

# An Analysis of the Consequences of the Herdsmen-Farmers Crisis in North Central Nigeria using Agent - Based Modelling

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## ABSTRACT

In the North Central part of Nigeria, the indigenous farmers, who mostly practice small-scale agriculture, and the herdsmen, who raise cows and other animals using the free ranging or the open grazing method, have been engaged in a fierce crisis that has led to the loss of many lives and properties. In this work, a model of these violent interactions has been created with the aid of NetLogo which is a suitable computer environment for modelling complex natural phenomena that involve the interactions of multiple heterogeneous agents. The agents that populate the model include the herdsmen, farmers, military, local militias, cows, and the farming environment.

The results of the simulations indicate that very drastic degradation of the farming environment as well as depopulation of both the indigenous farmers and the herdsmen could occur if the conflict is allowed to linger for a long time. There is also an indication that there may be no victory for any party in this crisis. It is important that governments, policy makers, and even sponsors of this violence pay attention to the results of this work in order to enable them to adjust their strategies of dealing with the crisis.

(Keywords: herdsmen, farmers, crisis, conflict, agent based modeling)

## INTRODUCTION

The North Central part of Nigeria, also known as the Middle Belt of Nigeria, is generally considered to be made up of the States of Benue, Kogi, Nasarawa, Plateau, Taraba, Kwara, Niger, and Adamawa as well as southern parts of Kaduna, Kebbi, Bauchi, Gombe, Yobe, and Borno States

as shown in Figure 1 [1]. This part of Nigeria is inhabited by various ethnic nationalities who practice mostly small-scale agriculture and grow yams, guinea corn, corn, millet, rice, cassava, potatoes, and many other arable crops [2].

The inter relationship between the farmers of this area and herdsmen dates back more than a century [3-5]. However, over the past five years, and especially since the beginning of 2013, there has been a deepening violent crisis that has arisen as a result of the incursion of armed herdsmen into the Middle Belt area from the far northern parts of the country and even beyond the borders of Nigeria [6-9]. These herdsmen rear cows and other animals and they practice the open grazing method of feeding their animals [10]. The herdsmen have been accused of deliberately setting their animals on the farms of the farmers; a practice that has led to violent confrontations between the herdsmen and the farmers [11].

This crisis appears to be obviously a competition for the control of land resources for farming, on the part of the farmers, and for grazing on the part of the herdsmen [1]. Ethno-religious factors, population explosion, drought and desertification are among some other causes that have been deduced as reasons for the crisis by some authors [7, 12-14].

In an effort to curb these confrontations, the government of Benue State enacted the anti-open grazing law in 2017 [15]. The leadership of the cattle breeders association (known as the Miyetti Allah Cattle Breeders Association) has called for the repeal of this law and has acted in such a way as to undermine this law [16-17]. This disagreement has resulted in more violence and more deaths among the two warring parties [18].



**Figure 1:** Map of Nigeria Showing the Middle Belt Region in Blue.

It has been asserted that from the year 2014 to the end of April 2018, more than 5,000 deaths have been recorded as a result of these confrontations, with up to 890 deaths occurring in the first quarter of 2018 alone [13 & 19].

The incessant violence in this area of Nigeria has led to worsening levels of insecurity. Many farmers have fled their ancestral homes and have ended up in camps set up for the internally displaced persons (IDP) [13]. The Middle Belt states contribute a great amount to the national food production and the displacement of these farmers, as well as the killing of cattle owned by the herdsmen, will threaten the overall national food security [6 & 20].

In an effort to quell this crisis the federal government of Nigeria deployed the Police and the Military to these states to conduct military exercises [13]. While the spate of violence may have been abated during these military exercises, there is no doubting the fact that the killings and destruction of properties have continued: in April

2018, a church located in a rural community in Benue State was attacked and two Priests of the Roman Catholic Church were among the 19 people killed [21]. Recent events suggest that the crisis may escalate further in the foreseeable future [22].

The feeling of helplessness among some people of Middle Belt and of the inability of the Military to stop these killings have led to the call for the formation of local Militias to rise in self-defense and to the outright denunciation of the Military who have been accused of collusion with the herdsmen in the perpetration of the violence [23-24]. In a rebuttal, however, the Military has denied any involvement in such a heinous complicity [25]. Many well-reasoned and dispassionate solutions to the crisis have been proffered by individuals and groups [1, 7, 12 & 20].

