



**FACOLTÀ
ECONOMIA
TORINO**

Report on Netlogo project:

Microcredit and child labour in a rural village

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1. Introduction to model

I

Our model is an attempt to analyse the effect of microcredit on child labour of a small village in a developing country.

The microcredit represents a way to make credit available to the families in third world, thus these loans represent an aid for people in difficulty, but their presence may affect the hours of child labour of children living with their parents.

Whereas theoretical models commonly predict a negative relation between credit and child labour, microcredit may increase child work in families with particular characteristics.

We aim to monitor the way microcredit loans influence child labour among different kinds of families combined with particular environmental characteristics.

The children of our model divide their time among leisure, school-attendance, domestic work and economic work.

We will consider three types of families in our model:

- *Landowner families*: they represent the rural population and are mostly involved in agricultural activity. In general these families live isolated from the village, thus the information reaches them with difficulty and they are not affected by imitative behaviour. These families are more likely to make their children work instead of sending them to school since they are less sensitized to the child labour problem given the low level of education that usually characterize this category.
- *Entrepreneurial families*: this category represents the part of population of the village that carries out its own activity. They tend to be wealthier and educated, for these reasons they are more willingness to send their children to school.
- *Employed families*: they represent the share of population hired by other families; they also are likely to live in the village with a medium standard of life and to have an imitative behaviour towards the other better off population.

In the society can be present different environmental characteristics that influence in different ways the behaviour of the population:

- *Education*: it is an important tool to reduce the child labour problem, for this reason, we expect that a higher level of education is associated with a lower level of child labour.
- *Information*: it is a key element in order to sensitize people about the negative effects of child labour and the importance of education.

- *Microcredit loan*: an access to microcredit loans gives the possibility to the family to expand their activity and so this is likely to enhance the use of children as a labour force. In particular the landowner families tend to use their children into domestic works and especially into their economic activity.

The entrepreneurial families usually make use of their children for their domestic work since they are busier with their own activity.

The effect should be ambiguous for the last category as they can have different reactions to the microcredit.

- *Expenditure*: in developing countries this variable measures the level of wealth of a family. The level of expenditure is very important to the head-household decision in taking advantage of the use of their children into their economic activity. Generally there exists a given threshold above which expenditure level has a negative effect on the child labour.

2 Implementation of the model

2.1 description of program

The model starts with the village divided in the three categories:

- Landowner families own 120 children
- Entrepreneur families own 50 children
- Employer families own 80 children

At the beginning the information about the problem of child labour is not present in the village; the user can introduce it, when this happen the information reaches first the entrepreneur families, than the employer and lastly the landowner families, since they are most isolated. We represent this variable with an agent that go household by household to sensitize about child labour problem.

The education, instead, is already present in the village with different levels among the categories and it is accessible to everyone.

Every category starts with a given level of income: on average entrepreneur families are the richest ones, the employed and landowners compete in the level of income that is very similar to each other, but the latter one tends to be the poorest.

The user can change the level of wealth in the village, but the proportions among the families stay unchanged. Even if it is not visible there is a threshold below which a family is considered poor and

child labour represents a significant help in the economy of the family, instead above the threshold the household does not need the aid of children at the same level as before.

In our model, microcredit loans are given randomly to all the families, at least you choose to direct it to a particular kind of family.

The model is beat in a period of time long enough to understand the effects of microcredit and information on the child labour phenomena. In particular, one tick represents 2/3 months.

According to these variables, the categories of families have different behaviour:

- *Landowner families*: when this category access to microcredit loans the use of children in domestic work and in particular economic work increases substantially.
Since they live in the rural area near the village, the information tends to reach them later and they are not subject to imitative behaviours. Even if information reaches them, they are not very sensitized to the child labour problem. This category starts with a low level of expenditure, which is in general below the poverty threshold. If the user increases the level of income in the model the child labour will decrease only when such income overcomes the threshold.
- *Employed families*: in general, when the microcredit agent reaches them, they tend to start their own activity, for this reason the child labour tends to increase, in fact they employ their children in the new activity. Anyway the result can be ambiguous according to the level of information present in the village. We expect that these families are not going to increase so much the economic and domestic work of children in the case where their income is already relatively high. Moreover, if information is more present in the village, this expectation is more likely to happen, even because they tend to have an imitative behaviour towards the better off people. This category is peculiar because it can be influenced by the entrepreneurs' behaviour. In fact, as the information agent or the banker reaches this category, the workers tend to imitate the change in the behaviour of entrepreneurs. There is also the special case in which workers with higher income and higher education level become entrepreneurs.
- *Entrepreneur families*: they are the more educated and rich families, for these reasons they tend to be not very affected by the microcredit variable, which may increase domestic work of children because the parents are busier with their activity. Although it is not the school attendance to decrease, the children will tend to use their leisure time to work instead of studying. For what concerns the information, they are the first to receive it and so they are very sensitized to child labour problems.

According to the distribution of microcredit that the user gives to each category, we can imagine three different situations:

- *Microcredit is more accessible to the landowners*

We expect that the child labour increases considerably in this category. This is given by the fact that they are more isolated and, even if the information is enhanced in the village, it takes more time for them to be impacted by such variables. This is related even with the activity that they deliver (agriculture needs more workforce and households do not need high skill labour in order to execute this kind of activity) and the background of the family (usually they are less educated and tend to pass this characteristic to their children). For this reason, even if both domestic and economic works will increase, the effect is more significant for the latter one. When the information, and the income increase, the positive effect on child labour is less remarkable but, at the same time, these variables do not have a great power on the phenomena.

In this situation, entrepreneurs and employed families keep their normal life, in few words they are not affected by the changes in the landowners' standard of life.

