A Natural Fortress Defense Condition as a Necessary Circumstance of an Agricultural Society Born (As a Branch of the Classical Oasis Theory)

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***Abstract*—Starting from the prof. Emelyanov's paradoxes, here we present a specific theory of young agricultural societies boning. We insist that the agrarian society may appear with enough probability only in a substantially specific region, where alternative nomadic societies and cultures cannot destroy it or at least its innovations for a two-digit number of human generations. That means we should expect such occasions in poorly populated (desert) and poorly transportable landscapes and we put forward a three-stage theory. For reasons of susceptibility to external raids by armies and small enough groups of the "Asian type" using the rush-retreat tactics, the primary focus of agriculture can be formed only in the zone of maximum rest, that is, isolation (a typical "two-layer contour" - (arid) mountainous terrain - desert or semi-desert). As productivity increases, the requirements for the degree of spatial isolation of the agricultural area gradually decrease and secondary foci of agriculture with a weaker level of isolation may arise: a hollow bounded in a mountain range near the sea or a large flat river in a radically arid desert. Only at the last stage - mainly with the invention of normal firearms - agriculture can penetrate arbitrary open and forested areas that are most convenient for this.**

Keywords—natural fortress condition, yemelyanov's paradox

I. INTRODUCTION

Earlier, in [2-5] and, especially, in [2,3], a minimalist model of occupation of the enclosing landscape was formulated. The model is based on two technologies: intensive and extensive. The former refers to agriculture, while the latter, in various interpretations, refers to a low-productivity technology that requires very little human effort, from cattle breeding (in more developed agricultural societies) to more elementary and also relatively labor-intensive hunting and gathering.

In this paper, we apply the substantive conclusions of this model, in particular, regarding the military tension associated with the share and number of unemployed laborers to the question of spatial and geographical conditions of the formation of ancient agricultural crops.

The main factor, as it is not difficult to assume from the name, will be military (defense). Its accounting is intended to explain what we call the Y.V.Yemelyanov paradox.

Let us formulate the paradox in the form in which it is known to the author.

There are the more convenient places for farming. For example, at the African continent, it is surrounded by an open fertile plain of the Orange River (Southern Africa). However, large states have emerged in much harsher areas (the Nile Valley is no exception) , and there are many examples of failure from the point of view of the early emergence of a settled state, such as the Orange River (on all continents).

The version argued in this paper is that it is necessary to take into account the time of quiet existence of such a settled community based on the factors of military parity with the surrounding society using tactics that are now commonly called the tactics of Asian-type armies - raid-rebound tactics. This imposes restrictions on the combination of transportability and productivity of a unit of territory in the surrounding landscape, which ultimately make up the frequency and strength of impacts.

The deeply respected Professor Yu. V. Yemelyanov has his own fundamentally sound hypothesis in this regard, rightly pointing, out that almost all centers of agriculture, as a rule, pass through the migration routes of animals. In this case, we do not try to dispute this fact, but we insist on the most likely (easily explained and we will talk about this later) false correlation.

We do not support the version of our highly respected professor (about the migration routes of animals), but the essence of the phenomenon is correctly captured by him: such areas as Liguria located between the sea and the Alps, or any rivers in the mountain or flat desert, being in our terminology natural fortresses, are also the focus of animal migration flows for the same reasons that these areas present challenges for hostile communities to infiltrate.

There is another version of these events. We conventionally call it an extreme necessity. The essence of the hypothesis lies in the fact that hunter-gatherers lived in general quite normally (for example, in the Near East), and then in the process of glaciation the desert came and it became clear"that you can't live like this" and people (translated into modern terminology) did agricultural R & D and developed an alternative life support system.

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This is an argument that is difficult to reject directly - the fact is that even in modern conditions, the lack of extreme necessity leads to the loss of many technologies that, for one reason or another, were not included in textbooks when simple and understandable alternatives appeared, and an extreme necessity is the most important assistant at the stage of primary development. We put forward two theses against this explanation

1) not the main one - there has always been a significant (not quite extreme) need: the host landscape is limited, and in a single-product society there are always free hands. You always want to borrow them for the survival of more members of society

2) R&D takes time. During this time, the multi-generational research community should not lose its technology.