In the midst of this chaos, it is interesting to develop a predictive computer model that seeks

to answer some pertinent research questions concerning the evolution of the crisis:

1. How will the populations of the herdsmen, farmers, and cows in this area change as a result of a prolonged violent interactions between them?
2. How will these violent interactions affect the farmlands and the entire environment?
3. What are the effects of the intervention of the Military in this crisis if they are positively disposed to aid the herdsmen or the farmers to achieve their desires, whatever those may be?
4. What are the effects of the intervention of the local Militias whose avowed intention is to repel the incursion of the herdsmen?

## **AGENTS AND THEIR BEHAVIOURS**

The modelling and simulation in this work have been carried out with the aid of NetLogo 6.0.3 [26]. This is a computer environment that is convenient for modelling complex natural phenomena that involve the interactions of multiple heterogeneous agents [27-28].

The four types of agents that are used in the NetLogo environment are the turtles, the links, the patch, and the observer. The turtles are mobile agents and for this work, the breeds of turtles include the herdsmen, farmers, military, local militias, and the cows. These agents move within the rectangular NetLogo patch that is considered to be the world, but in reality, represents the physical environment. In this work the world has been configured to have the topology of a box by making it to be non-wrapping both vertically and horizontally.

The herdsmen, who possess firearms, move randomly with their cows within this world and then encounter the farmers who are also randomly distributed within the world. This encounter leads to the killing of farmers by the herdsmen, the killing of herdsmen by the farmers and also the killing of cows by the farmers [13]. In what may be termed “agenticide” the farmers have been reported to have killed their own kind in many communal clashes [29-30]. The local militias are people, from the same environment as the farmers, who also possess firearms and have the avowed intention of warding off the incursions by the herdsmen by attacking and killing the

herdsmen and their cows. The herdsmen, in turn, also kill some of these local militias. The environment is thus populated with these murderous agents who move randomly within the landscape and incessantly engage in internecine confrontations. During these confrontations, the cows may be killed by the farmers and the militias but may also die naturally due to inadequate pasture to graze upon which may result from the scorched-earth policy sometimes practiced by the herdsmen that leaves the environment severely degraded [9 & 29].

In this chaotic world of the agents, the military (which here is a generalization of members of the Armed Forces and the Police since their roles in the conflict appear to be the same) intervenes, ostensibly, to quell the crisis, although, as sometimes reported, may have favorable disposition towards either the herdsmen or the farmers thus aggravating the situation further [7 & 9].

In the model, the herdsmen have the turtle shape of black wolves; the farmers have the shape of yellow persons; the military have the shape of persons in red and green colors; the militias have the shape of persons in red, white, and grey colors; and the cows have the shape of cows in white color. The combined population of the indigenous people of the Middle Belt states is more than 25 million [31]; the population of the herdsmen in this area is estimated to be 1.5 million while the cattle number more than 4 million [6]. In order to be able to accommodate these large numbers in the model the population of these agents have been proportionately scaled down to reasonable values.

## **Simulation Scenarios**

It is ideally desired that the herdsmen and farmers live together in peace and harmony with neither party possessing firearms and with little violent interactions between them. This situation will perhaps lead to a stable, regenerative ecosystem that may need no further investigation. The interest of the researcher has been kindled by the fact that the herdsmen and farmers possess firearms which leads to violent interactions between them. It is important to evaluate the consequences of these interactions for three possible herdsmen-farmers firepower conditions when:

- (i) The herdsmen have superior firepower to the farmers.
- (ii) The herdsmen have as much firepower as the farmers.
- (iii) The herdsmen have firepower that is inferior to that of the farmers.