- *Microcredit is more accessible to the entrepreneurs*

We do not expect to see big changes in this category. We think their behaviour is not going to be contradictory with the tendency they follow in a normal situation. Anyway, as we discussed above, since they are going to be busier with their activity, as a response to the microcredit loan access, domestic work has the tendency to fill the children's leisure time.

Since, in general, they are more sensitized to child labour and will not hire children in their activities, even when the information is not present in the village.

In the meantime the employed are likely to imitate the entrepreneurs' behaviour and culture. For this reason it is possible that they are going to reduce child labour force and to give more importance to the education. Instead this is not going to happen with landowners' category that is immune to the imitative behaviour.

- *Microcredit is more accessible to the employed.*

The effect is ambiguous since they can act in different ways according to the behaviour of the entrepreneurs and the value of information in the village. In general microcredit allows this cluster to start their own activity and therefore to employ their children. The effect changes when the information is present, since the category imitates the entrepreneurs' behaviour, turning to be more sensitized to the child labour problem. Another possibility is that they use less child labour when the user increases the wealth of the village (this happens only when the poverty threshold is overcome).

The behaviour of the employers' category does not affect the others.

2.2 Code description

Now we will expose in more detail the most interesting part of code written for the realization of the model described above.

```
globals [microcredit-on?  
information-on?  
microcredit-to-landowners-on?  
microcredit-to-entrepreneurs-on?  
microcredit-to-workers-on?  
basic-income  
counter  
time  
imit_beha_banker?  
imit_beha_inform?  
threshold  
previously-pressed?  
information-agent-die?  
firsttime?  
workerslime  
workersyellow  
]
```

Figure 1: Global assignments

Firstly we defined the global variables (figure 1). They can be read and set at any time by any section of the code and this allows to track the changes that affect our simulation world, such as the presence of microcredit and information in the village. The ease of accessibility is of great help principally when dealing with the presence of microcredit in the different categories in the model (“microcredit-to-landowners-on?” “microcredit-to-entrepreneurs-on?” “microcredit-to-workers-on?”) and when dealing with the imitative behavior of workers when the banker or the information agent (or both of them) goes to the entrepreneurs' family (“imit_beha_banker?” “imit_beha_inform?”).

Among the others, the variable named “threshold” defines the level of income needed for a turtle of a category to improve its conditions.

Further on, the variable named “basic-income” stores the approximate value of wealth that the three categories of families start with.

The other variables are helpful in order to execute the code.

```

landowners-own [ income
                 landowners-information-agent-contact?
                 landowners-banker-contact?]

entrepreneurs-own [ income
                   entrepreneurs-information-agent-contact?
                   entrepreneurs-banker-contact?
                   well-off]

workers-own [ income
             workers-information-agent-contact?
             workers-banker-contact?
             well-off]

```

Figure 2: breed-own assignments

Secondly we defined the variables (figure 2) that are owned by each of the three breeds: entrepreneurs, landowners and workers.

Great attention is deserved to the variable named “well-off” that, as a boolean variable, it can assume 2 values (0,1). When well-off is equal to one it identifies the workers with income higher than the threshold and with higher education. This allows us to move these workers to the entrepreneurs’ family when the model runs the go procedure. It is also interesting to note the true/false variable that is named “landowners-information-agent-contact?”; when it is true, it means that the information agent has met the landowners’ family and they are affected by information: we can see this effect through the change in the color of each landowner (the same happens for entrepreneurs’ and workers’ family). The other true/false variable, “landowners-banker-contact?”, works in the same way explained for “landowners-information-agent-contact?” but it refers to the banker instead of the information agent.

The last, “income”, is the outcome of the sum between basic income and a random number picked up in the range of a defined basic income percentage ($basic\ income + random(basic\ income * 0.1)$, for example). In this way we obtain in each family a random distribution of the income among the turtles of that family.

Then we populate the world with the setup procedure.

It creates landowners' family, entrepreneurs' family and workers family coloring the patches placed in 3 different corners of the screen with 3 different colors. This is implemented through “setup-landowners-family” “setup-workers-family” “setup-entrepreneurs-family”.

“setup-turtles” creates the turtles: workers, entrepreneurs and landowners, it places them randomly within their respective family.

In order to color the turtles in each family we use “color-landowners” / “color-workers”/ “color-entrepreneurs”.

Each turtle of the three families owns a basic-income and its value depends on the value set by the slider of wealth (“set basic-income wealth”).

```
to setup
  ca
  set microcredit-on? false
  set information-on? false
  set microcredit-to-landowners-on? false
  set microcredit-to-entrepreneurs-on? false
  set microcredit-to-workers-on? false
  set basic-income wealth
  set counter -1
  set time 10
  set threshold 200
  set firsttime? true
  set previously-pressed? false
  set information-agent-die? false
  setup-turtles
  ask patches [setup-landowners-family
               setup-entrepreneurs-family
               setup-workers-family]

  color-landowners
  color-entrepreneurs
  color-workers
  increase-wealth
  do-plots
  reset-ticks
end
```

Figure 3: setup procedure

We can see from the figure 3 that, in the initial situation, the microcredit and information variable are inactive (false).

It is interesting to analyze the creation of banker through the procedure “microcredit” that is linked to the respective button in the interface: as we can see in the setup, the model starts with “microcredit-on?” false.

```
to microcredit
  ifelse microcredit-on? = false
  [set microcredit-on? true
   set-default-shape bankers "person business"
   create-bankers 1 [set size 2.0
                    set color red]]
  [set microcredit-on? false
   set microcredit-to-workers-on? false
   set microcredit-to-entrepreneurs-on? false
   set microcredit-to-landowners-on? false]
  set previously-pressed? false
  ask bankers [die]
  ask workers [set workers-banker-contact? false
              set imit_beha_banker? false]
  ask entrepreneurs [set entrepreneurs-banker-contact? false]]
end
```

Figure 4: microcredit setup

In figure 4 we see that, when the user clicks on the button microcredit, the procedure sets “microcredit-on?” true and creates the turtle banker with specific shape, size and color.