II. Main Variables and Primary Problem Formalization

So we denote by

r_a - the radius of the agricultural area, and after

S_a - its area (the subscript a is taken from the term agricultural)

r_n and S_n - the radius and area of the Asian-type military technology zone (the lower index n is taken from the term - non - settled-nomadic).

The total population of these regions is denoted by N_a and N_n, respectively.

$$N_\xi = S_\xi n_\xi$$

where ξ is the index of the region (a or n), n_ξ and is the population density.

In the simplest model

$n_\xi = \alpha_\xi$, where α is the productivity and of the agricultural technology or technology vector being used.

In its purest form, the population is not a means of warfare. Mobilization opportunities are important. In this case, at least two aspects are important: the quantity of the (potentially) free (male) population and its quality.

In a number of societies (most non-sedentary and most southern sedentary of the modern type (developed agricultural technology of the sample of the XIX century)) we observe a monotechnological situation and then, if labor $\beta < \alpha$ intensity , then we have a free population

$$n^{UnEmploied} = \alpha - \beta$$

The unemployment rate can be calculated

$$u = \frac{n^{UnEmploied}}{n}$$

In the previous case of a monotechnological economy

$$u = 1 - \frac{\beta}{\alpha}$$

This model [2, 3] considers the free population, which is prone to external military expansion, if it is not employed in highly developed societies in the construction of pyramids and other super-labor-intensive religious structures such as Anchor Var (or other infrastructure such as roads and capitols, as it was in the conditions of approximately the same crisis of over-labor in the United States in 1929-1940).

In a monocultural non-sedentary economy, the share of such a population can reach 80-90%.

For an agricultural civilization, the situation is more diverse. At the time of the Neolithic revolution, for a new highly productive technology, the key inequality $\beta < \alpha$ was not fulfilled, so at the first stage, for a (young) agricultural society, the next point model should be used, which gives near-zero unemployment, with low productivity of intensive technology (especially in high-altitude zone conditions).

In later areas, which are usually secondary foci, as a rule, there is also a labor surplus. It is observed at high population densities, but its share (which increases as the productivity of agricultural crops increases) lags behind less than that of people with naturally occurring Asian-type crops.

However, the most important factor is the ratio of readiness of the employed or free (let's call it that) "conscript" for war: living in a hunting and pastoral regime, each member of the tribal community continuously learns dual-use technologies: javelin throwing, archery, covert and open synchronous actions to corral game, and also fights well-honed skills of moving around the terrain, organizing camping life, etc., so even with an order of magnitude smaller population, a nomadic community can be a formidable force in the confrontation with a settled civilization.

$$N_\xi^{Eff} = k_{mob} N_\xi = k_{mob} S_\xi n_\xi ,$$

where $k_{mob}(u, WarShare)$.

where $WarShare$ is the proportion of dual-use skills acquired in a peaceful life.

This means that the number of males in the threatened area should be one, but rather two orders of magnitude larger than in the area from which the threat originates. At the same time, if we are talking about the stage of primary R&D when the first plant cultures are honed (or the first mammalian species are domesticated for the first time), to avoid the loss of developments, we need centuries (up to a thousand years) of relative rest, when a relatively small cultivating community does not suffer defeats that lead to the loss of the results of multi-hundred-year (thousand-year) spontaneous.

III. Probability of Survival

When modeling military operations (for equally armed and trained armies), the following functions are popular:

$$p_1^{Win} = \frac{N_{\xi_1}^{Eff^\delta}}{N_{\xi_1}^{Eff^\delta} + N_{\xi_2}^{Eff^\delta}},$$

where δ (the degree to which efficiently available resources are raised) is an analog of the scale factor.

If we assume that it is not very far from 1, then to survive in one collision, you just need to have a comparable population.

Examples of historical and modern settlements in the Middle East regions are illustrative. Consider, what Hebron looked like. The idea of this structure (according to those

concepts - a city) can be interpreted as a tank tower: it is conventionally a rounded dome with a hatch through which you can get inside from above, and close with a stone lid.

It is clear that the primary task that the inhabitants of such structures solved was defense. In the Caucasus, stone houses are still common, where there are interior loopholes, in order to conduct a layered defense against the penetration of ill-wishers into the dwelling.

Why natural fortress is so important natural fortress.

