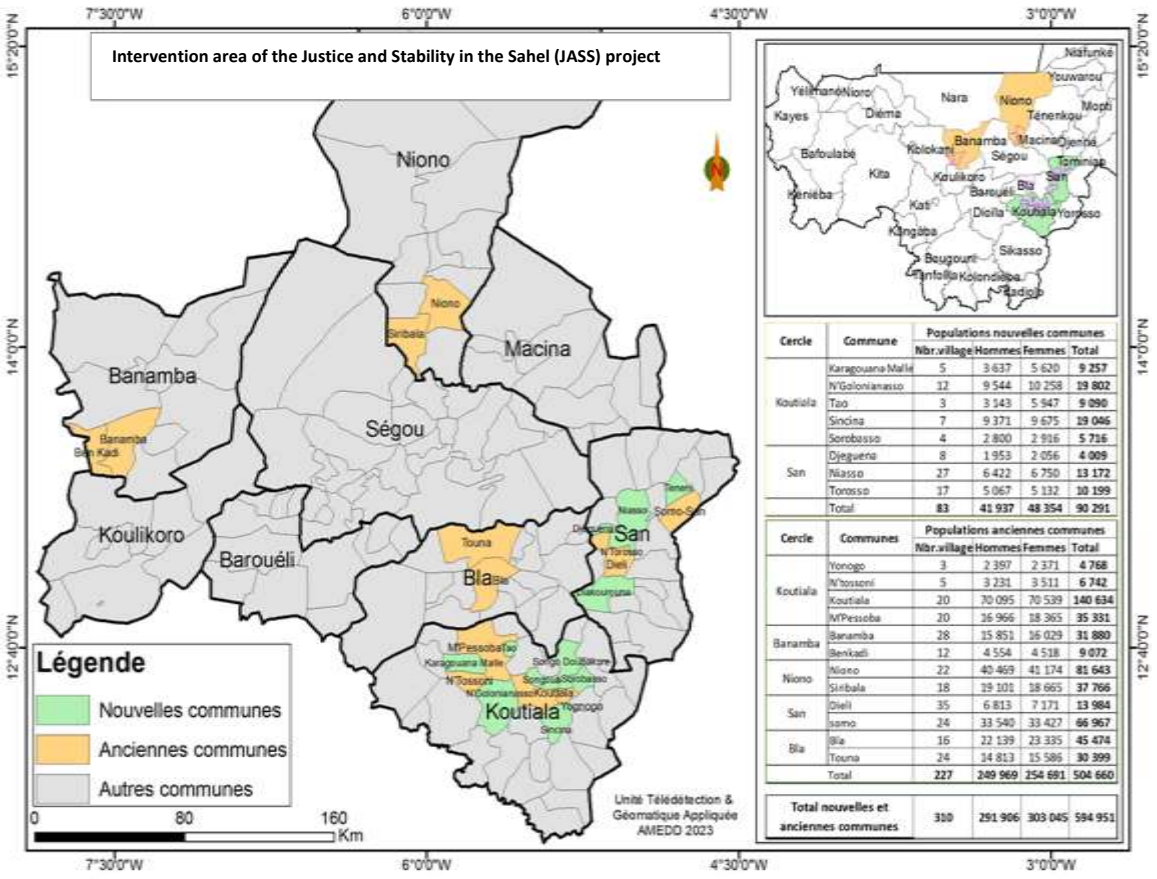
DYNAMICS OF LAND COVER AND LAND USE IN THE AREAS OF JUSTICE AND STABILITY PROJECT IN THE SAHEL

Remote sensing study report



Cercle	Commune	Populations nouvelles communes			
		Nbr.village	Hommes	Femmes	Total
Koutiala	Karagouana Malle	5	3 637	5 620	9 257
	N'Golonianasso	12	9 544	10 258	19 802
	Tao	3	3 143	5 947	9 090
	Sincina	7	9 371	9 675	19 046
	Sorobasso	4	2 800	2 916	5 716
San	Djeguena	8	1 953	2 056	4 009
	Niasso	27	6 422	6 750	13 172
	Torosso	17	5 067	5 132	10 199
	Total	83	41 937	48 354	90 291

Cercle	Communes	Populations anciennes communes			
		Nbr.village	Hommes	Femmes	Total
Koutiala	Yorogo	3	2 397	2 371	4 768
	N'tossoni	5	3 231	3 511	6 742
	Koutiala	20	70 095	70 539	140 634
	M'Pessoba	20	16 966	18 365	35 331
Banamba	Banamba	28	15 851	16 029	31 880
	Benkadi	12	4 554	4 518	9 072
Niono	Niono	22	40 469	41 174	81 643
	Siribala	18	19 101	18 665	37 766
San	Dieli	35	6 813	7 171	13 984
	somo	24	33 540	33 427	66 967
Bla	Bla	16	22 139	23 335	45 474
	Touna	24	14 813	15 586	30 399
	Total	227	249 969	254 681	504 660

Total nouvelles et anciennes communes	310	291 906	303 045	594 951

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Content

I. Summary

The Justice and Stability in the Sahel (JASS) project, funded by the FCDO, has the overall objective of improving equitable and inclusive outcomes in land, natural resource governance and justice in Mali and Niger. The project covers 20 municipalities spread between the regions of Koulikoro, Koutiala, San and Ségou in Mali and those of Maradi and Tahoua in Niger.

Beyond the various ways of using land (agriculture, pastoralism, land marking), the project implementation environments are affected by climate variability and change. Thus, the implementation of a justice and stability project in these regions requires detailed knowledge of the spatiotemporal evolution of the dynamics of land occupation and use. This precise knowledge of the bio-geophysical environment will help the sharing of knowledge on convincing data for each space in order to collectively promote methods of restoration and sustainable management of spaces and natural resources of the territories. It is in this perspective that remote sensing tools were used to carry out a detailed mapping of the dynamics of land occupation and use over the last two decades in the 20 municipalities of intervention of the JASS project in Mali.

The surface area of land use classes and the transition matrices were developed with the aim of facilitating the understanding of the different transitions (change in the dynamics of land use and occupation). The results of satellite image processing made it possible to develop 60 graphs illustrating the dynamics of land occupation and use in the 20 municipalities of the project.

The analysis of maps and graphs overall shows a dominance of agricultural areas to the detriment of savannahs and/or natural forests over time from 2003 to 2023. Savannas occupied 48% of the total surface area of the 20 municipalities studied in 2003 and decreased to 41% in 2013 and to 33% in 2023.

The fields experienced an increase between 2003 and 2023. They went from 51% in 2003 to 58% in 2013 and 65% in 2023 in the 20 study municipalities. Data analysis shows low availability of permanent water areas in the 20 municipalities.

The overall trend in water resources shows a slight increase in water surfaces between 2003 and 2023. They increased from 0.37% in 2003 to 0.55% in 2013 and to 0.75% in 2023.

These trends partly explain the strong competition between users of spaces and natural resources and its corollary of potential intra- and inter-community conflicts.

Beyond this overall characterization, the details of the spatiotemporal evolution of each municipality have been established. The situations are presented in the form of maps with statistics of occupation classes, which make it possible to propose concrete sized and coherent actions for restoration and/or sustainable management of natural resources, including pastoral development plans and local consensual conventions or rules for managing spaces and natural resources.