When the user clicks again the button the banker dies and his effect on entrepreneurs and workers does not persist anymore, so they return to their previous situation (“set workers-banker-contact? false”, “set imit_beha_banker? false” and “set entrepreneurs-banker-contact? false”). We note that it is not the same for the landowners, because for this category the microcredit’s persistence is high and so once they have obtained the microcredit loan they tend to maintain the new status even when the microcredit disappears.

In particular, as we also see in figure 3, “microcredit-to-landowners-on?”, “microcredit-to-workers-on?” and “microcredit-to-entrepreneurs-on?” are initially set false. Clicking one of their corresponding buttons (microcredit-to-landowners, microcredit-to-entrepreneurs and microcredit-to-workers), the true/false variable turns true and the banker goes, directly, to the corresponding family.

The Go procedure , in accordance with what specified by the user regarding the level of wealth, the presence of microcredit and/or the information in the village, define how the turtles have to behave.

```
to go
  move-workers-once
  do-plots
  move-bankers
  move-information-agents
  start
  tick
end
```

Figure 5: Go procedure

“move-bankers” procedure makes the banker move according to the button chosen by the user. The “start” procedure colors landowners and entrepreneurs in base of the true/false variables: “landowners-information-agent-contact?”, “entrepreneurs-information-agent-contact?”, “landowners-banker-contact?” and “entrepreneurs-banker-contact?”.

The workers are colored depending on their contact with banker and/or information agent, similarly to entrepreneurs and landowners, and also according to the imitative behavior with respect to the entrepreneurs’ contact with information-agent and/or the banker.

It is interesting to analyze the “move-information-agents” procedure, which makes the information-agent move following a specific scheme: it has to move firstly to the entrepreneurs’ family, after 10 ticks it leaves entrepreneurs’ family and moves to the workers’ family and again after 10 ticks it moves to the landowners’ family. We have chosen this scheme because the entrepreneurs are the most sensitized to the information, in particular to child labour phenomena, and the landowners are

less affected by the information, given their lowest level of education and their attitude to make use of child labour. In the figure below we see that if there is any information-agent on the patches with color black and the counter is set as in the setup procedure (counter= -1), the information-agent moves to entrepreneurs' family and the counter is set equal to zero. Since the counter is smaller than the time (that is a global variable and into setup we defined time = 10) the counter starts to increase by one and until the counter reaches the value of time (10) the information-agent stays on the same family. When counter is equal to time the information-agent moves to the workers family and then the counter is set equal to zero. From this moment the procedure is repeated again as we explained above.

At the end it reaches landowners' family and after 10 ticks the information-agent goes to one of patches with color black.

Right now the true/false variable "information-on?" is true. If the user clicks again the button information, the information-agent dies and sets the counter equal to -1. In this way we return in the situation of setup, and every time that the user clicks the information button the information-agent follows this chain of commands.

```

to move-information-agents
  if information-agent-die? = false and information-on? = true
  [
    set counter -1
    set information-agent-die? true
  ]
  if any? information-agents-on patches with [pcolor = black] and counter = -1
  [ask information-agents [move-to one-of patches with [pcolor = sky - 3]]
  set counter 0
  ]
  if any? information-agents-on patches with [pcolor = sky - 3] and counter < time
  [set counter (counter + 1)]
  if any? information-agents-on patches with [pcolor = sky - 3] and counter = time
  [ask information-agents [ move-to one-of patches with [pcolor = magenta + 3]]]
  if any? information-agents-on patches with [pcolor = magenta + 3] and counter = time
  [set counter 0]
  if any? information-agents-on patches with [pcolor = magenta + 3] and counter < time
  [set counter (counter + 1)]

  if any? information-agents-on patches with [pcolor = magenta + 3] and counter = time
  [ask information-agents [ move-to one-of patches with [pcolor = brown]]]

  ask landowners [set landowners-information-agent-contact? true]]

  if any? information-agents-on patches with [pcolor = brown] and counter = time
  [set counter 0]
  if any? information-agents-on patches with [pcolor = brown] and counter < time
  [set counter (counter + 1)]
  if any? information-agents-on patches with [pcolor = brown] and counter = time
  [ask information-agents [ move-to one-of patches with [pcolor = black]]]
  if any? information-agents-on patches with [pcolor = black] and counter = time
  [set counter 0
  ask landowners [set landowners-information-agent-contact? false]]
end

```

Figure 6: move information agent procedure

“move-workers-once” (figure 7) is another significant procedure that allows the movement of workers with higher level of education (all those that are colored in yellow and lime + 3) and with a level of income higher than the threshold, from their family to the entrepreneurs’ family. This way they acquire the same behavior of the entrepreneurs but maintain a higher level of income. In order to obtain this outcome we use a trick into the procedure. In fact we first kill these particular workers and then we create a number of entrepreneurs into the entrepreneurs’ family equal to the number of dead workers, with the same parameters of the dead workers.

```

to move-workers-once
set workersyellow (count workers with [well-off = 1 and color = yellow])
set workerslime (count workers with [well-off = 1 and color = lime + 3])
ask workers with [well-off = 1] [die]
  create-entrepreneurs (workersyellow) [set well-off 1
    ask entrepreneurs with [well-off = 1] [set color yellow]
    set size 1.0
    setxy ((random -10)+ 16) ((random 10)+ -16)
    set income 230
    set entrepreneurs-banker-contact? false
    set entrepreneurs-information-agent-contact? false
    set imit_beha_banker? false
    set imit_beha_inform? false]
  create-entrepreneurs (workerslime) [set well-off 2
    ask entrepreneurs with [well-off = 2][set color lime + 3]
    set size 1.0
    setxy ((random -10)+ 16) ((random 10)+ -16)
    set income 230
    set entrepreneurs-banker-contact? false
    set entrepreneurs-information-agent-contact? false
    set imit_beha_banker? false
    set imit_beha_inform? false]
end

```

Figure 7: move workers once

In the code we create the global variables “workersyellow” and “workerslime” which count workers with well-off=1 (it is a variable that can assume only two values: 0 and 1: it is equal to one when the workers have the income greater than the threshold and a high level of education) and color respectively yellow and lime + 3.