Agricultural civilization has both advantages and disadvantages.

Much more densely populated.

Technologically more developed (but not necessarily immediately transformed into military superiority)

Sometimes it can resort to fortification

Neighbors

They have mobility and can fight a war of the Asian type or tactically similar to it (perhaps without weapons of non-contact combat, but with the ability to retreat briefly and, if necessary, permanently, and sometimes even relocate).

Sometimes they can hide behind a complex landscape (forest on both flat and mountainous surfaces)

They have a higher mobilization coefficient, and develop dual-use technologies (military and peaceful): hunting for forest dwellers, transport, and hunting for steppe residents.

By performing hunting and nomadic maneuvers, they have the primary coherence of future military units.

As a rule, they have quite a lot of time, because, at the level of technology available to them, the operation of the host landscape does not require much effort, which leaves time for internal struggle (which provokes, in particular, the honing of combat skills).

The lack of internal borders provokes internal strife and additional debugging of military skills, military technologies, and the military-effective organization of society.

Hence, a possible failure for potential farmers is the proximity to a not-too-poor landscape (which allows them to retreat and advance (acceptable semi-desert, savanna, and steppe) or make sorties without fear of reverse pursuit-for example, a dense forest, less often, a flat river and the sea).

That is, theoretically, we are unlikely to see agriculture (no matter how productive the region is) if there is a close border with savanna, steppe, forest-steppe, and with a fairly densely populated (i.e. productive) forest. At the same time, the traffic capacity is important (depending on the available traffic technology).

Our deduced requirement is that

$\frac{N_a^{Eff^\delta}}{N_a^{Eff^\delta}+N_n^{Eff^\delta}}$ not too close to zero should be specified,

taking into account the time during which the civilization should be restored.

If we are talking about a secondary focus of civilization, then restoration requires only a few generations, if we are talking about a primary one, then primary research can take from 10-20 to 40 generations.

Here we have to write a different formula.

$$p_a^{Win}=\left(\frac{N_a^{Eff^\delta}}{N_a^{Eff^\delta}+N_n^{Eff^\delta}}\right)^{\frac{T}{\Delta}},$$

where T is the minimum period of quiet life required for R&D (at the first stage) and simple recovery (at the stage of secondary foci), and Δ - the interval between the considered attacks.

$f=\frac{T}{\Delta}$ It can take a value from several units to hundreds.

The frequency of raids usually varies from annual to about 1 time per generation (if the settled community is able and able to deal a decisive defeat to periodically invading nomadic communities on their landscape) and, sometimes, less often.

Then we have a more stringent (minimum) requirement

$\frac{T}{\Delta}\left(1-\frac{N_a^{Eff^\delta}}{N_a^{Eff^\delta}+N_n^{Eff^\delta}}\right)\approx 1$ or (slightly) less.

if $\delta\approx 1$, then $N_a^{Eff} >> N_n^{Eff}$

and, in this approximation, we can write $\frac{T}{\Delta}\frac{N_n^{Eff^\delta}}{N_a^{Eff^\delta}}\approx 1$

or (slightly) less, i.e.

$$N_a^{Eff}\Delta > N_n^{Eff}T$$

which given the meaning of the effective population in the primary variables means

$$n_a k_{mob} S_a \Delta > n_n k_{mob} S_n T$$

or, in terms of size (in the circular area approximation)

$$n_a k_{mob} \Delta {r^2}_a > n_n k_{mob} T {r_n}^2.$$

Recall that r_n - is determined by the transport conductivity of the region (a r_a is the characteristic size of a sedentary (usually agricultural) isolate that can be controlled by the corresponding innovation community).

In the next paragraph, we will largely restore the model from [2], which determines the specific population density of agricultural n_a and hunting-nomadic n_n populations .

IV. A Full-fledged Mathematical Model of Using a (Homogeneous) Landscape

The model is defined by a system of constraints.

$$n\to\max$$

$$\begin{cases}\alpha_1 x_1+\alpha_2 x_2\ge n\\ \beta_1 x_1+\beta_2 x_2\le n\\ x_1+x_2\le 1\end{cases},$$

$$\vec{x}\ge 0$$

where x_1, x_2 - respectively, extensively and intensively used territories, $s=1$ - the total territory of the state, n - the population of a unit of territory, which increases at every opportunity and is forced to optimally use the territory to feed the maximum number of people.