II. Methodology

The methodology used as part of this study is based on the processing and analysis of multi-date Landsat images covering the 20 municipalities of the JASS project. These are Landsat images of TM (Thematic mapper) for satellite images from 2003 and ETM+ (Enhanced Thematic Mapper) for satellite images from 2013 and 2023. The Landsat images with 30 m spatial resolution were downloaded from of the Earth Explorer platform of the United States Geological Survey (USGS).

For each year, two (2) satellite products were downloaded. These are images of the dry season and those of the rainy season. The choice of the two products makes it easier to discriminate between land use classes, in particular agricultural space classes and water bodies.

The pre-processing carried out on the satellite images was the clipping of the images at the extent of each of the 20 study communes and the stacking of the bands of the dry season and rainy season. The training data was collected on the composite images of the near infrared, red and green bands (PIR/R/V).

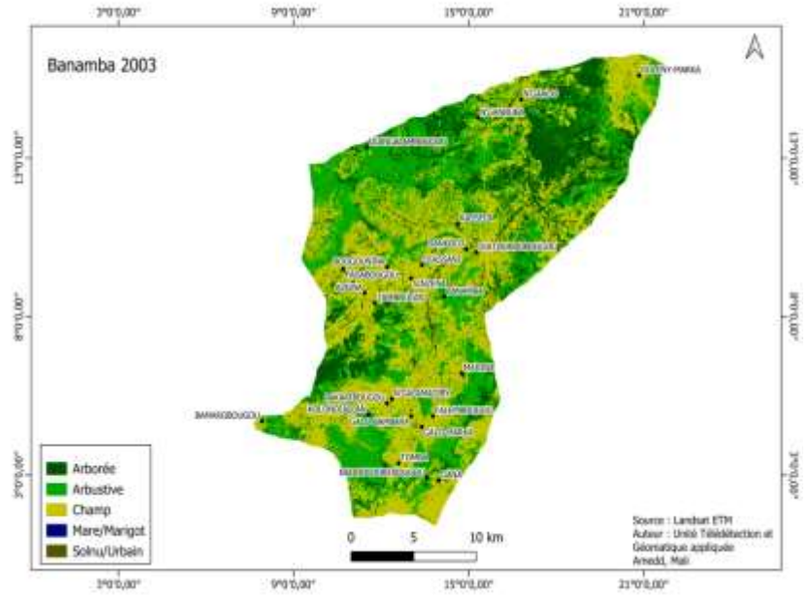
The Random Forest algorithm was used to classify the images. The areas of the different land use classes were calculated by summing the pixels of each class, using QGIS software (SCP plugin). The transition matrices of the different classes (forest, shrub savannahs, fields, water bodies, bare soils and urban environments) were produced using ENVI remote sensing software. This made it possible to carry out a diachronic study of the situations of the reference years in order to highlight the dynamics of land occupation and use from 2003 to 2023.

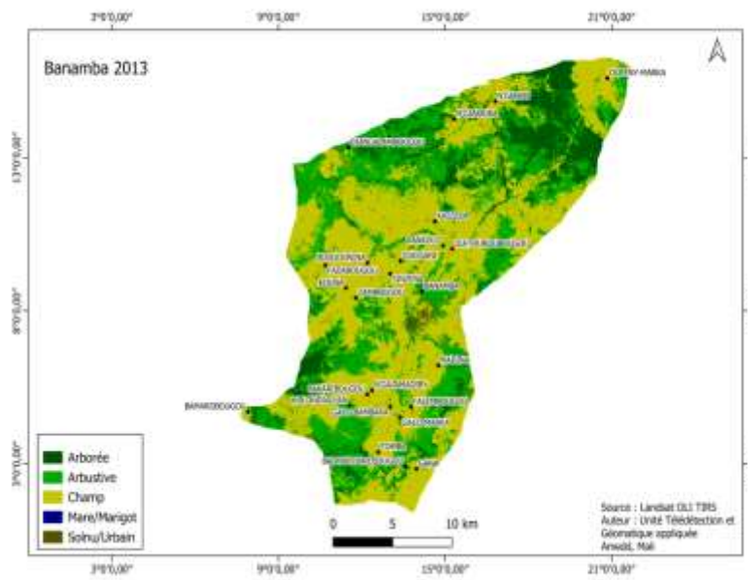
Based on these results, expert opinions were used to propose concrete actions for the sustainable management of spaces and natural resources as well as adapted measures to improve the production system and the restoration of spaces and natural resources with regard to climatic changes and variabilities of the terroirs studied.