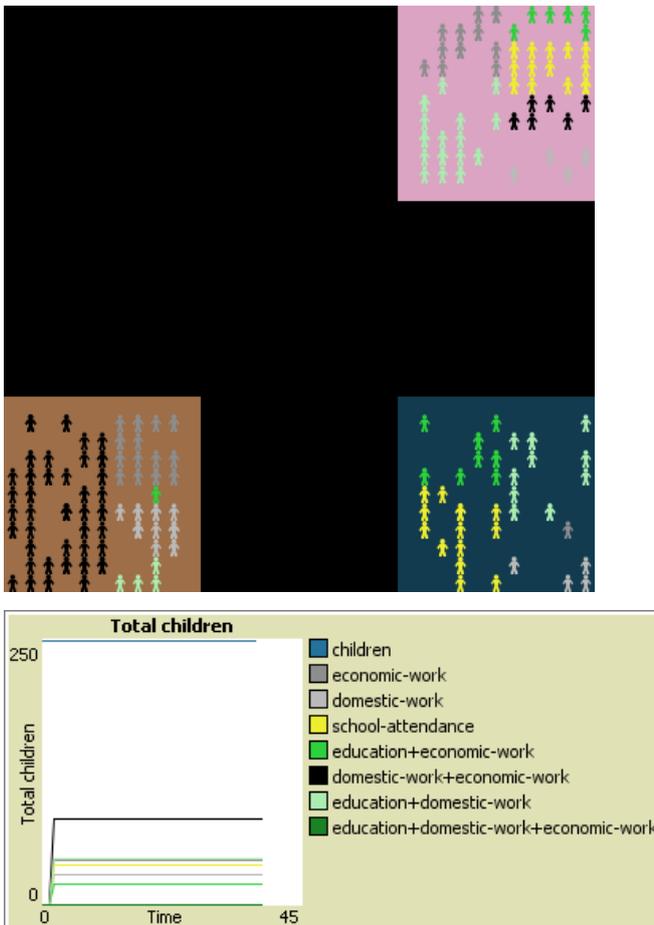
“ask workers with [well-off = 1] [die]” makes these workers die. The next commands, following the creation of entrepreneurs in the setup, create the correspondent entrepreneurs with color yellow and with color lime + 3, specifying their higher level of income and education.

3. Plan of experiments and results

3.1 Initial situation

In the picture below we can see the initial working/schooling status of the children, for the three categories in our model, when the income is under the threshold:

- **entrepreneurs:** 30% school attendance; 20% education + economic work; 35% education + domestic work; 15% domestic work;
- **workers:** 20% economic work; 30% education + domestic work; 20% school attendance; 10% economic work + domestic work; 10% education + economic work;
- **landowners:** 60% economic work + domestic work; 20% economic work; 2% education + economic work; 3% education + domestic work; 15% domestic work;



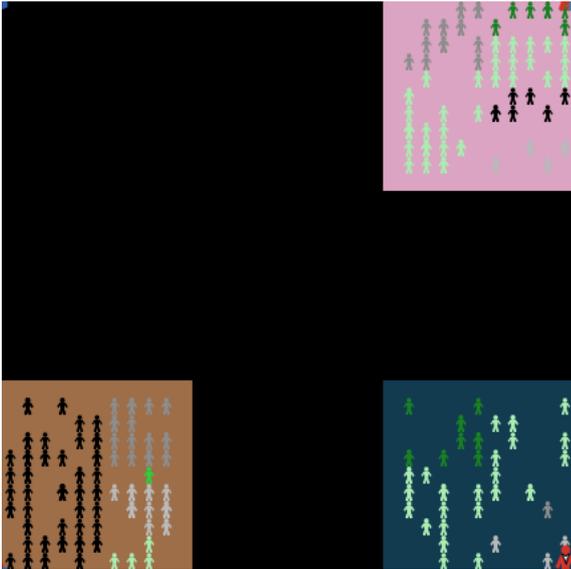
Given the starting situation we are going to make some expectations about what can happen to each category given certain conditions and variable interaction.

When the variables of microcredit and information are combined together, we activate first the information agent and then the banker.

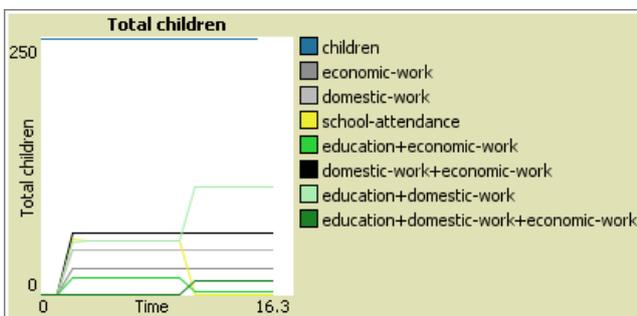
3.2 Entrepreneurs

· *Microcredit plus information*: since this category is the more sensitized and the microcredit does not have a big negative effect, we expect the information to have a higher impact when both the variables are on. For this reason, we expect that the children situation after the interaction between the variable will be a little better than the initial situation.

