<td>Baga Khentii</td>
<td>132</td>
<td>-1.31</td>
<td>1929.0</td>
<td>312.6</td>
<td>1.94</td>
<td>-22.8 (16.8). [76]</td>
</tr>
</tbody>
</table>

*Source: Meteorological and Environmental Monitoring Agency
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Seed region includes the following territory of soums</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tsagaan taiga</td>
<td>Tsagaannuur soum, Khovsgol aimag;</td>
</tr>
<tr>
<td>2</td>
<td>Ulaan taiga</td>
<td>Renchinlkhümbe soum, Khovsgol aimag;</td>
</tr>
<tr>
<td>3</td>
<td>Jid</td>
<td>Tushig, Tsagaannuur soum, Selenge aimag;</td>
</tr>
<tr>
<td>4</td>
<td>Yuroo - Khuder</td>
<td>Yuroo, Khuder, Bugant, Mandal soums, Selenge aimag;</td>
</tr>
<tr>
<td>5</td>
<td>Zakhar - Minj</td>
<td>Mandal soum, Selenge aimag; Mongnmorti soum, Tov aimag; Batshireet soum, Khenitii aimag;</td>
</tr>
<tr>
<td>6</td>
<td>Baga Khentii</td>
<td>Monggonmorti soum, Tov aimag;</td>
</tr>
</tbody>
</table>
### Table 9. Seed regions of Siberian spruce forests

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Vegetation period, day</th>
<th>Vegetation period, day</th>
<th>Average annual air temperature, °C</th>
<th>Sum of the temperature above 5°C</th>
<th>Total annual precipitation, mm</th>
<th>Moisture coefficient</th>
<th>Average air temperature, °C [Conrad’s index of continentally, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yoltiin Gol</td>
<td>131</td>
<td>-0.34</td>
<td>2147.1</td>
<td>107.0</td>
<td>0.65</td>
<td>-21.4 (17.3)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Uvs Nuur</td>
<td>155</td>
<td>-1.41</td>
<td>2848.2</td>
<td>109.2</td>
<td>0.42</td>
<td>-31.6 (22.4)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Tesiin Gol</td>
<td>130</td>
<td>-0.39</td>
<td>2002.2</td>
<td>185.9</td>
<td>1.08</td>
<td>-32.4 (17.8)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Shishgedii Gol</td>
<td>121</td>
<td>-6.67</td>
<td>1536.3</td>
<td>218.3</td>
<td>1.58</td>
<td>-34.4 (15.7)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ulaan Taiga</td>
<td>123</td>
<td>-5.37</td>
<td>1592.4</td>
<td>272.2</td>
<td>1.96</td>
<td>-30.1 (15.2)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Jid</td>
<td>143</td>
<td>0.16</td>
<td>2119.9</td>
<td>309.6</td>
<td>1.46</td>
<td>-23.3 (19.4)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Yuroo - Khuder</td>
<td>133</td>
<td>-1.01</td>
<td>1565.0</td>
<td>334.3</td>
<td>1.55</td>
<td>-26.8 (19.4)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Zakhar Minj</td>
<td>146</td>
<td>-0.34</td>
<td>2050.5</td>
<td>292.2</td>
<td>1.45</td>
<td>-23.2 (19.1)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Baga Khentii</td>
<td>132</td>
<td>-1.31</td>
<td>1929.0</td>
<td>312.6</td>
<td>1.94</td>
<td>-22.8 (16.8)</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Meteorological and Environmental Monitoring Agency*

### Table 10. Siberian spruce (Picea obovata Ldb.) seed region covers the following soums in certain aimag territory

<table>
<thead>
<tr>
<th>№</th>
<th>Seed region</th>
<th>Seed region includes the following territory of soums</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yoltiin Gol</td>
<td>Altai soum, Bayan-Olgii aimag;</td>
</tr>
<tr>
<td>2</td>
<td>Uvs Nuur</td>
<td>Davst soum, Uvs aimag;</td>
</tr>
<tr>
<td>3</td>
<td>Tesiin Gol</td>
<td>Tes, Bayantes soums, Zavkhan aimag;</td>
</tr>
<tr>
<td>4</td>
<td>Shishigtii Gol</td>
<td>Tsagaannuur soum, Khovsgol aimag;</td>
</tr>
<tr>
<td>5</td>
<td>Ulaan Taiga</td>
<td>Renchinlkhumbe soum, Khovsgol aimag;</td>
</tr>
<tr>
<td>6</td>
<td>Jid</td>
<td>Tushig, Tsagaannuur soums, Selenge aimag;</td>
</tr>
<tr>
<td>7</td>
<td>Yuroo - Khuder</td>
<td>Yuroo, Khuder, Bugant soums Selenge aimag;</td>
</tr>
<tr>
<td>8</td>
<td>Zakhar - Minj</td>
<td>Mongonmorti soums, Tov aimag; Tsenkhermandal, Batshireet, Binder Delgerkhaan soums, Khentii aimag;</td>
</tr>
<tr>
<td>9</td>
<td>Baga Khentii</td>
<td>Capital (metropolis) Ulaanbaatar; Erdene, Bayandelger soums, Tov aimag;</td>
</tr>
</tbody>
</table>
CONCLUSIONS

We have identified 19 seed regions for Siberian larch \((\textit{Larix sibirica} \text{Ldb.})\), Dahurian larch \((\textit{Larix dahurica} \text{Turcz.})\), Chekanowskii larch \((\textit{Larix Chekanowskii} \text{Szaf.})\); 12 regions for Scots pine \((\textit{Pinus sylvestris} \text{L.})\); 9 regions for Siberian pine \((\textit{Pinus sibirica} \text{Du Tour.})\); 6 regions for Siberian fir \((\textit{Abies sibirica} \text{Ldb.})\); and 9 seed regions for Siberian spruce forests \((\textit{Picea obovata} \text{Ldb.})\), and have developed a map on a scale of 1:1 000 000 which will serve as a basic material for further seed management efforts with an emphasis on conservation of forest genetic resources and tree breeding in coniferous forests in Mongolia.

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