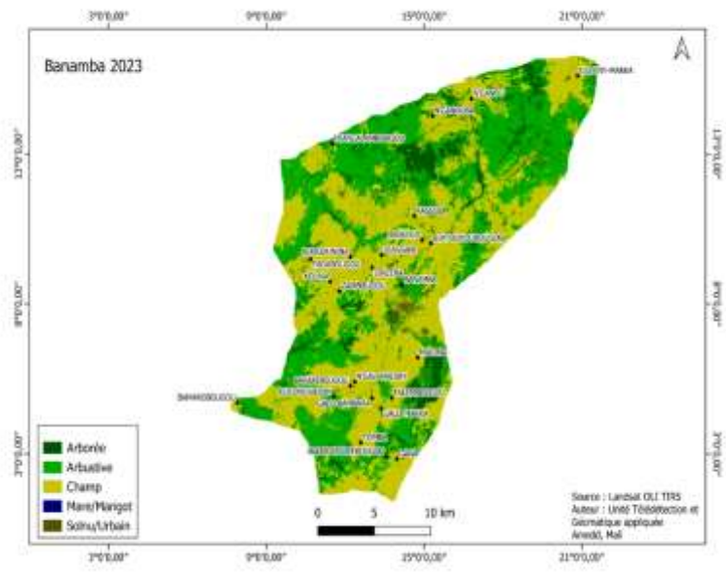
III. Results

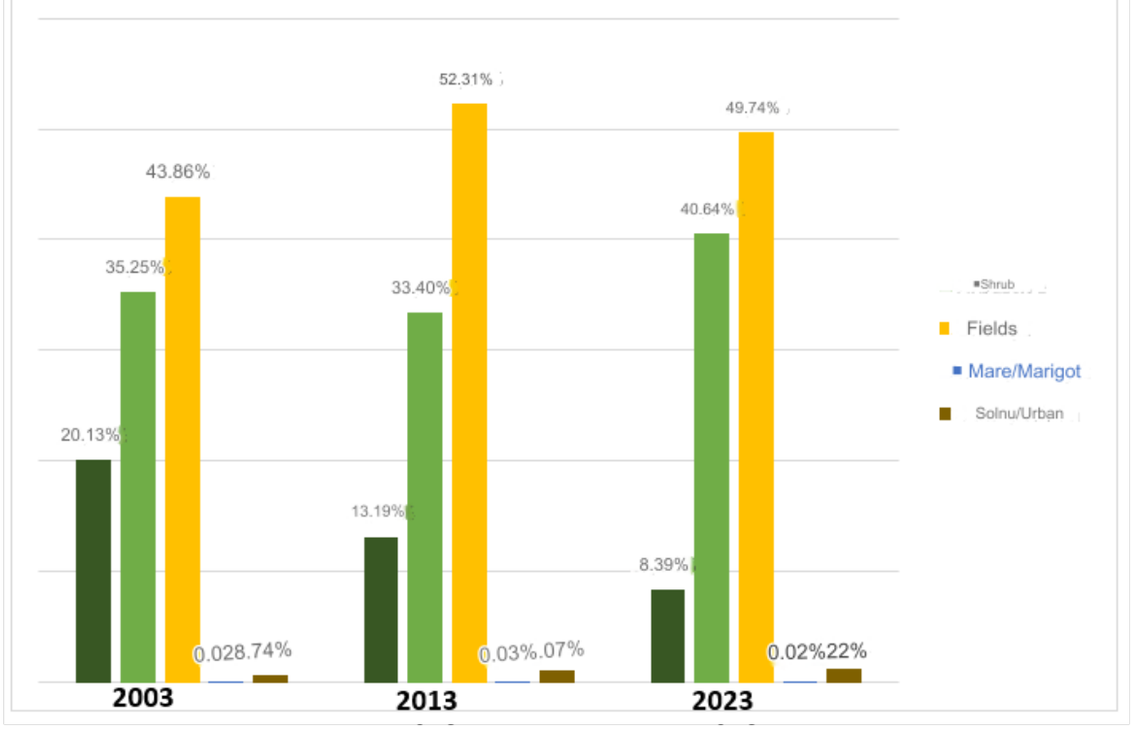
The results obtained during this study were the production of 60 maps and 20 graphs illustrating the occupation and dynamics of land use in the 20 municipalities of intervention of the JASS project in Mali. The maps below show the state of the dynamics of land occupation and use in the communes of Banamba, Ben Kadi, Bla, Dieli, Djeguena, Karagouana Malle, Koutiala, M'pessoba, N'golonianasso, Niasso, Niono, N'torosso, N'tossoni, Sincina, Siribala, Somo, Sorobasso, Tao, Touna and Yagnoko. A proposal for concrete actions necessary depending on the specific situation of each municipality is presented, with a view to guiding JASS operational teams in their project implementation process.

III.1 Dynamics of land cover and land use in the commune of Banamba









Occupancy class	Banamba			
	2003 to 2013	Surface unit	2013_2023	Surface unit
Forest	382,22	Hectares transformed into other classes per year	264,67	Hectares transformed into other classes per year
Shrubby	101,95	Hectares transformed into other classes per year	399,1	Hectares acquired (increasing) per year
Field	465,8	Hectares increasing per year	141,77	Hectares slightly decreasing per year
Backwater	0,26	Hectares blocked per year	0,63	Hectares slightly reduced per year
Bare soil / Urban	18,08	Hectares per year (increase)	7,97	Hectares per year (increase)

The commune of Banamba has 28 villages with a total population of 31,880 inhabitants including 16,029 women. The analysis of the spatiotemporal evolution of land occupation and use shows that between 2013 and 2023, 264.67 hectares of forest and 399.1 hectares of shrub savannah were transformed into crop fields each year. This represents 663.77 hectares of environmental degradation per year. This continued expansion of crop fields responds to a need to increase agricultural production. Which means a need to improve the yields of crops grown in the villages of the commune through the use of improved varieties, the practice of combining crops and actions to conserve water and soil fertility. To reverse the trend of evolution, it is necessary to introduce and scale out new varieties of crops adapted to the context of climate change and variability and to carry out mass training on cultivation techniques adapted to new varieties of crops. This includes the use of climate information and the production/use of organic manure in the 15 villages most affected by soil degradation. Maintaining soil fertility requires carrying out contour bundings in cultivated fields.

Over the next two years, at least 20 hectares of contour bundings should be carried out in each of the 15-targeted villages, for a total of 300 hectares across the commune of Banamba. Technical teams in a “learning by doing” format will carry out these activities, so that the technology will be widely mastered and disseminated in all of the commune villages. In addition, the equivalent of the area of land deforested over the last two years must be restored by reforestation and/or by assisted natural regeneration (RNA), i.e. 1327.54 hectares to be distributed among the villages of the commune.

The pre-identified villages are: Ouleny-marka, Nganou, Nganouba, Kassela, Dankolo, Diatoubougou, Diassani, Bougounina, Fadabougou, Kouna, Zambougou, Sinzena, Galo-marka, Tomba and Gana. Community mobilization for engagement in the process of improving the agricultural production system and soil restoration should be done through communal self-assessment workshops and planning of multi-local testing activities for new varieties of annual crops. , reforestation and assisted regeneration (RNA).

In summary, in view of climatic variabilities and the experience of land occupation and use practices in the commune of Banamba, the activities mentioned below are necessary:

- One (1) communal workshop to report on the state of degradation of spaces and natural resources with 50 participants from villages and local management organization ; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Fifteen (15) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved varieties of corn, sorghum, millet, rice, cowpea, fonio) and restoration, maintenance of fertility of soils (contour bunding, RNA, reforestation)
- Purchase and distribution of improved seeds in targeted villages for demonstrations and knowledge sharing:
    - Corn: 5 hectares (demonstration) * 15 villages * 25kg/ha, or **1,875 kg** of yellow corn seeds (Brico variety), 70 days, with a production capacity of 4 tonnes per hectare.
    - Sorghum: 5 hectares (demonstration) * 15 villages * 10kg/ha, or **750 kg** of dual-use sorghum seeds (Diakounbè variety) early, 70 days, yield 2.5 tonnes per hectare.
    - Millet: 5 hectares (demonstration) * 15 villages * 10 kg/ha, or **750 kg** of millet seeds, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tonnes per hectare.
    - Rice: 5 hectares (demonstration) * 15 villages * 50 kg/ha, or 3750 kg of rice seeds, rainfed variety Nerika 8 (20cm by 20 cm spatial arrangement).
    - Cowpea: 5 hectares (demonstration) * 15 villages * 20 kg/ha, or **1500 kg** of cowpea seeds, Acar 1 or wilibali variety (75cm between rows and 30 between pockets).

- Fonio: 2 hectares (demonstration) * 15 villages * 50 kg/ha, or **1500 kg** of fonio seeds, Kassamara or Niatia variety (sowing by hand).

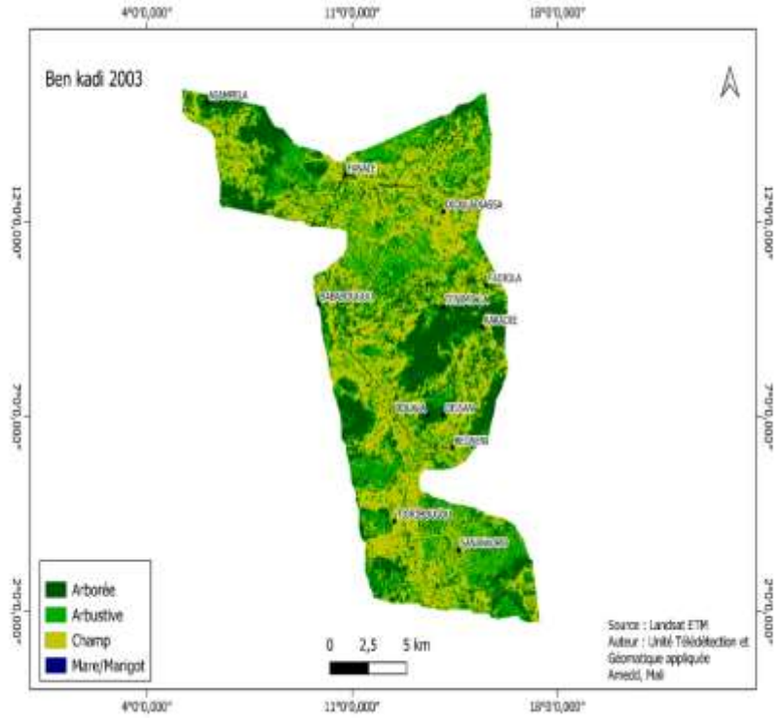
The demonstrations will be carried out in the form of showcases of comparative options in each of the villages as a prelude to intra- and inter-farmer visits with a view to scaling out to all farms the options for improving production systems in the varieties of local contexts.

