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# **Desert Wheel Tractor and Agricultural Machines Aggregated to It**

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**ABSTRACT:** The article provides solutions to problems of improving desert and semi-desert (arid) pastures and hayfields, and creating perspective seed crops of arid fodder plants using specialized mechanization in Astrakhan farms in arid zones of Uzbekistan. These studies are working on creation of innovative technologies and technical tools for cultivating desert lands, developing productive pastures and hayfields for livestock and testes on them. The main goal and objective of project is to create universal cultivating tractor with increased stability and passability to work in desert zones and, if necessary, in areas of irrigated agriculture. One of the main problems in desert zones of the republic is water supply to the population and livestock. Basically, water is raised using submersible pumps from apertures or wells.

**KEYWORDS:** arid, desert, semi-desert, fodder, plants, leban, universal cultivating tractor, harvester, mower, water-supply, testing, basic, surface, improvement.

## **I. INTRODUCTION**

Considering large amount of work to create forestland, pasture of protective and fodder pasture plantations in desert and semi-desert areas. As well as on territory of drained bottom of the Aral Sea, outlined by government according to the development strategy for the period 2017-2021, a special place is occupied by the harvesting of perspective 15 species of fodder seeds plants (in particular, leban and saxaul) to improve pastures and hayfields, and create their testes, which have disappeared in recent years (Shamsutdinov, 1963, 1969; Shamsutdinov et al., 1983).

In world space, arid fodder plants comprise more than 250 species.

A number of government documents of the Republic of Uzbekistan noted that country's agriculture is in urgent need of modernization, technical and technological updating, and use of energy-saving technologies.

Within the framework of general program for modernization of agriculture, qualitative renewal and saturation of agricultural machinery park is required, especially equipping it with new high-performance tractors capable of working in various soil and climatic conditions of the Republic, in particular desert regions (Kholmiraev, 2013).

These issues supplemented by creation problems of agricultural machines for the tractor under development for (Shamsutdinov et al., 1969):

- improvement of arid (desert and semi-desert) pastures and hayfields, and creation of perspective testes (saltwort, leban, white and black saxaul etc.) of fodder plants;
- harvesting forage plants for hay;
- seeds collection of desert fodder plants;
- pest control of feed plants.

An effective solution of tasks set is possible only in case of an integrated approach to their implementation, in particular, it is necessary to simultaneously work on scientific substantiations for new solutions, engage in concrete

design, and develop new agricultural technologies for efficient use of new machines in agricultural production (Shamsutdinov, 1969).

Given above, in front of number of specialized organizations:

- LLC "Design and Technology Center for Agricultural Engineering"
- Tashkent Institute for the Design, Construction and Operation of Roads;
- Institute of Mechanics and Earthquake Engineering of the Academy of Sciences of the Republic of Uzbekistan;
- Joint-stock company of specialized head design bureau for agricultural machinery (BMKB-Agromash JSC);
- Uzbek State Center for Certification and Testing of Agricultural Techniques and Technologies (UzSCCTT), task was to develop design of new generation of domestic 4-wheel universal row-crop tractors, designed to work primarily on desert lands.

## II. SCOPE OF RESEARCH AND PROPOSED METHODOLOGY

It is known that agricultural tractors, depending on their purpose and type, have different requirements, which is largely due to climatic, soil and economic conditions. About 75 % of the territory of Uzbekistan occupied by deserts (Abdullaev, 1974; Urdiev, 1974; Turabaev, 1983). The largest desert is Kyzylkum, second most important is the eastern part of the Ustyurt plateau, which is part of Uzbekistan.

In Uzbekistan, sand deserts are predominant. The main natural component here is sand. High flowability and mobility of sand causes, in turn, mobility of physical and biological phenomena (Novitsky, 2018). Unregulated and excessive exploitation of sand pastures, deforestation of shrubs (saxaul, etc.) for firewood leads to disruption of ecological balance (Cormack, 2014), destruction of vegetation, and blowing of sand massifs – deflation, degradation (Figure 1).



Figure 1: Degraded astrakhan pastures and hayfields (Jizzakh region, Farish area, 2016, June)

Currently, intensive desertification of the territory of Uzbekistan continues (Ergashev et al., 2018). In particular, new sandy desert Aralkum formed on site of the Aral Sea with an area of more than 5.5 million hectares is gradually spreading to entire Aral Sea area, annually poisoning atmosphere with about 100 million tons of dust and poisonous salts carried by sandstorms and hurricanes far beyond the Aral Sea (Figure 2).



Figure 2: Drying lake Aydar Kul (Jizzakh region), around salt and salt marshes, 2016, July

To prevent further spread of these detrimental phenomena (Beuerlein et al., 2003), measures are being taken in the country to sow and plant sand plants in order to protect against salt storms and create natural barrier against salt from the bottom of the dried-up territory of the Aral Sea and Lake Aidar Kul (Berezina et al., 1975). In addition, these studies are working on creation of innovative technologies and technical tools for cultivating desert lands, developing productive pastures and hayfields for livestock and testes on them (Figures 3, 4, 5, 6, 7.8, 9, 10).