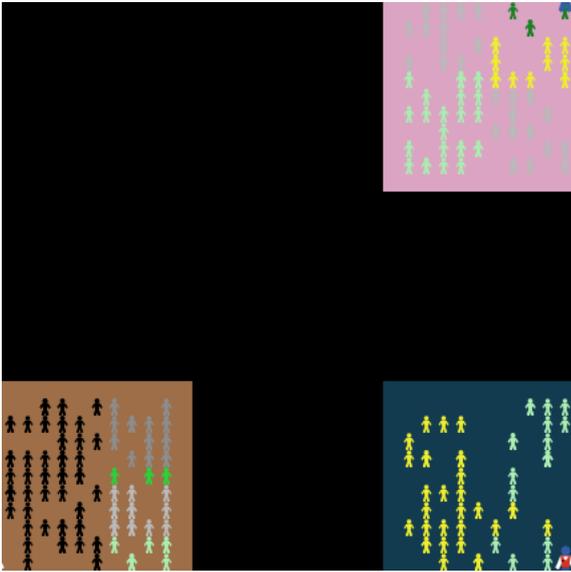
– MICROCREDIT



From the picture we can see the effect of the microcredit when it acts alone on this category. It brings a decrease in the education of the children of this category and an increase of the domestic work. In fact in the new situation we have 80% of the children engaged in education + domestic work; 10% in domestic work and 20% in education + domestic work + economic work. These changes are visible by the chart below.



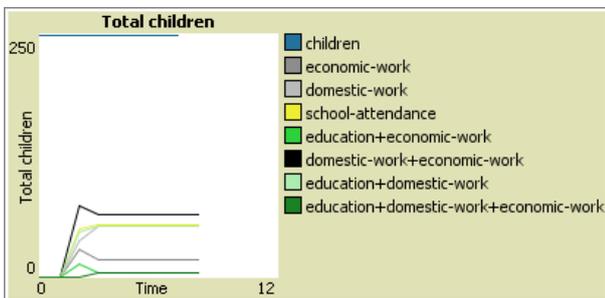
- INFORMATION



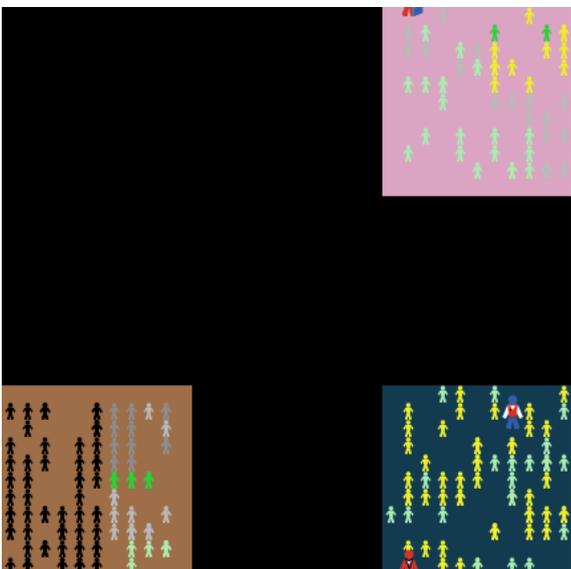
The effect of the information is instead negative on the economic work.

From the results we can see that there is a drop in economic work and education + economic work.

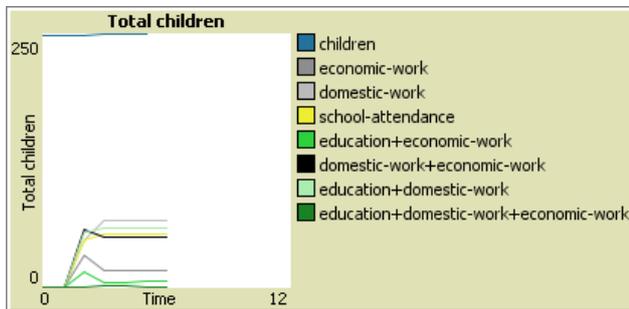
The new situation we have is 70% school attendance and 30% education + domestic work.



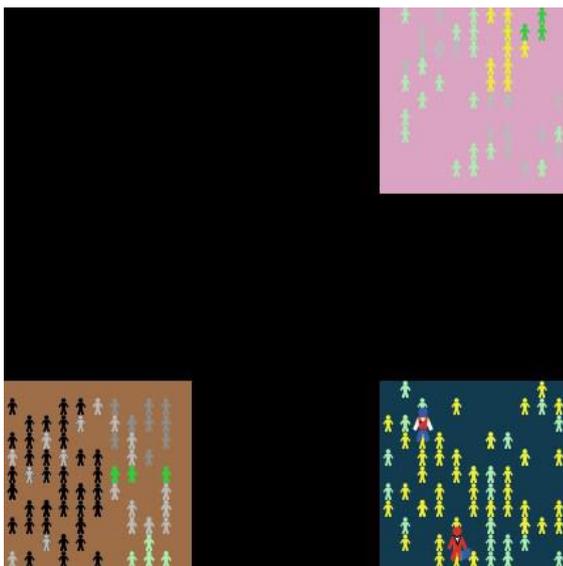
-MICROCREDIT VS INFORMATION



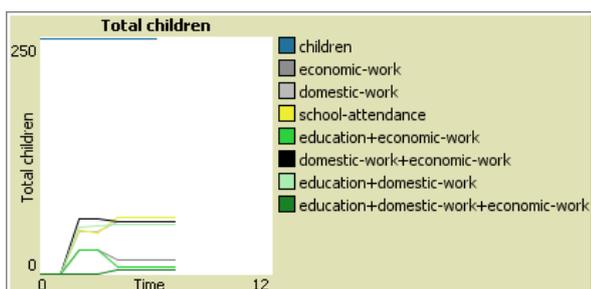
When combined together, the overall effect is highly in favor of the information that tends to have a persistent effect on the entrepreneurs. As we expected when both the variable are on, in this category, the resulting situation is 80% school attendance; 20% domestic work + education.