α_1,α_2 - the coefficient of productivity of the territory for each technology, and β_1,β_2 - the corresponding coefficients of labor costs.

It is almost always possible to assume that extensive technology means animal husbandry and intensive agriculture.

Next, we will look at qualitatively different important situations. In a situation of hungry homeostasis, i.e. equilibrium with the host landscape.

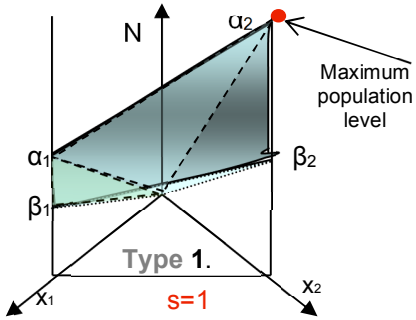

Fig. 1. Type 1-purely agricultural.

Type 1 represents a typical agricultural civilization. It has quite a lot of free human resources, but this is a very late stage in the development of agricultural technologies.

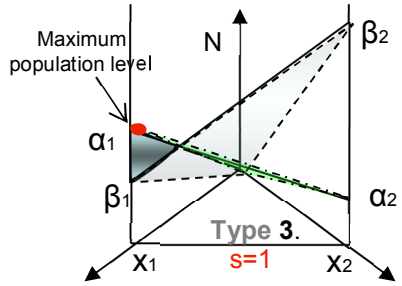

Fig. 2. Type 3. Typical hunting and nomadic culture.

The first type is the rarest-hunting-pastoral (often nomadic) type. It is dramatically oversupplied

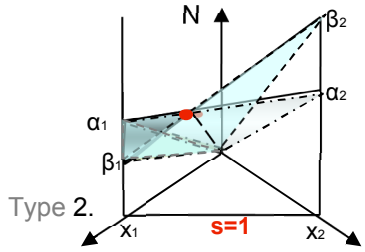

Fig. 3. Areas of labor excess and labor sufficiency in a "purely" agricultural economy: (right) and (left) the characteristic position of restrictions necessary for mass demand or non-zero wages.

Type 2 is the only one where labor resources are not available. At the end of the widespread dominance of agrarian society in the region of the XIX century, this type was preserved only in the northeast of Europe.

But historically, at the stage of the emergence of agriculture, especially crop production, the productivity of this technology was insignificant (as well as for any insufficiently developed technology), which meant type 2.

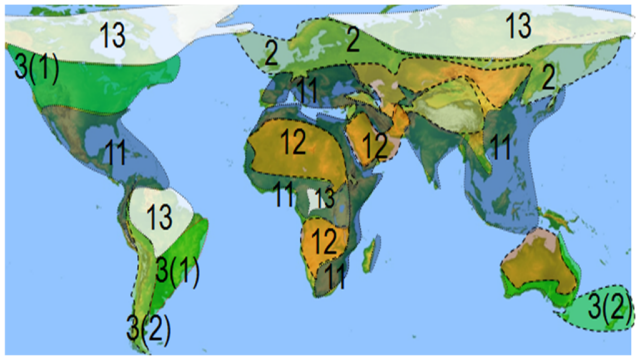

Fig. 4. Social-economic Agricultural types in the XIX century. Notations: 11 – labor-excessive crop-productive, 12 – deep labor-excessive cattle-breading, 13 – weakly labor-excessive hunter-gatherers agriculture, 2 – mixed (crop productive plus cattle-breading), Nonequilibrium (generally so-called immigrant), 3(1)– nonequilibrium (over labor-excessive) (practically the labor deficit substantially depends on the property access regime)

It would be interesting to build the same map for different epochs. Unfortunately, we have only fragmentary information that says that in the last ice age 10-12 thousand years ago (when the transition from hunting and gathering, including in Near East Asia, took place), modern arid zones were even more deserts, and this transition itself took place in oases, which confirms what was deduced almost at the tip of the Earth. Per conclusion.

V. The Real History

So, agriculture (except for fruit and berry crops) was primarily localized in isolated areas. This is indicated by two groups of facts:

well-known territories of origin of crops (especially crops of field and garden cultivation)

areas of crops found during excavations.