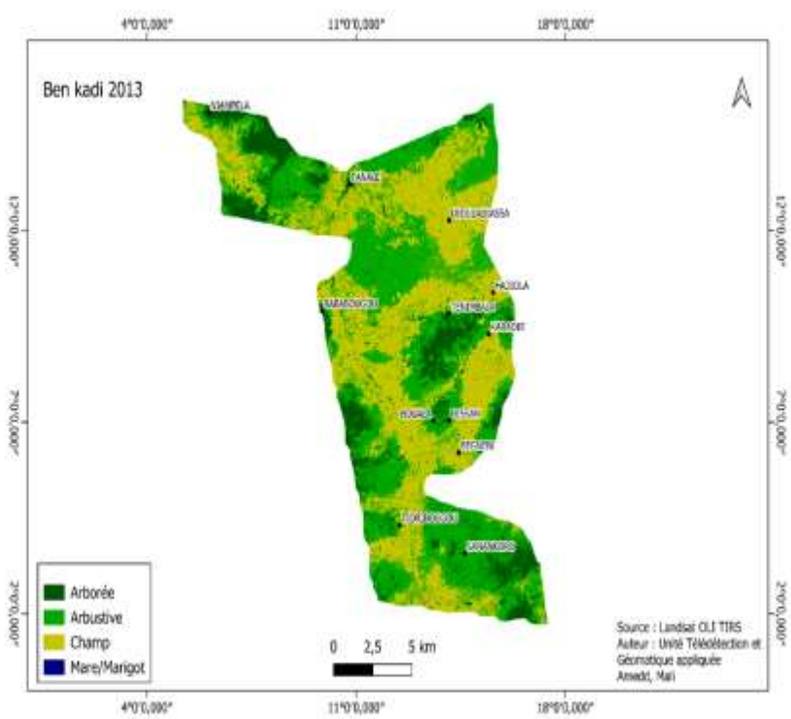
- Training of 1,500 producers on the technical routes for growing improved seeds varieties, including 150 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Proximity monitoring by agricultural technical services and multi-purpose advisors from the NGO AMEDD to be recruited (service contract) in the number of one farm advisory agent per municipality.
- Carrying out contour bundings: 300 ha (20 ha per village) in the form of demonstration and training of independent teams providing services for the development of cultivated fields along contour lines using the optical level or the water level.
- Reforestation of 327.54 hectares and assisted regeneration of 1000 hectares of land area.
- Dissemination of climate information in the form of a video in local language targeting 100 producers per village, i.e. 1,500 producers including young people and women.
- Organization of 15 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 15 village self-assessment and programming workshops each year to resize interventions in accordance with the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

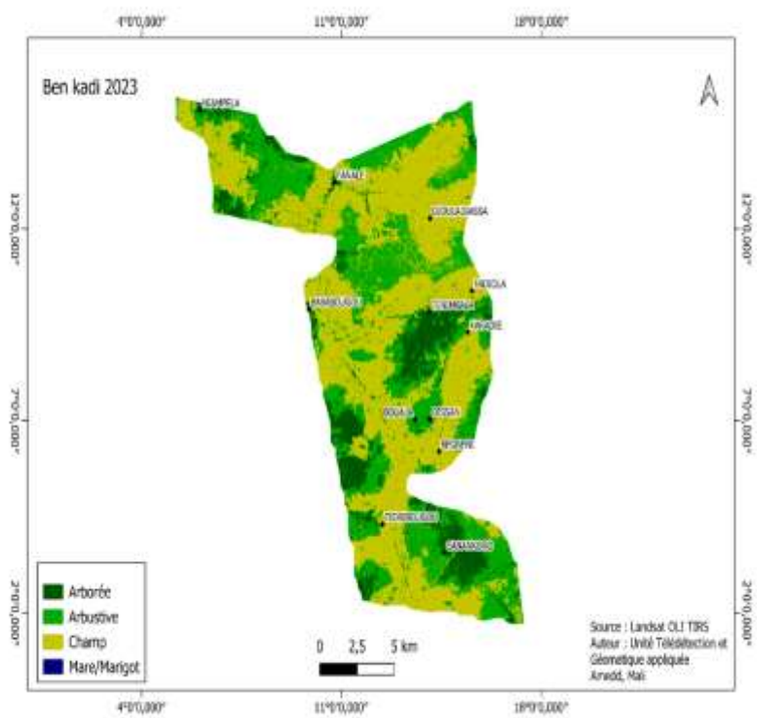
The performance indicators to be observed include, among others:

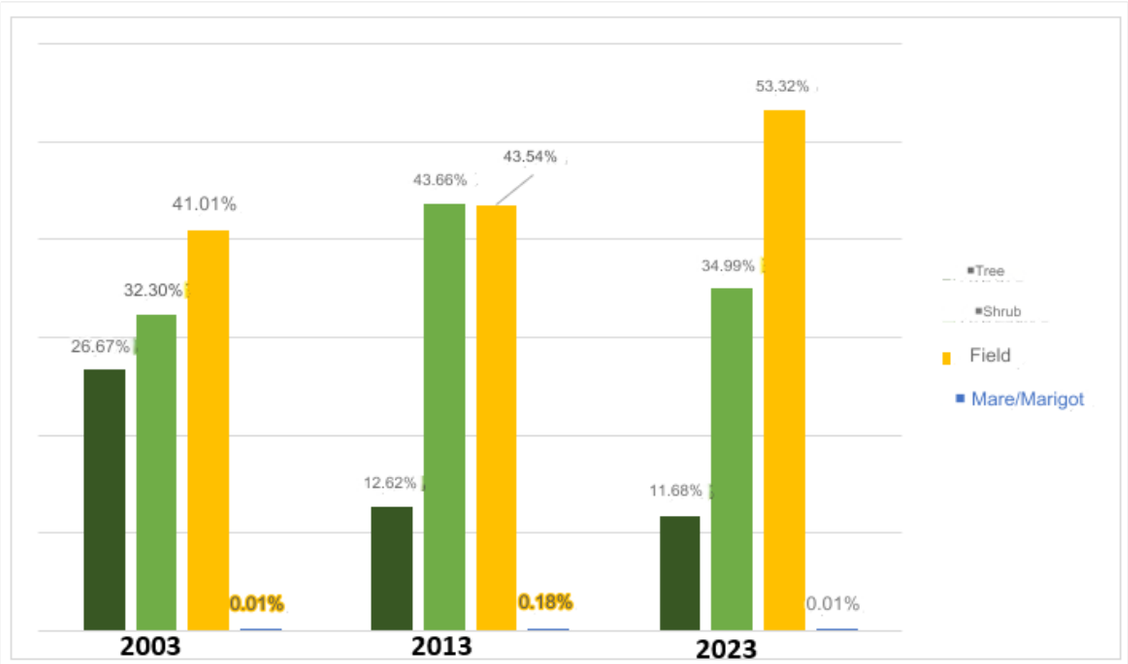
- Change in land occupation and use: Fields VS shrub savannahs and forests;
- Diversity of annual crops in target villages and communes compared to villages and communes not affected by the project;
- Evolution in the level of adoption of innovations and technologies for adaptation to climate change and variability;
- Change in the level of knowledge of innovations and technologies for improving the production system by farmers.