The following scenarios are thus of interest to the research questions:

- (a) Herdsmen, farmers, and cows move around the world with the herdsmen and farmers possessing firearms for each of the three possible herdsmen-farmers firepower conditions.
- (b) Herdsmen, farmers, militias, and cows move around the world with the herdsmen, farmers, and militias possessing firearms for each of the three possible herdsmen-farmers firepower conditions.
- (c) Herdsmen, farmers, military, and cows move around the world with the herdsmen, farmers, and military possessing firearms for each of the three possible herdsmen-farmers firepower conditions and with the military disposed towards aiding the herdsmen or the farmers in the conflict.
- (d) Herdsmen, farmers, military, militias, and cows move around the world with the herdsmen, farmers, military, and militias possessing firearms for each of the three possible herdsmen-farmers firepower conditions and with the military disposed towards aiding the herdsmen or the farmers in the conflict. The effect of the presence of the local militias is also taken into consideration. This is the complete model that examines the participation of all the agents in the conflict.
- (e) Each of the models (a) to (d) is finally re-examined to consider the effect of "agenticide" i.e. the situation in which the farmers kill each other as a result of communal clashes.

The description of the behaviors of the agents in this section represents the pseudo-code for the

program that has been developed in the NetLogo environment.

## RESULTS

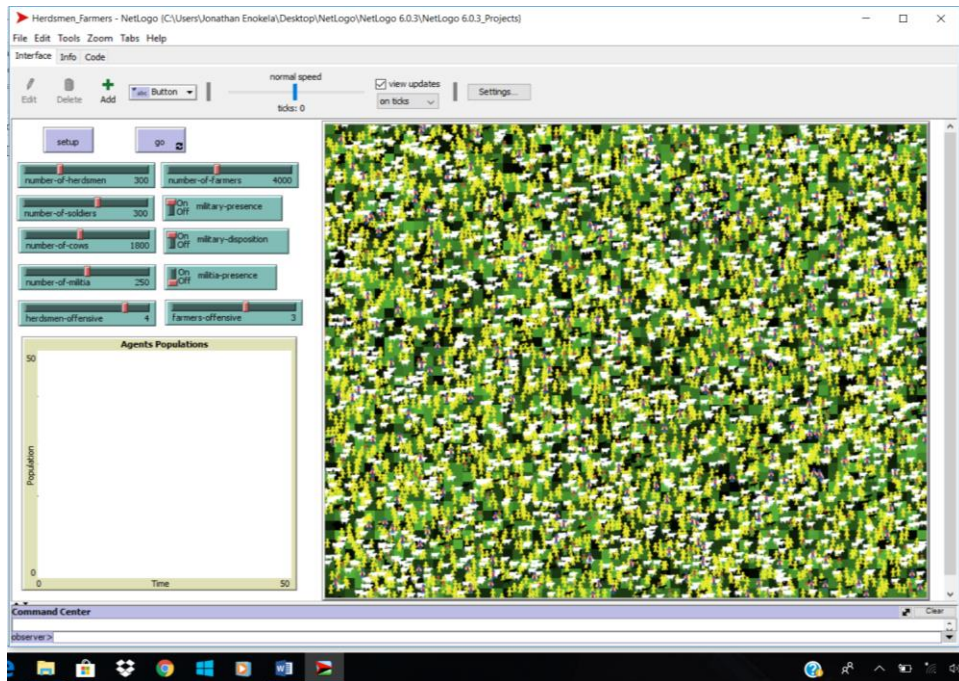
The results of the simulations are shown in Figures 2 to 9. Figure 2 shows the complete NetLogo interface with the initialization of the agents. Figures 3 and 4 show the results when the herdsmen and farmers only are engaged in the conflict. Figures 5 and 6 show the results of the intervention of the military in the conflict. Figure 7 shows the intervention of the local militias while Figures 8 and 9 show the involvement of all the agents in the conflict.