Figure 3: Improvement (sowing of saxaul and leban seeds by partial-surface improvement method) of degraded pastures and hayfields (Jizzakh region, Farish area, farm Mansura Akhmedova – testing ground of BMKB-Agromash JSC, 2016, early March). Sowing is performed by experimental combined aggregate AYM-2.1

For the effectiveness of these works, specialized equipment is needed, and desert tractors capable of operating in semi-desert and desert conditions needed to aggregate them (Musaev, 1969; Abdullaev, 1970; Mamadzhonov, 1986; Kuibakov, 1993).



Figure 4: Improved pastures and hayfields with arid fodder plant (leban crops of the 1st year of standing, 2017, April), sowing in 2016, March



Figure 5: Improved pastures and hayfields with arid fodder planting of leban of the 3rd year of standing, 2018, August



Figure 6: Improved pastures and hayfields by arid fodder plant (crops of saxaul of the 3rd year of standing), 2018, August



Figure 7: Experimental mounted seeder SKA-2,1N for sowing seeds of arid fodder crops (in particular, creation of seed plants)



Figure 8: Cultural sowing testes of leban (3rd year of standing), 2018, August



Figure 9: Test ground for improving pastures and hayfields, seeds production of arid fodder plants (Jizzakh region Farish area, Astrakhan farms Mansura Akhmedova, 200 hectares)



Figure 10: Experimental mower for harvesting hay and collecting seeds of arid fodder plants, SSP-3, rear view

However, today in Uzbekistan there is no technical equipment sufficiently adapted to work in desert conditions. Narrow-gauge serial tractors with small base have insufficient passability and stability, because of which they burrow into loose sandy soils and are highly likely to tip over (Leshko, 1971).

To address these shortcomings, tractors operating in desert should have an adjustable track and base, and wheels should have a wide tire (Tukhtabayev, 2019). The fulfillment of these requirements makes it possible to ensure possibility of tractor operation, both in desert and in irrigated agriculture with sufficient passability and stability. Since, as noted above, today such equipment is practically absent in Uzbekistan, this determined the need for work on above-mentioned project.

Thus, the main goal and objective of project is to create universal cultivating tractor with increased stability and passability to work in desert zones and, if necessary, in areas of irrigated agriculture (Figure 11).



Figure 11: Experimental four-wheel tractor with increased passability and stability for desert zones, based on TTZ

One of the main problems in desert zones of the republic is water supply to the population and livestock (Electrical stimulation of plants, 2005). Basically, water is raised using submersible pumps from apertures or wells (Figure 12 and 13).

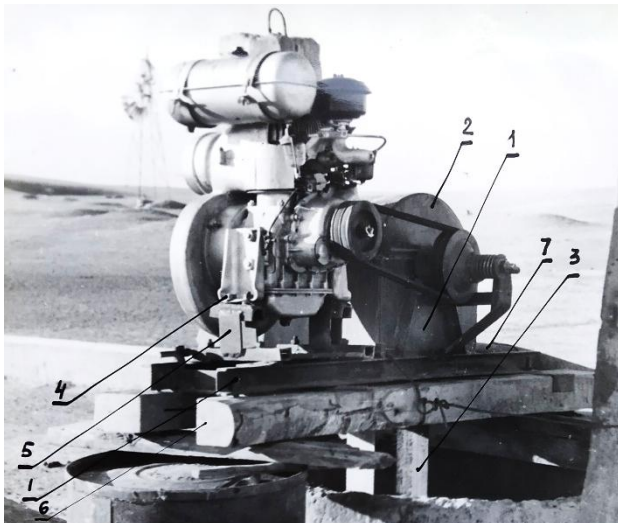


Figure 12: VLM-100 water lift with engine mounted on a well  
1-base; 2-sheave; 3-support arm; 4-flywheel; 5-casing;  
6-abutment; 7-stirrup bolt

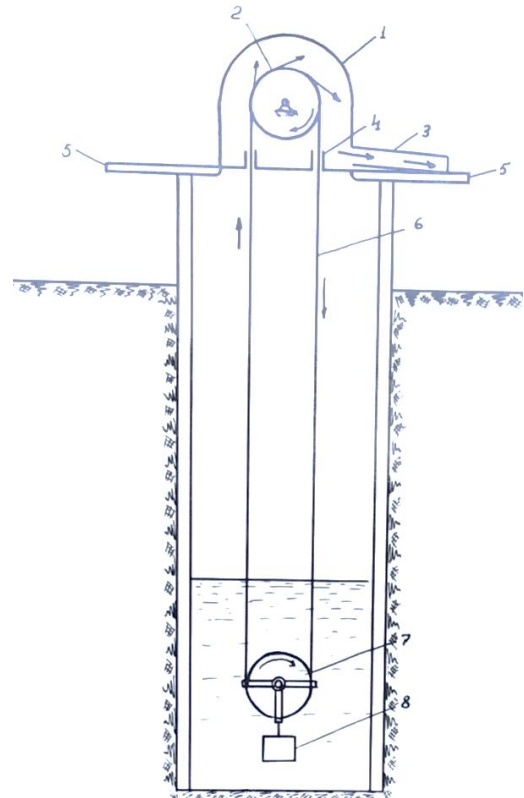


Figure 13: Technological scheme of water lift  
1-cover; 2-upper pulley; 3-exhaust bottom;  
4-squeeze; 5-basis; 6-belt; 7-bottom block; 8- anchor