III.2 Dynamics of land cover and land use in the BenKadi commune









Occupancy class	Benkadi			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	386,21	Hectares transformed into other classes per year	25,78	Hectares transformed into other classes per year
Shrubby	312,15	Hectares increasing per year	238,25	Hectares decreasing per year
Field	69,47	A slight increase in ha per year	268,75	Hectares acquired per year
Backwater	4,58	A slight increase in ha per year	4,72	Hectares decreasing per year

The commune of Benkadi has 12 villages and a population of 9,072 inhabitants, including 4,518 women.

The dynamics of land occupation and use shows that 53.32% of the municipality's spaces in 2023 are occupied by crop fields. The rate of change of wooded areas into crop fields is 25.78 hectares per year. A modification of this trend or trajectory requires actions to fix crop fields and the adoption of agroecological intensification.

The establishment of crop fields at the scale of all the villages of the commune involves contour bunding of 20 to 25 hectares per village per year during 3 years, i.e. a total of 900 hectares of cultivated fields. From a perspective of sustainability of the continuity of the development of fields cultivated on contour lines, 50 young people per village from agricultural operations must be trained in the creation and maintenance of the development of fields cultivated on contour lines, i.e. a total of 600 youth. They will also be trained on the rapid production and use of organic manure and calcium amendment of fields. These measures will contribute to improving yields and therefore agricultural production in crop fields. This provision for improving agricultural production will be reinforced by the use of varieties adapted to climatic variability in the areas of the intervention villages.

The introduction of seed varieties and demonstrations mentioned below will help in the large-scale dissemination of climate-smart agriculture practices:

  - Corn: 5 hectares (demonstration) * 12 villages * 25kg/ha, or **1,500 kg** of yellow corn seeds (Brico variety: 3ha, Denbagnuma variety: 2 ha), respectively 70 days, with a production capacity of 4 tonnes per hectare and 90 days with a production capacity of 6 tonnes per hectare.
  - Sorghum: 5 hectares (demonstration) * 12 villages * 10kg/ha, or **600 kg** of dual-use sorghum seeds (Diakounbè variety) early, 70 days, yield 2.5 tonnes per hectare.
  - Millet: 5 hectares (demonstration) * 12 villages * 10 kg/ha, or **600 kg** of millet seeds, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tonnes per hectare.
  - Rice: 5 hectares (demonstration) * 12 villages * 50 kg/ha, or **3000 kg** of rice seeds, rainfed variety Nerika 8 (20cm by 20 cm spatial arrangement).
  - Cowpea: 5 hectares (demonstration) * 12 villages * 20 kg/ha, or **1200 kg** of cowpea seeds, Acar 1 or wilibali variety (75cm between rows and 30 between pockets).
  - Fonio: 2 hectares (demonstration) * 12 villages * 50 kg/ha, or **1200 kg** of fonio seeds, Kassamara or Niatia variety (sowing by hand).

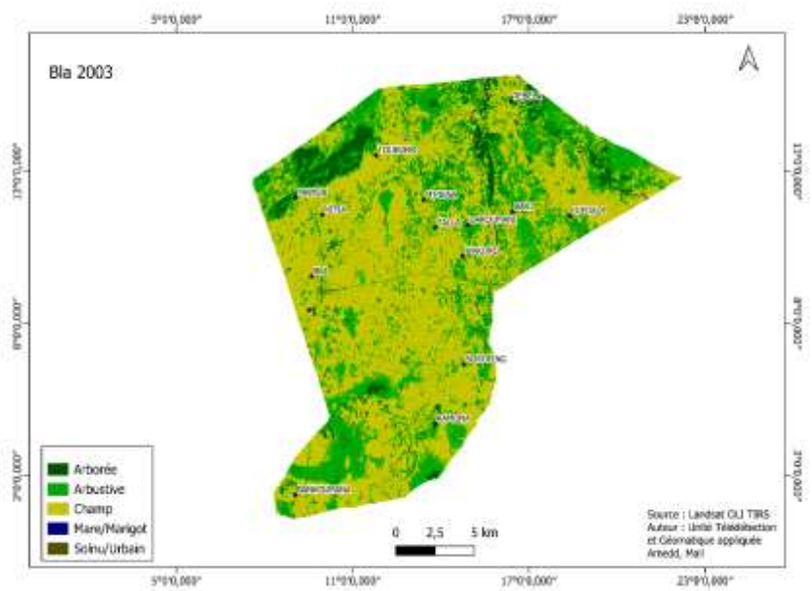
- Training of 2,400 producers (young people and women) on the technical routes for growing improved seeds, including 200 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.

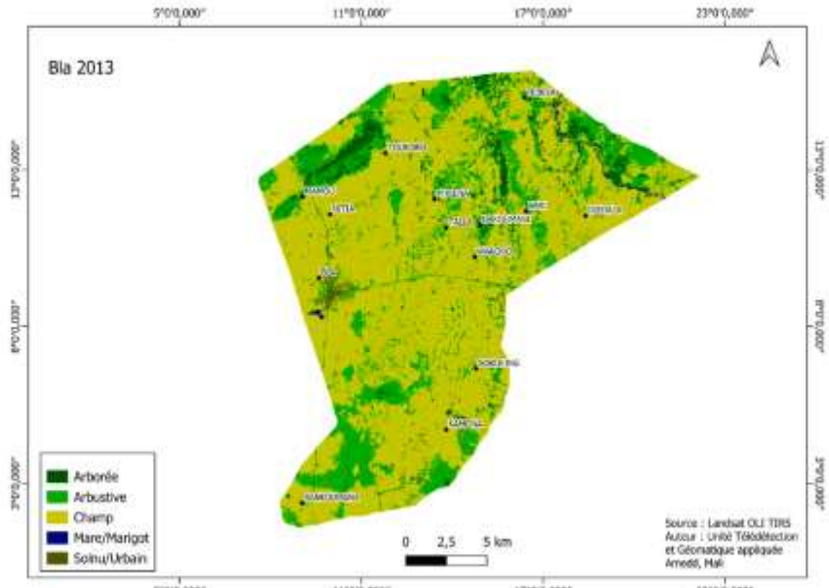
Considering the rate of deforestation (25.78 ha/year), it is appropriate to undertake assisted natural regeneration and reforestation of the equivalent of the last two (2) years deforestation, i.e. 51.44 hectares. The number of hectares per village and per agricultural operation must be clarified following information/awareness workshops and mobilization of commitments on the honor of agricultural operations in the villages. Close monitoring of AMEDD, its partners as well as technical services is necessary for the success of the actions.

