Methods of land management when locating tea plantations

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Abstract. The article deals with the issues of modernization of land management as an economic branch. Due to digitalization of the economy, modernization is aimed at creating a digital land management system. The article analyzes land management methods used for location of tea plantations. The potential of the tea industry in China and other leading tea producing countries was analyzed.

1. Introduction
Identification of new land areas suitable for tea cultivation (selection of a land plot) is an important issue when organizing tea plantations. Design companies often have to design new tea farms in a certain area with established boundaries [1, 5–8, 12]. As a result of the pre-design works, land of such farms is either unsuitable for tea due to its natural conditions, or long-term and costly reclamation measures are required for its development.

Sometimes land allocated for tea farms is of poor quality. This land is allocated because tea production can cover any costs of funds and materials. This approach causes great damage to the agro-industrial sector and cannot be justified [1, 2, 5, 9–12]. Organizations of tea farms should be preceded by detailed surveys and feasibility studies that confirm the possibility of observing optimal conditions for organizing such farms. In all cases, it is necessary to have a sufficient amount of suitable land, close to transport communication systems and processing plants [3, 9, 10].

These requirements can be taken into account only on the basis of a special land management project. It is necessary to establish an exact sequence of all phases of a land management project, including preparatory works which include a detailed survey of the area. [4]

2. Materials and methods
Tea is a subtropical evergreen plant. Some of its varieties (grown in Russia and Georgia) are so hardy that they do not die even at temperatures below –20 °C. [1, 3, 5, 9, 10]

The tea plant grows in areas located between 45° north latitude and 30° south latitude at an altitude of 300 to 2000 meters above sea level. Tea plants are usually grown in the jungle or in the places of any old plantings. When preparing a tea plantation, old roots are uprooted, pampas grass is sown to loosen soil. The ground sprouted with grass is plowed and tea bushes are planted [1, 5, 9, 12]
However, the choice of location for tea plantations and their orientation in the direction of bushes require compliance with certain conditions. The main factor is high temperatures in summer and autumn and relatively low ones in winter. For the active growth of tea plants, long light days are required. Otherwise, tea leaves will lose their aroma. The tea plant is very susceptible to air pollution, the air must be clean and humid. [1, 12]

Tea bushes must be placed on the slopes, so that moisture does not stagnate under the roots. It is a moisture-loving plant that requires constant moisture. It is necessary to locate tea plantations at an altitude of 1.5 km above the sea level.

For the tea plant to produce green leaves, heat and moisture are required. Camellia feels well at a high humidity and heavy precipitation. But tea plants do not stand water stagnation under the roots; they should be washed with water rather than be located in water. [1, 5, 12]

In the provinces of China, India and other countries with tropical and subtropical climatic conditions, peasants grow tea bushes every year. They grow them on mountain slopes with a warm climate and high humidity. Most of the fertile fields can yield up to four or five times a year. The most valuable and elite yield is the first or the second one.

Tea cultivation is an extremely time-consuming process. Labor of farmers is hard, because in a few hours it is possible to collect only a few kilograms of tea leaves, of which only one fourth can be used as a finished product. In addition, during one working day, peasants travel tens of kilometers from one plantation to another one.

Leaves are manually sorted into several varieties: young unblown buds, buds and leaves used to make the best varieties. The leaves from the middle part of the bush are used for coarser varieties.

Manual tea harvesting is necessary, as machine harvesting can damage wet leaves and impair tea taste and aroma. Plantations are mainly located in the countries with cheap labor.

It is necessary to analyze the following issues:

- Production specialization;
- Selection of tea varieties;
- Choosing a site for a tea plantation;
- Natural conditions;
- Reduction of cost and increase in the product quality by improving working conditions.

### 3. Results and discussion

**Selection of a site for a tea plantation.** Areas that were under the forest or shrubs, or annual crops are used for this purpose. In all wet areas, a drainage network is arranged.

In order to mitigate harmful effects of dry and cold winds, forest protective stripes are arranged. Flat areas and slopes with a steepness up to 30° are used. Continuous tillage is made to a depth of 45 cm, carefully loosening and cleaning the soil from tree roots, rhizomes, weeds, stones, etc.

Plots with poor and weakly structured soils are sowed with perennial cereal and leguminous grass. [1, 5, 12]

The soil is plowed. For plowing, phosphate fertilizers are applied (200-300 kg per 1 hectare). Rows are created: in flat areas and on slopes with a steepness up to 8° - straight rows with a distance of 1.5 m; on slopes with a steepness of 8° - along the horizontals (across the slope) with a distance of 1.25 m.

To eliminate soil erosion, the following measures are used:

- a) deep tillage across the slope;
- b) division of rows along horizontals, thickened sowing of tea seeds;
- c) a creation of a water regulating network and anti-erosion terraces;
- d) sodding of the slopes of terraces and inter-rows of tea plantations with soil-fixing grasses.