First, about the large agricultural centers: a glance at the map is enough to understand that these are usually mountainous isolated regions. These are the Andes and Cordillera, Western Asia, Southern Europe (mountains or narrow strips of land between mountains and the sea), the Iranian Highlands, A separate story – the islands of modern Indonesia and Indochina (there is primarily the sea, but the mountains also played a role in the development of small, at the first stage of agricultural centers). Specific conditions in Egypt (not specified), Central Asia, Australia, and the Yellow River basin. In all these conditions, the role is played by passable, but poor (often super poor) landscapes, the productivity of which is many orders of magnitude less than the small agricultural area they cover.

Finally, India is a territory that is about as poorly acceptable for agriculture as any open forest area (although the climate has changed quite a lot over the past millennia), but there exist agriculture centers, having originated on the mountainous border of the region and, apparently, passing along the semi-desert river banks (Indus), was able to spread to the Indian subcontinent covered by the Asian mountain belt. In places of open forest, all this happened much later and with the use of virtually modern military technologies.

If we look in more detail, we can see the formula for success

A river in the desert (Huanghe, Egypt, Babylon, Indus, etc.), and possibly some areas of Australia.

Wells on the parched plain (Maya, Yucatan Peninsula), and smaller scale kerizas in Iran and Central Asia

Mountains + Desert: Northwestern United States, Atacama Desert, Afghanistan, Mexico, Iranian Highlands, some areas in Australia,

Mountains and sea: Liguria, Greece, the coast of Asia Minor, Korea, Catalonia and other coastal areas

Sea and desert (one of the most dangerous options) – Maghreb.

Island (Sumatra, Kalimantan, Java, New.Guinea).

Although we haven't discuss two cases 1) New Guinea and possiable Asian rice domestication point and some points in Southern America - swamp island that is a ready fortification and 2) forrest gardenry that becourse of low labor consumption is possible in semi-nomadic culture.

VI. Conclusion

Once again, about the success factors. Agriculture never originated on fertile soils. It was always born only under the primary umbrella of security that provided the landscape, usually in the form of a combination of mountains and deserts (as a double defense of an agricultural area) at the first stage and mountains or deserts (sometimes water barriers) at a later stage, when the defense capability of the hearth allowed using a weaker contour-still circular or almost circular security features.

Farmers are always initially located in a very limited area suitable for agriculture (the vast black soils of the Great Steppe from the Danube to the Volga, or from the Appalachian Mountains to the Cordillera, or from South Africa to Namibia and the Great Lakes region, as mentioned above, do not count for the reasons described above their control requires non-contact weapons, preferably firearms). This limited territory (a piece of land) should not be bordered by anyone (either by a very narrow isthmus (Crimea is not a very good example) or by a mountain pass (Liguria, Andean civilization, etc.)) or border on a large open space, the population of which is restricted based on the above factors:

The area of open space is 10-100, sometimes 1000 times larger. The coefficient of military tension is 10-20-30 or more times higher. The population in the open space (or its army) has the opportunity to retreat and disperse.

A social structure built on sedentary principles cannot retreat, has no transport, has no alternative habitat, and its defeat strongly rejects it in most parameters (population, infrastructure, public (military) organization).

All this means that, depending on transport mobility and the ratio of military technologies, the population of the threatened area should be two orders of magnitude smaller than the population of the threatened territory, and the population density, respectively, should be limited by the product of this ratio by the ratio of the areas of agricultural and hunting-pastoral territories.

At the same time, the calculation of the area of the threatened hunting and pastoral area should be based on the idea of how far the threat can come from, and this (all other things being equal in terms of transport characteristics) primarily depends on the period during which the raid is being prepared.

That is, smaller raids should occur from a smaller area, but more often, rarer raids can involve an order of magnitude (or orders of magnitude) larger area.

In practice, this means that if an agricultural crop bordering on a completely open landscape cannot hide in the forest (and permanently retreat into it for times of problems, as the North-Eastern part of the future Great Russia could), then there is one acceptable continental option – a landscape that is 10000-1000 times less productive for a threatened area, like Egypt ancient Uyghur cities and the Gobi Desert, the Indus River and the surrounding desert, etc.

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