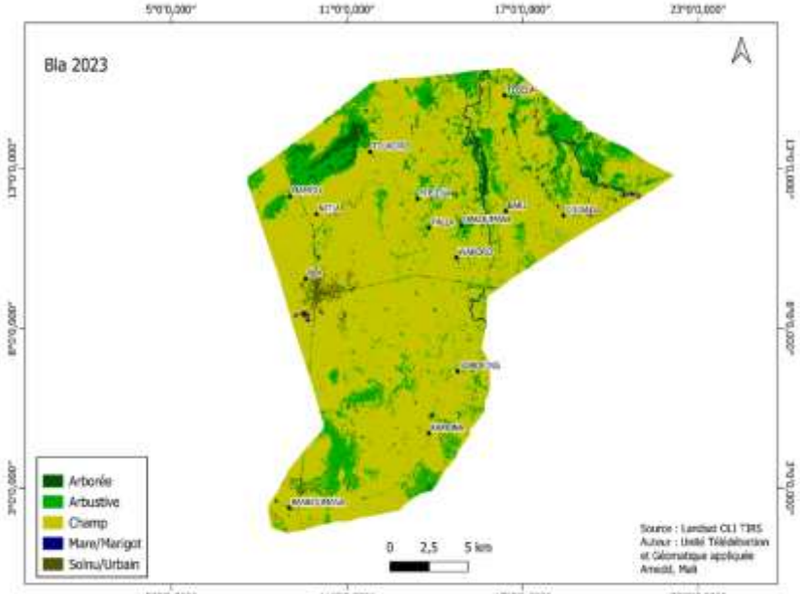
Surface water infrastructure (ponds and backwaters) are clogged at the rate of 4.72 hectares per year, hence the need to overfill certain ponds and the undertaking of action to restore the banks through the reforestation of the 25 m all aground the developed ponds and backwaters. As part of this program, beyond including the actions in the development plan of the municipality, 5 agropastoral ponds will be developed and restored.

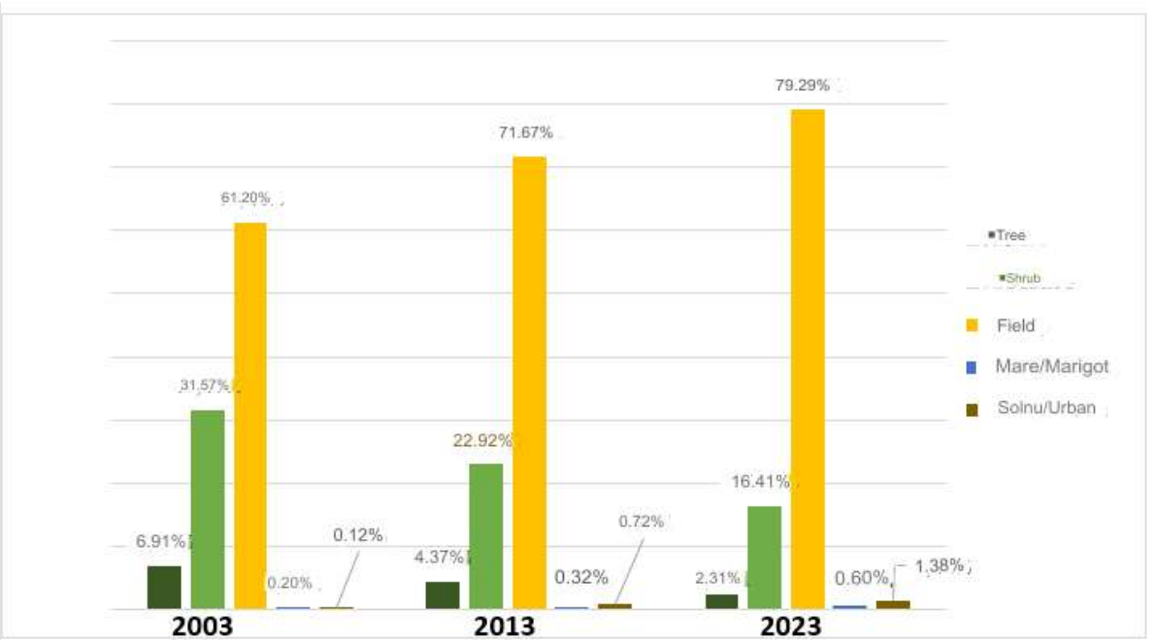
In the interest of general mobilization of the community for sustainable management of spaces and sustainable management of natural resources, habits and customs will be inventoried by village, then engage with all stakeholders in the development of local management conventions spaces and natural resources including a pastoral plan in the villages and the commune.

III.3 Dynamics of land cover and land use in the commune of Bla









Occupancy class	Bla			
	2003_2013	Area Unit	2013_2023	Area Unit
Forest	98,41	Hectares per year (decreasing)	79,99	Hectares decreasing per year
Shrubby	335,69	Hectares per year (reduced)	252,72	Hectares decreasing per year
Field	406,29	Hectares increasing per year	296,009	An increase in hectare per year
Pond/Backwater	4,76	Hectares slightly increasing per year	10,93	Slight increase in hectare per year
Bare soil/Urban	23,04	An increase in ha per year	25,76	An increase in hectare per year

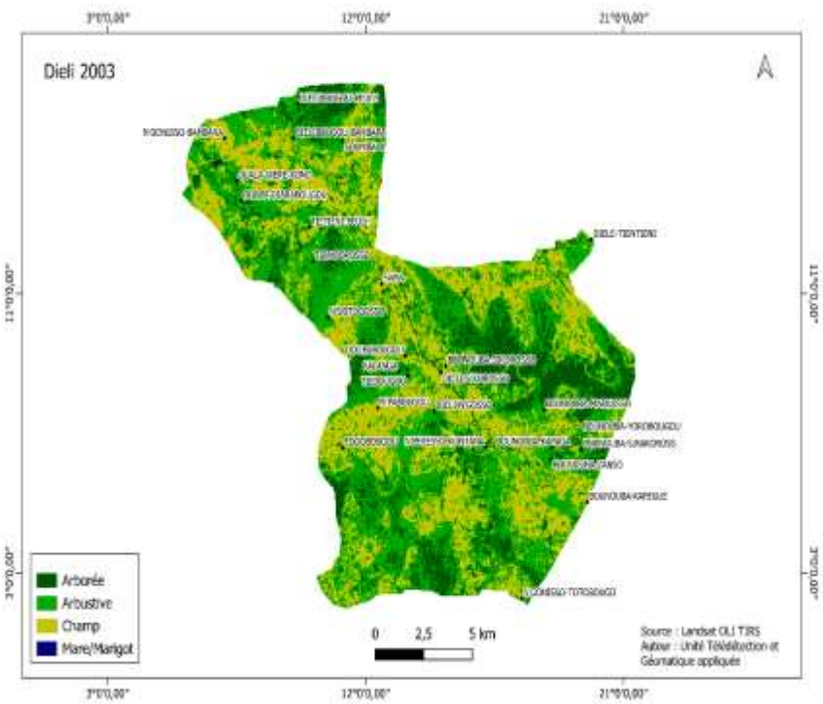
The municipality of Bla has 16 villages with a population of 45,474 inhabitants, including 23,335 women. The high population density and a trend towards urbanization are accelerating the expansion of crop fields to the detriment of wooded areas. Cultivated fields increased from 61.20% in 2003 to 79.29% in 2023.
Beyond the abusive use of wood energy by 100% of the rural and urban population of Bla, 100% of industries (modern and traditional bakeries) operate exclusively on wood energy. This state of affairs increases the pressure on the natural resources of rural areas. Climate change and variability aggravate the vulnerability of ecological ecosystems and community resilience.