Tea plantations are created in spring and autumn. For sowing, seeds with a size of 1.2 cm in diameter are used. They are sown in nests, 5-7 seeds in each nest at a distance of 25-35 cm from each other.

When the belt sowing method is used, seeds are sown in grooves at a distance of 5 cm between them. The seeding depth is 4-5 cm.
In areas exposed to dry winds, 5–7 cm. The average seeding rate, depending on the width of the aisles and the method of sowing, 150 to 250 kg / ha of future tea plants located on the southern slopes and 350 - are used for laying out each hectare of plantations. 400 or more kg of seed on the northern slopes. [1, 5, 12]

In arid districts, to protect the soil from drying out, rows of tea seeds are covered with fern, grass or branches. In May, in order to protect tea seedlings from sun, seedlings are protected with green branches. For shading, annual plants are used (bush beans, soybeans) which are sown in the rows.

The main agricultural measures used at tea plantations are as follows: weeding in the rows of tea seedlings 3-4 times during the growing season and soil loosening; repair of plantations in spring and autumn; on thinned areas of annual plantations, seeds are sowed, on 2-year-old and older plantations, seedlings are planted after soil loosening to a depth of 35 - 40 cm; planting with a clod; cultivation of rows in spring and summer, weeding; soil loosening; autumn-winter digging or plowing between the rows to a depth of 12 - 15 cm since the 3rd year. On well-developed plantations, autumn-winter tillage should be done every 3-4 years.

Forming and cutting of 2-3-year old tea bushes from mid-February to April are required. Bushes are cut in order to cause the branching, create a skeleton which ensures further development of a compact and wide crown. The trellis pruning of full-aged plantations is aimed at leveling all trellis by raising low bushes, maintaining the shape, height and width, and enhancing the emergence and reduction of fruiting. For pruning, a tea-cutting machine has been designed [1, 5, 12]

The correct choice of sites determines productivity and durability of future plantings. At the same time, tea variety requirements to the environmental conditions, soil and climatic features and possibilities of mechanization of tea cultivation must be taken into account (Figure 1). In Russian conditions, for example, in Sochi, the vertical limit of possible land development for tea plantations is an altitude of 500-600 m above the sea level, although the potential has not been fully studied. Slope with a steepness of 22-25° or less can be used for tea plantations. On steeper slopes, it is advisable to leave natural vegetation.

The following issues are addressed when selecting sites and locating tea plantations:
1. Identification of new lands suitable for tea cultivation.
2. Determination of the size of land areas and rational arrangement of territories suitable for tea cultivation.
3. Expansion of areas.
4. Selection of tea varieties.
5. Improvement of productivity by improving seed and planting material quality, using fertilizers, choosing the best sites.
6. Removal of old plantations, preparation and planting of new ones.
7. Irrigation.
8. Application of fertilizers during the growing season based on data obtained from UAV monitoring.
9. The use of technical equipment during harvest.
10. Monitoring of the content of tea plantations.

Identification of new areas of land suitable for tea cultivation of tea. Design organizations have to design new tea farms within established boundaries.

Lands of some farms are either unsuitable for tea cultivation due to their natural conditions, or long-term and costly reclamation measures are required for their development.

Lands allocated for tea farms can have poor quality. They are selected due to the fact that tea production can justify any costs of funds and materials. It can cause damage.

Organizations of tea farms should be preceded by detailed surveys and feasibility studies that confirm the possibility of observing optimal conditions for organizing such farms. [3–5, 12]
Sites are selected taking into account plant requirements for soil and climatic conditions, on the basis of farm management projects, soil and other surveys. Design and exploration determine practical suitability and economic feasibility of various plots used for tea plantations. Roads, water regulation networks, and protective forest belts should be created. A drainage network should be created [1, 5, 12].

Tea plants are responsive to mineral fertilizers; they are applied according to agrochemical cartograms reflecting the actual content of mineral substances in the soil.

Today, various organizations have developed indices of plant availability with nitrogen, phosphorus and potassium NDVI. These indices are used to determine the degree of nutrients. Using unmanned aerial vehicles (UAVs) equipped with special spectral chambers, it is possible to determine the degree of nutrients for tea plants and identify their optimal rates.

One of the reserves to increase the yield of tea plantations is alignment of trellises. Until now, in some farms, tea lanes are wavy curves. This surface reduces the leaf area and makes it difficult for workers to collect tea leaves. Differentiated trimming of plants can level these trellises.

4. Conclusion
1. When reviving the tea industry in Russia, it is necessary to use the experience of the Chinese agro-industrial complex, including mechanisms of state regulation, taxation and integrated development of rural areas based on food, social, environmental and other types of security.
2. When choosing a tea plantation site, slopes with a warm climate and high humidity are optimal. Most plantations can give yield 4-5 times a year. The most valuable and elite tea is of the first and second yields.

3. Application of these results will provide an additional annual income from tea production.

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