· *Microcredit/information plus wealth*: we expect the interaction of microcredit with wealth will not change too much according to the level of the second variable. Either if they are above or below the threshold, there won't be a big difference since they are sensible to the child labour problem anyway. Also in this case the effect won't change a lot according to the wealth situation.



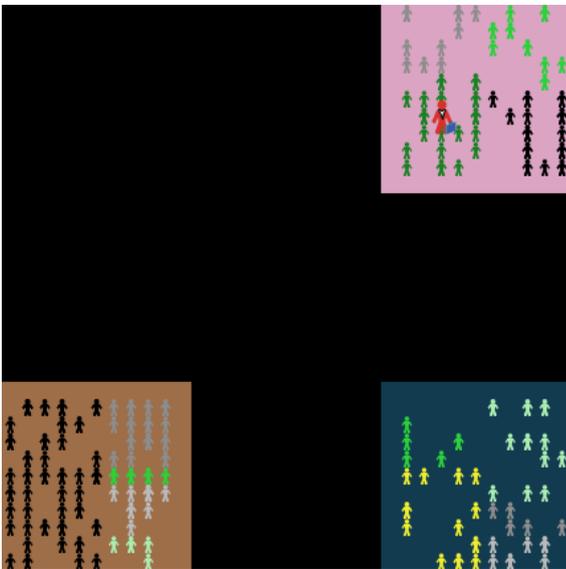
When the income overcomes the threshold the effect of microcredit and information together combined is really close to the effect of the two variables, when the income is below the threshold. The only difference is the amount of children present in the category that increased since the workers that overcome the threshold changed their status becoming entrepreneurs.



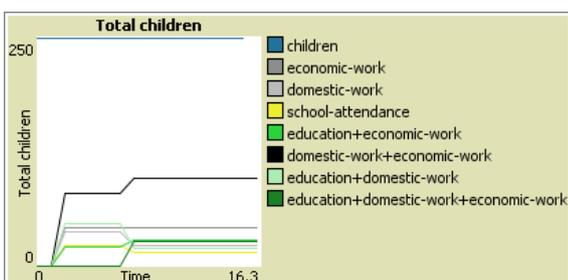
3.2 Workers

· *Microcredit plus information*: the effect is ambiguous since it depends also from their imitative behaviour. On one hand we expect the information to have a greater impact since it goes first to the entrepreneurs and then to the workers and given that they tend to imitate the former category, they will have a double effect. Instead, the microcredit can go first directly to the workers and in this case the category doesn't suffer also the "imitative effect". On the other hand, it can happen the microcredit goes first to the entrepreneurs (as the information), in this case the effect of the two variables will be contrasted at the same level, and as a result we won't have a big change.

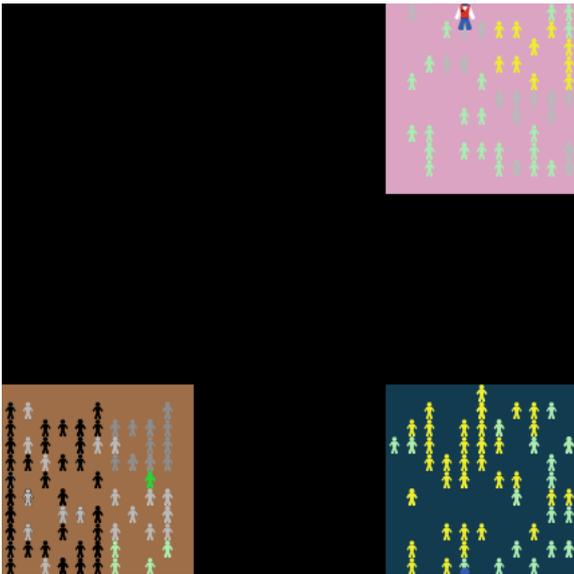
- MICROCREDIT



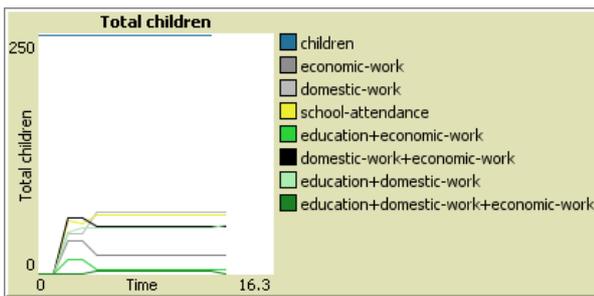
On the workers' category, the microcredit makes increase the economic work. After banker reaches this category, the situation we have is: economic work 20%, education + economic work 30%, domestic work + economic work 25%, education + economic work 25%. Children who only attended school completely disappeared.



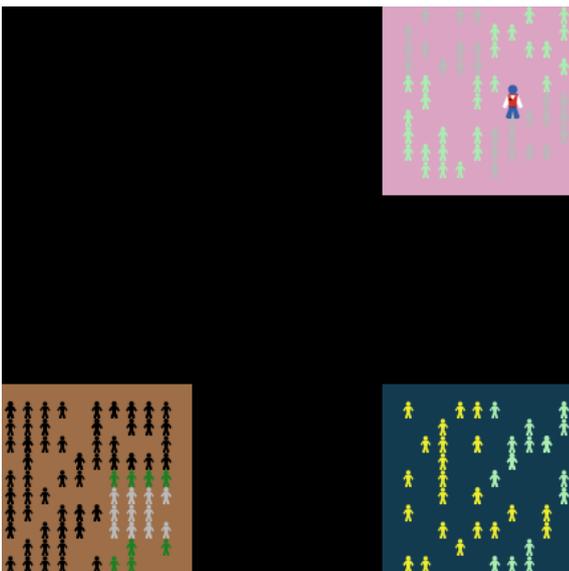
- INFORMATION



The effect of information alone, it's instead in favor of education and domestic work. We have, in fact, only 5% of economic work + education, 50% are the children belonging to the category domestic work, 10% only attend school, and 35% education + domestic work.