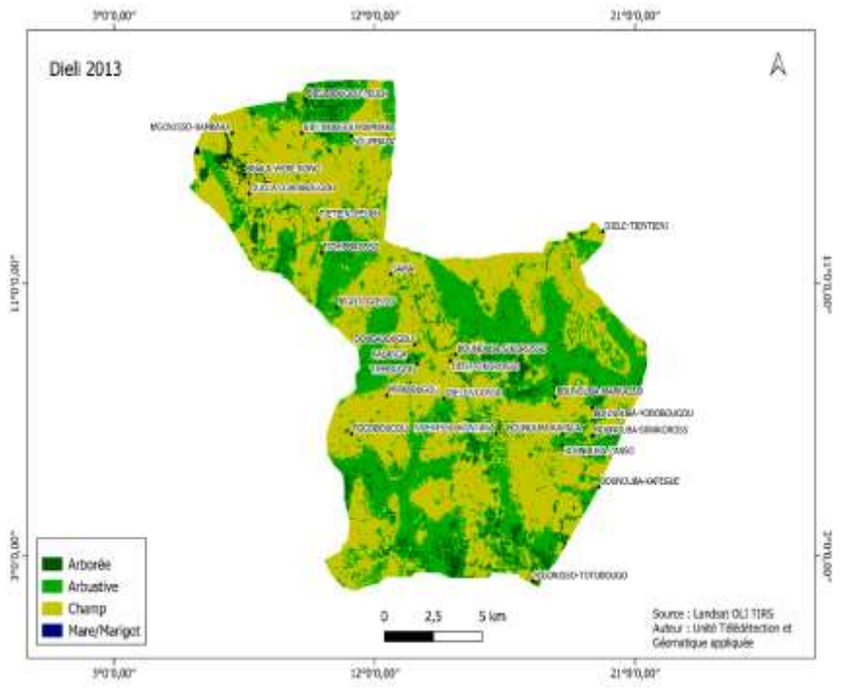
In the municipality of Bla, changing the trajectory of change requires major actions on the way wood energy is used in households and in local and regional industries. The large-scale concrete actions to be considered include, among others:

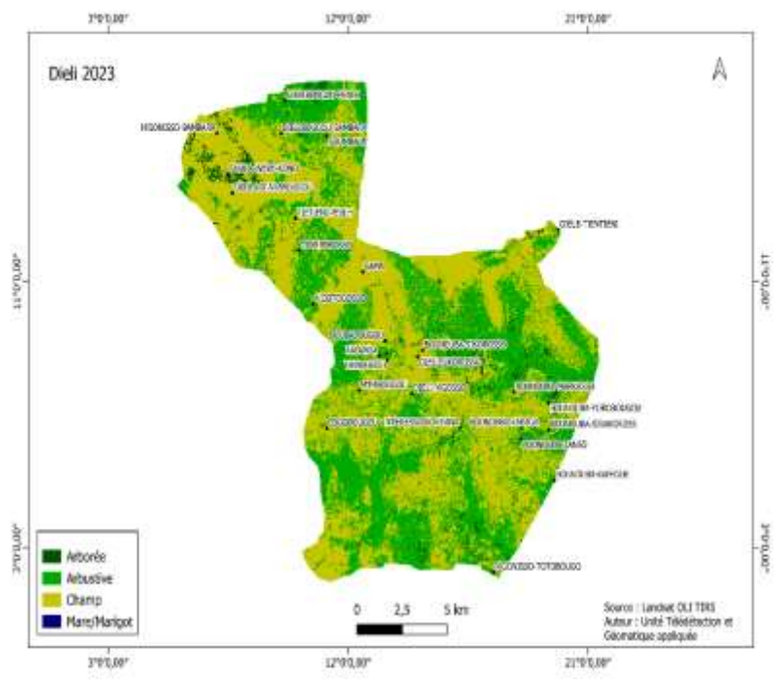
- Organization of 32 village information and awareness assemblies in order to reach 25,000 households (16 villages * 2 assemblies per village and 50 participants per assembly) for optimal use of energy resources and sustainable management of natural resources; presentation of maps of the spatiotemporal evolution of the degradation of spaces and natural resources.
- Reforestation or assisted regeneration of the equivalent of the deforestation of the last two (2) years, i.e. 665.42 hectares to be distributed among the villages during village information and awareness workshops.
- Support for 17 nursery growers in the production and sale of plants for reforestation (training, 17 production KITs + 17 tricycles for delivery).
- Cascade training of 1,600 rural and urban women and young people for the use of adapted improved stove models (100 women per village * 16 villages).
- Training of 10 young women and 5 young men per village in the making and sale of improved stoves (WASA and Yèrèdèmè model), i.e. a total of 240 people including 160 women and 80 young men.
- Launch of a “sigida kura” (new living environment) competition between the 16 participating villages to promote the use of improved stoves and sustainable management of energy resources.
- Organization of one (1) knowledge and innovation fair per year, for 3 years, to mobilize local, regional, and national institutional actors in the process of ecological and economic resilience of communities in the municipality of Bla.
- Support for two (2) artisanal companies manufacturing improved solar stoves for households in urban and semi-urban areas with a view to reducing wood energy consumption by 20%;
- Establishment of a protocol for measuring the reduction of GHG production from the improved stoves used;
- Introduction of new crop varieties in the form of demonstration showcases for large-scale dissemination of climate-smart agriculture practices:
    - Corn: 5 hectares (demonstration) * 16 villages * 25kg/ha, or 2000 kg of corn seeds (Brico variety: 3ha, Denbagnuma variety: 2 ha), respectively 70 days, with a production capacity of 4 tonnes per hectare and 90 days with a production capacity of 6 tonnes per hectare;
    - Sorghum: 5 hectares (demonstration) * 16 villages * 10kg/ha, or 800 kg of dual-use sorghum seeds (Diakounbè variety) early, 70 days, yield 2.5 tonnes per hectare;
    - Millet: 5 hectares (demonstration) * 16 villages * 10 kg/ha, or 800 kg of millet seeds, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tonnes per hectare;
    - Rice: 5 hectares (demonstration) * 16 villages * 50 kg/ha, or 4000 kg of rice seeds, rainfed variety Nerika 8 (20cm by 20 cm spatial arrangement);