## DISCUSSION

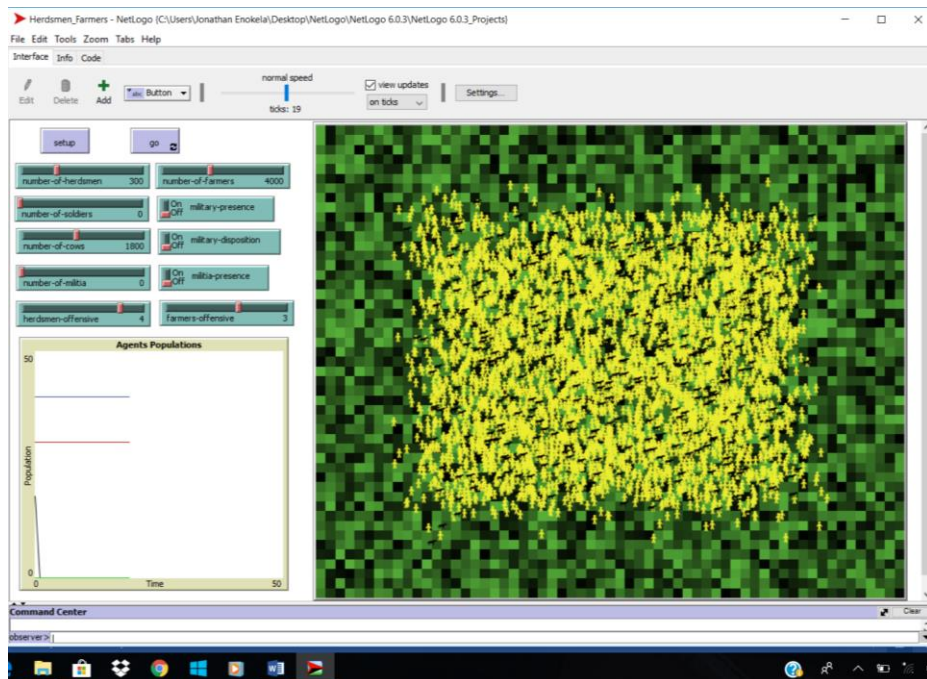
It can be seen from the simulation results that consistent and surprising patterns emerge. Figures 3 and 4 show the patterns that emerge irrespective of whether the party of the herdsmen or farmers has the superior firepower, as long as both parties are armed. These figures show that there is a gradual but total depopulation of the combatants from the countryside (Figure 3).

As the conflict lingers, the relentless chase of each other by the combatants will result in final mutual annihilations at the center of the world, probably in a city center where there will be intense final-stand battles (Figure 4). Thus there will indeed be no victor and no vanquished in this conflict if the herdsmen and the farmers are left alone to slug it out. The black patches that dot the landscape indicate lands that have been degraded as a result of the conflict.

The intervention of the military changes the nature and outcome of the conflict. Figure 5 shows the result when the military is favorably disposed to aid the herdsmen. In this situation the farmers are very quickly annihilated, and the farmlands are reduced to a charred environment, as the black patches show. The result when the military's support swings in favor of the farmers is shown in Figure 6. Under this condition, the herdsmen are beaten back in defeat while the farmers rapidly increase in number. The population count of the agents indicates that the military itself sustains some degree of loss irrespective of which camp it favors.



**Figure 2:** NetLogo Interface with Agents Initialized.



**Figure 3:** Herdsmen-Farmers Only; Intermediate Result.

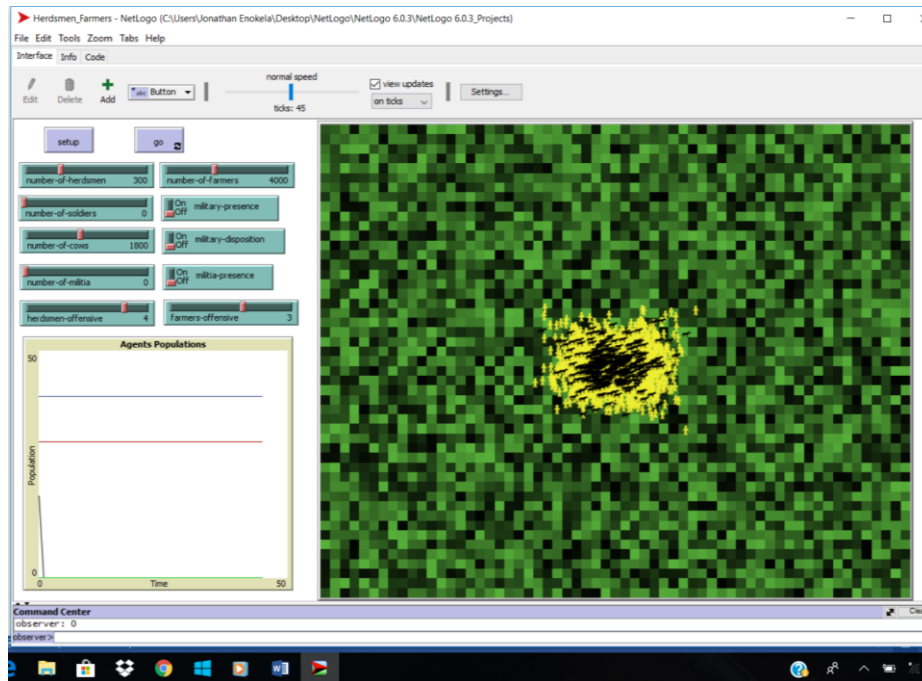


Figure 4: Herdsmen-Farmers Only; Final Result.