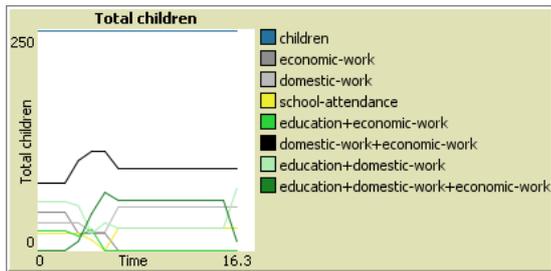


- - *MICROCREDIT VS INFORMATION*

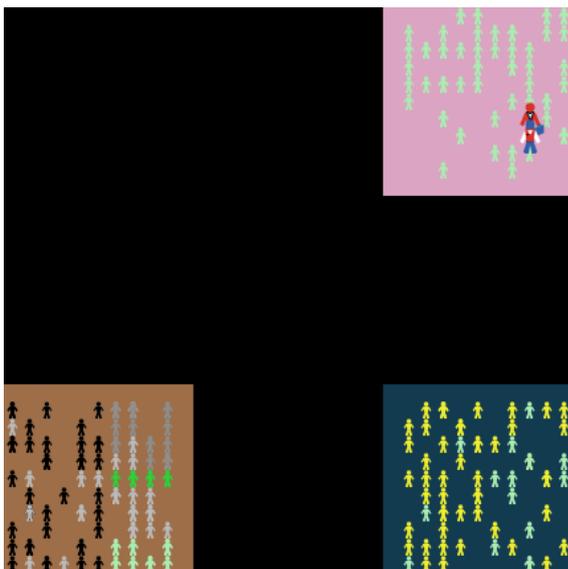


When information and microcredit are combined together they have in general a positive effect on child labour: we have 60% of children engaged in education + domestic work and 40% in economic

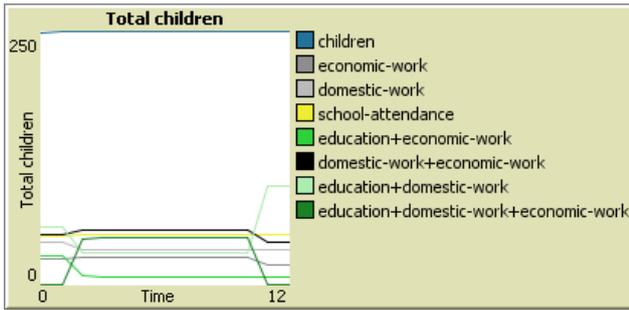
work. We can say, therefore, that the information has a more persistent effect on this category than microcredit.



· *Microcredit/information plus wealth*: when this category is below the threshold the microcredit effect is expected to be much higher compared when the category overcomes the threshold, also given the fact that some of them will move to the entrepreneurs category, changing their social status. The opposite effect is expected for the information that combined with the wealth above the threshold is expected to be much higher and below it will be lower since the workers are in a social status less sensitized to the problem of child labour.



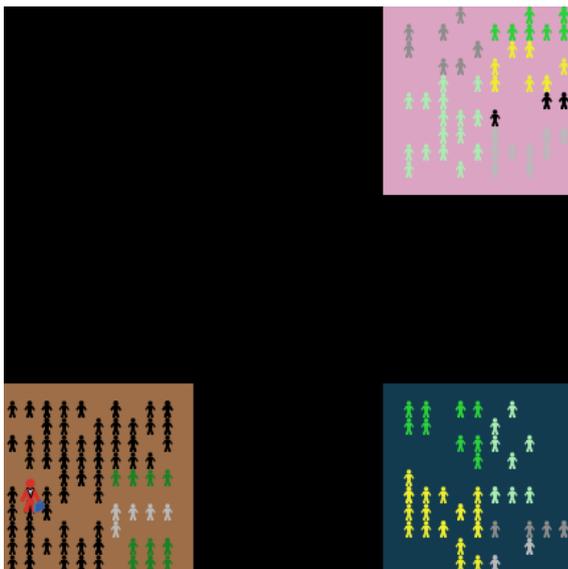
For this category what changes, once above the threshold, is that some of the workers become entrepreneurs improving their social status. The outcome of the two variables completely change when the income is above the threshold since now they are all engaged in economic-work and domestic-work.



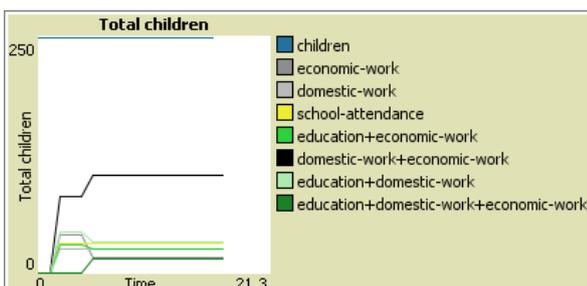
3.3 Landowners

- *Microcredit plus information*: since this category is not sensitized and the information does not have a big effect on them, we expect the microcredit overhang the other variable. When both the variables interact with this category the situation will be worse than the initial one.