However, in recent years, due to transfer of state organizations to private ownership, existing apertures and wells require overhauls. For this, farmers in the community must create special mechanized teams that have specialized equipment for drilling new wells, cleaning existing wells, acquiring modern pumps and engines or repairing existing submersible (deep) water pumps, engines and electricity generating stations. Research has begun on this issue.

### III. RESEARCH RESULTS AND DISCUSSION

LLC "Design and Technology Center for Agricultural Engineering", within framework of this project, explores and develops the design and technological parameters of universal cultivating tractor adapted to work in desert conditions (primarily sandy ones). In the course of work, tasks of creating 4-wheeled tractor of increased passability and stability, capable of aggregating designed for work in deserts, with existing serial (KIR-1,5 mower) and newly developed specialized agricultural machines (AYM-2,1 combined soil cultivating aggregate, mowers for harvesting feed KPP-3 and KPN-3, and harvesting seeds SSP-3 and KPN-3S, seeders SKA-2,1N and SZT-3,6P, sprayer of toxic chemicals VP-1M) and implements (small-leveling machine MT-3P), and irrigated agriculture. Based on the results of previous years and this year, a prototype tractor is being assembled.

On this subject, Tashkent Institute for Design, Construction and Operation of Roads, within the framework of its subproject, is engaged in selection of tread pattern and parameters of wheel mover, development mechanical-mathematical model of interaction of tractor's wheel mover with bearing surface, and experimental study of interaction of tractor's wheel track mover with bearing surface.

Institute of Mechanics and Earthquake Engineering of the Academy of Sciences conducts research to determine steerability and stability of desert tractor, taking into account relief roughness and selected mover characteristics, determining main parameters of tractor maneuverability in desert conditions (according to criteria of speed, maneuverability, ability to move in off-road conditions and under different soil conditions) and substantiation of tractor stability under development, aggregated by specialized agricultural machines and implements for desert conditions.



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«BMKB-Agromash» JSC designs and manufactures agricultural machines (AYM-2,1, KPP-3, KPN-3, CCP-3, KPN-3C, CKA-2,1H, CZT-3,6P, VP-1M, MT-3P) for production feed and seeds in desert and semi-desert regions of Uzbekistan. Uzbek State Center for Certification and Testing of Agricultural Techniques and Technologies (UzSCCTT) is engaged in collection and analysis of domestic, foreign and international regulatory and technical documents and test protocols for agricultural machinery of similar direction, developing program and methodology for laboratory field research, conducting laboratory field research, processing and analyzing results, and issuing recommendations for improving designs jointly developed tractor and farm machinery for desert conditions.

The relevance of ongoing research projects is confirmed by tasks formulated by number of government decrees, which provide for dramatic increases in the level of equipment of agriculture with modern agricultural equipment for production of feed and seed production of desert fodder plants that meet international requirements and standards.

## IV. CONCLUSION

Based on the studies, we obtain conclusions, basis for carrying out work on the projects is existing developments:

1. LLC "Design and Technology Center for Agricultural Engineering", Institute of Mechanics and Earthquake Engineering of the Academy of Sciences, Tashkent Institute for Design, Construction and Operation of Roads and State Center for Certification and Testing of Agricultural Techniques and Technologies on creation of new tractors received in 2006-2015 when carrying out projects under the State scientific and technical programs, in particular, under ГНТИ-13 and K15-037 programs "Creation of high-performance, competitive and export-oriented technologies, machines and equipment, equipment's, devices, reference tools, measurement and control methods for industry, transport, and rural and water management",
2. LLC "Design and Technology Center for Agricultural Engineering", BMKB-Agromash JSC and UzSCCTT on creation and testing of agricultural machinery for desert conditions, on problem III.4.139 "Development of design and technological parameters of four-wheel universal row-crop tractor with increased stability for working on desert lands" of the project MB-Atech-2018-94 "Development of design and technological parameters of four-wheeled universal cultivating tractor with increased stability for working on desert lands" subproject on theme: "Program development and methods for laboratory and field testing of four-wheel universal row-crop tractor for work on desert lands";
3. «BMKB-Agromash» JSC and UzSCCTT KX-Atech-2018-229 project on topic: "Development of effective technical solutions for protecting arid pastures from degradation and increasing their productivity" subproject on the topic: "Development of effective technical solutions for protecting arid pastures from degradation and increase their productivity".

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