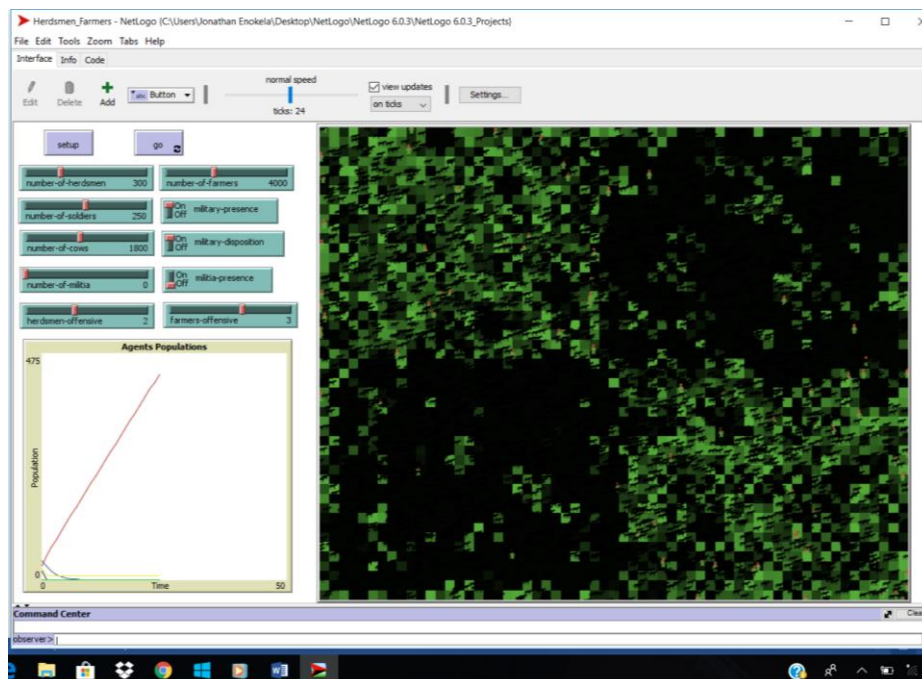


Figure 5: Result of Military Intervention that Favors Herdsmen.

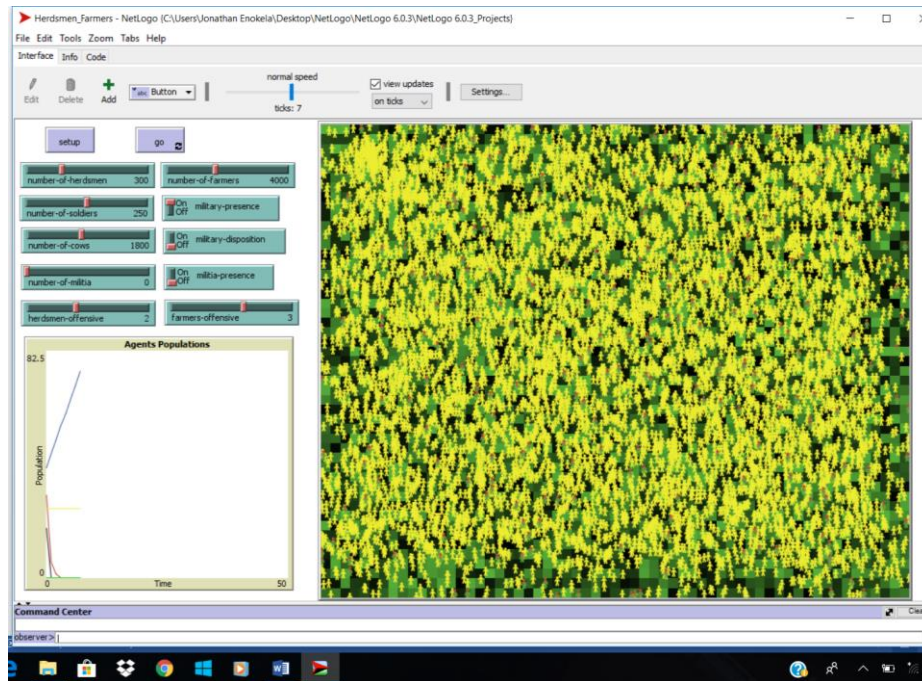


Figure 6: Result of Military Intervention that Favors Farmers.