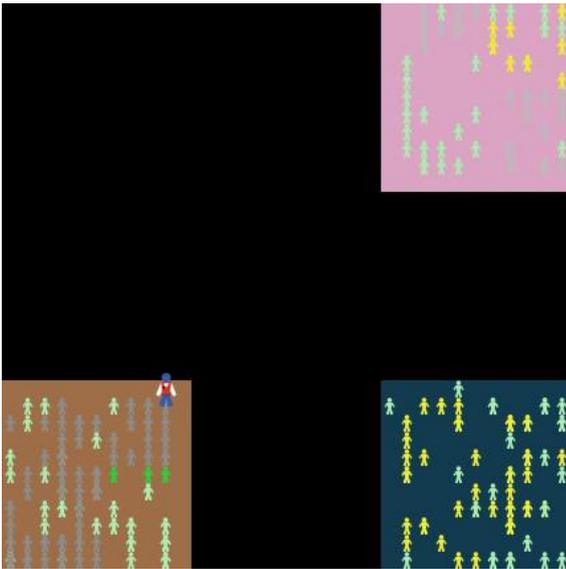
- *MICROCREDIT*



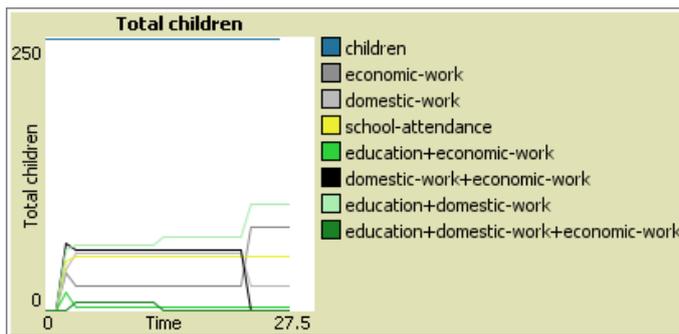
From the picture we can see that the microcredit makes increase economic work, the share of children not attending school at all and engaged in both working activities (domestic and economic) is the biggest one 70%. The children that are engaged in both activities but at the same time attend school are 20% and 10% are the children in domestic work.



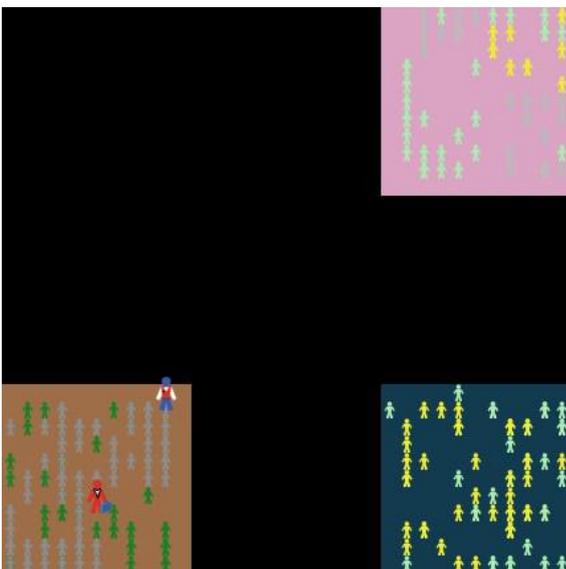
- INFORMATION



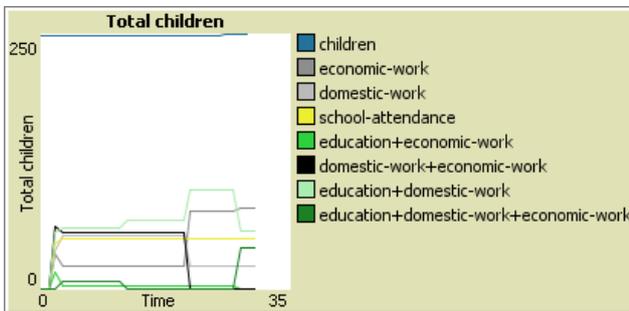
The information alone makes increase education and domestic work. 70% is the share of children engaged in economic, 20% domestic work + education and 10% education + economic work.



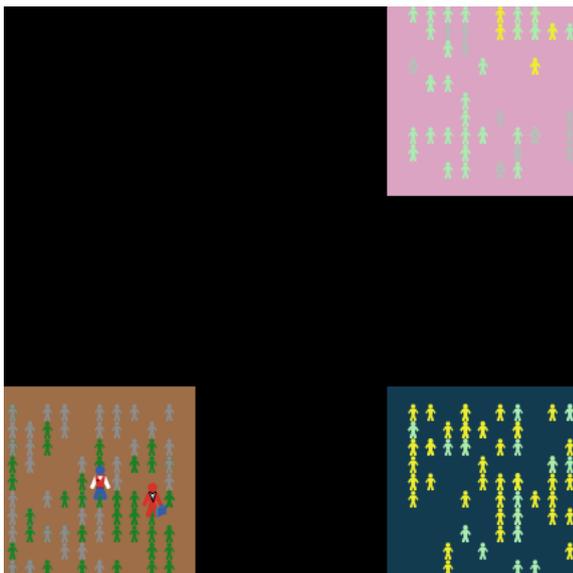
- MICROCREDIT VS INFORMATION



When combined together the 2 variable as an effect in favor of the domestic work. From the picture is possible to see that mainly children are engaged in domestic work (70%) The other 30% are domestic work + education.



· *Microcredit/information plus wealth*: for this category the possibility to overcome the wealth threshold is less likely to happen. But when it happens we expect the microcredit to have a lower impact but not with a great difference. For what concern the information, above the threshold we expect the effect to be higher but not very significant.



The effect of the 2 variables together, when the category is above the threshold, it's similar to the effect when the category is below the threshold. The new situation is 80% economic-work; 20% education + domestic-work + economic work. As we expected, the situation is in favor of economic-work.