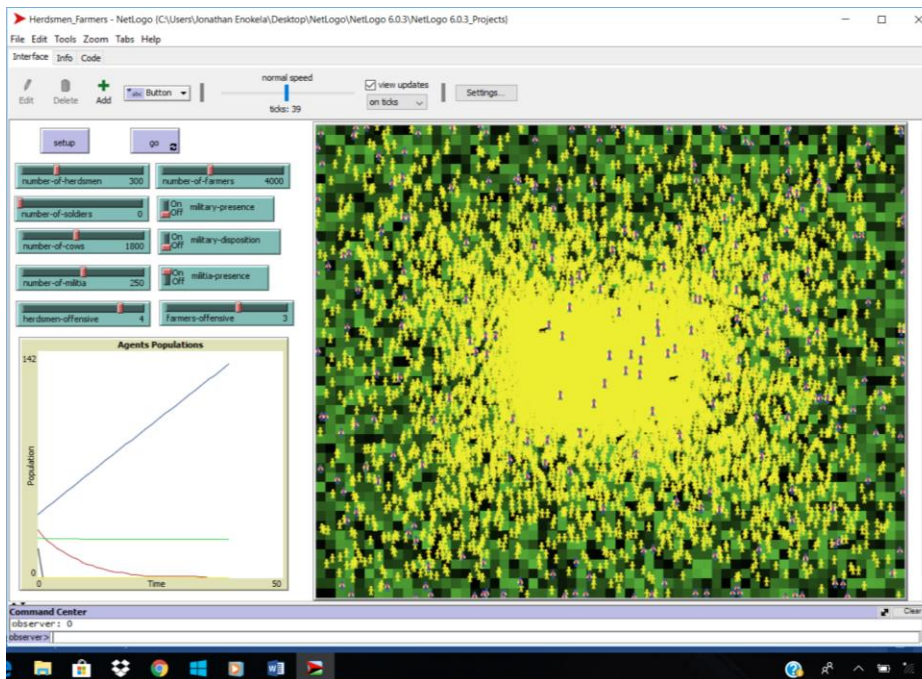
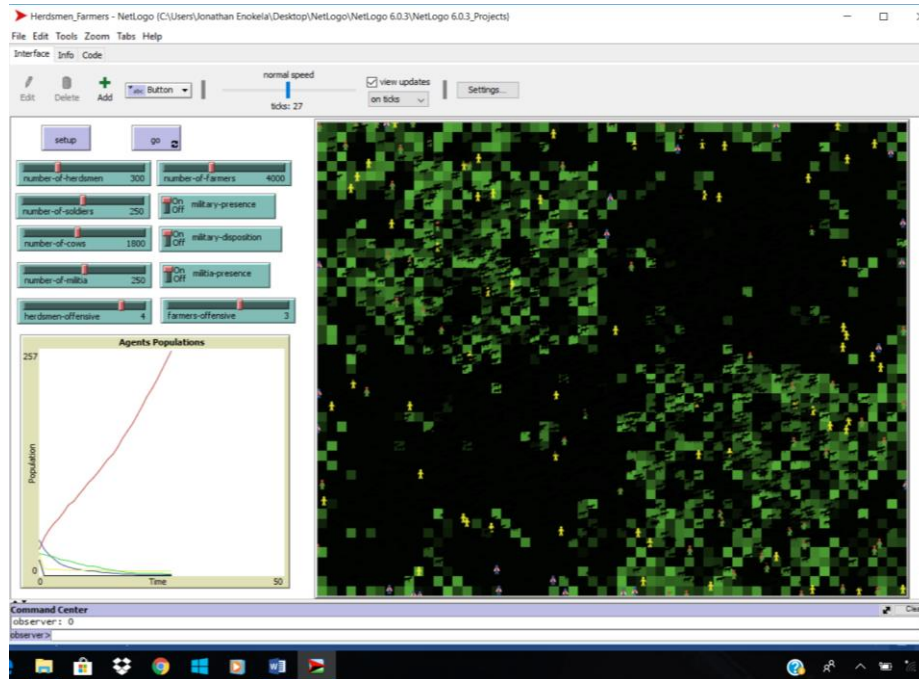
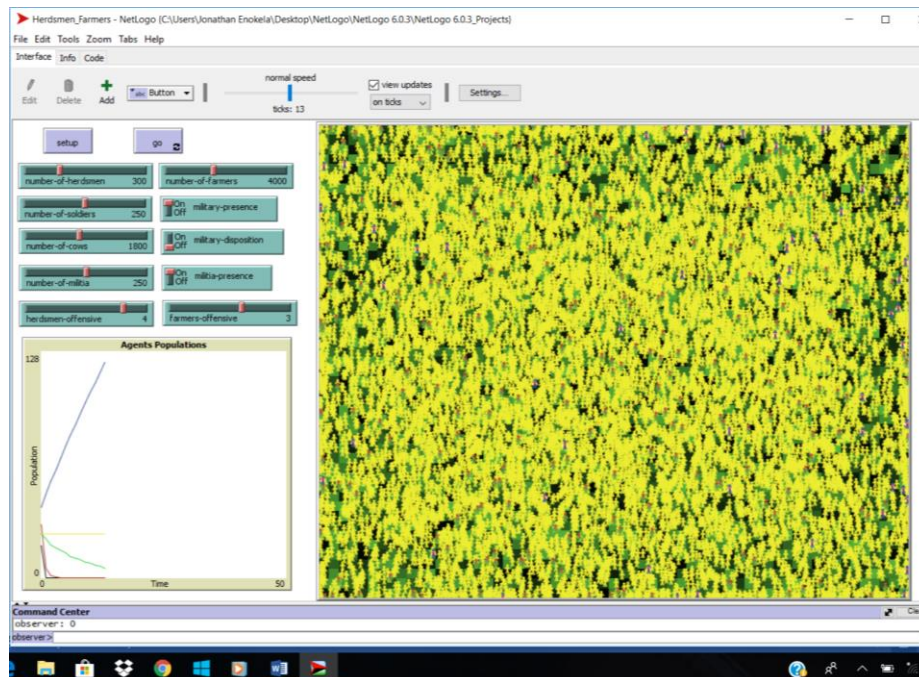


Figure 7: Result of Intervention of Local Militias.



**Figure 8:** Result with all Agents: Military Favoring Herdsmen.



**Figure 9:** Result with all Agents: Military Favoring Farmers.



The result of the intervention of the local militias in the conflict (in the absence of the military) is shown in Figure 7. This intervention increases the firepower of the farmers considerably resulting in a boom in the population of the farmers and a severe reduction in the population of the herdsmen.

Perhaps by far the most interesting scenario is obtained when all the agents (herdsmen, farmers, military, militias, and cows) participate simultaneously in the conflict. The result, with the military in full support of the herdsmen, is shown in Figure 8. This shows a reduction in the population of the farmers and militias and an increase in the population of the herdsmen. The farmlands are severely degraded.

Figure 9 shows the result when the military favors the farmers, with the participation of all the agents. This result shows a severe reduction in the number of herdsmen while the farmers rapidly increase in number.

The case of communal clashes resulting in agenticide is then taken into account in each of the simulations. The nature of the results remains essentially the same for each situation except that there is a drastic reduction in the number of farmers in each case.

Finally, it is seen from all the figures that the cows become rapidly extinct as a result of them being killed by both the farmers and the militias.

## CONCLUSION

In this work a predictive computer model that mimics the interactions of the agents involved in the herdsmen – farmers conflict in North Central Nigeria has been developed. The result shows the uneasy nature of this conflict. The authorities and all other actors are urged to have a re-think in their strategies for handling the crisis as it may result in terrible humanitarian and environmental consequences. The herdsmen and the farmers must be disarmed before any meaningful negotiations can take place.

Politicians play a great role in this crisis. They control the military and the local militias. They overtly or covertly support the herdsmen and the farmers through their utterances, and other means. The model has been realized only for agents who physically participate in the crisis.

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