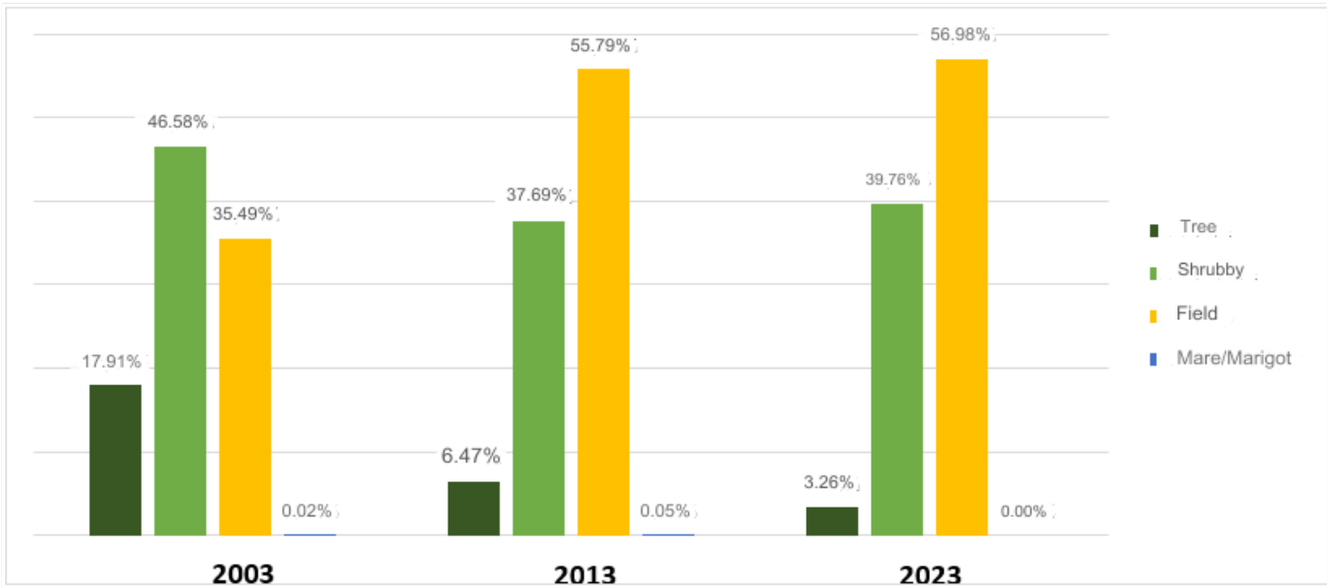
    - Cowpea: 5 hectares (demonstration) * 16 villages * 20 kg/ha, or 1600 kg of cowpea seeds, Acar 1 or wilibali variety (75cm between rows and 30 between pockets);
    - Fonio: 2 hectares (demonstration) * 16 villages * 50 kg/ha, or 1600 kg of fonio seeds, Kassamara or Niatia variety (sowing by hand).
- Training of 3,200 producers (young people and women) on the technical routes for growing improved seeds, including 200 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village;
- Training of 3,200 producers (young people and women) on the rapid production of compost and use of calcium amendments; recycling each year based on the inadequacies noted following self-assessments and programming by village;
- Fixation of crop fields in all villages of the commune by contour bunding of 20 hectares per village per year for 3 years, i.e. a total of 960 hectares of cultivated fields.

III.4 Dynamics of land cover and land use in the commune of Diéli









Occupancy class	Dieli			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	303,05	Hectares transformed into other classes per year	85,11	A slight decrease in ha per year
Shrubby	235,33	Hectares per year (reduced)	54,66	A slight increase in ha per year
Field	537,56	Hectares acquired (increasing) per year	31,67	A slight increase in ha per year
Pond/Back water	0,82	A slight increase in ha per year	1,23	A reduction in ha per year

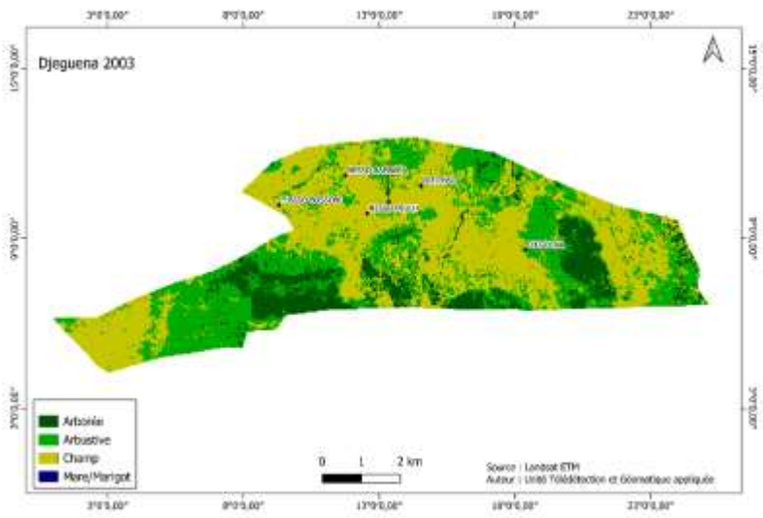
The commune of Dieli has 35 villages with a total population of 13,984 inhabitants including 7,171 women in 2023. The analysis of the spatiotemporal evolution of land cover and land use shows that between 2013 and 2023, 85 11 hectares of forest were transformed into crop fields each year. On the other hand, the shrub savannah experienced a slight increase of 54.66 hectares between 2013 and 2023. This explains why the forests are subject to continued strong degradation in favor of the fields and shrub savannah. The deterioration is located in the north and center of the commune of Dieli. The most affected villages are: Ngonisso-Bamabara, Ouala were, kono, Ouala Diarabougou, Tietieni peulh, Sama, Doubabougou, Bounoumba sikorosso, Dieli sikorosso, Mpabougou, Fokobougou.

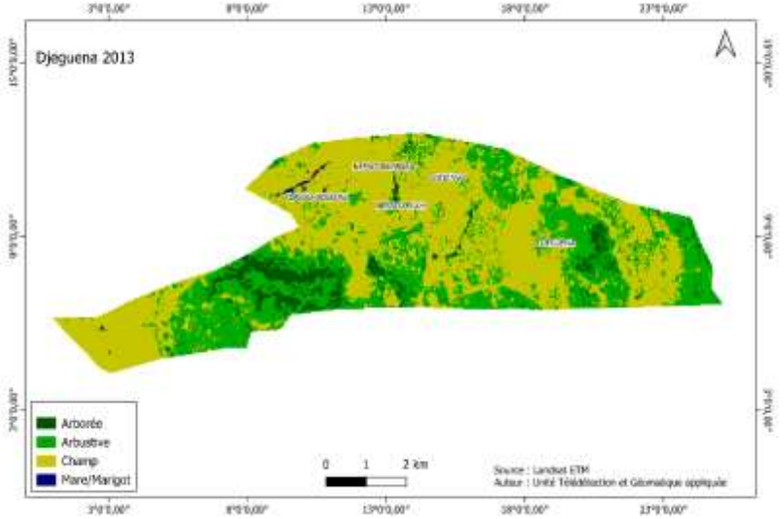
Adaptive measures include improving agricultural productivity in the villages of the commune using improved seed varieties, strengthening agroforestry practices (RNA, reforestation). Community mobilization for engagement in the soil restoration process should be done through municipal self-assessment and programming workshops.

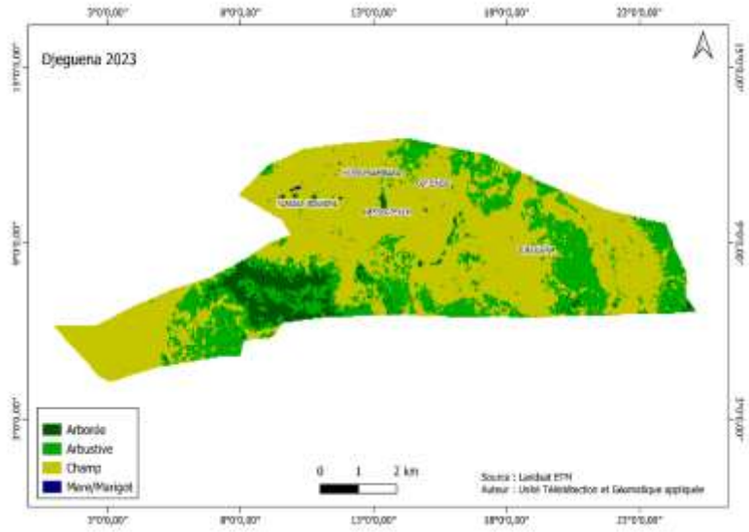
In view of climatic variabilities and the experience of land occupation and use practices in the commune of Dieli, the activities mentioned below are necessary:

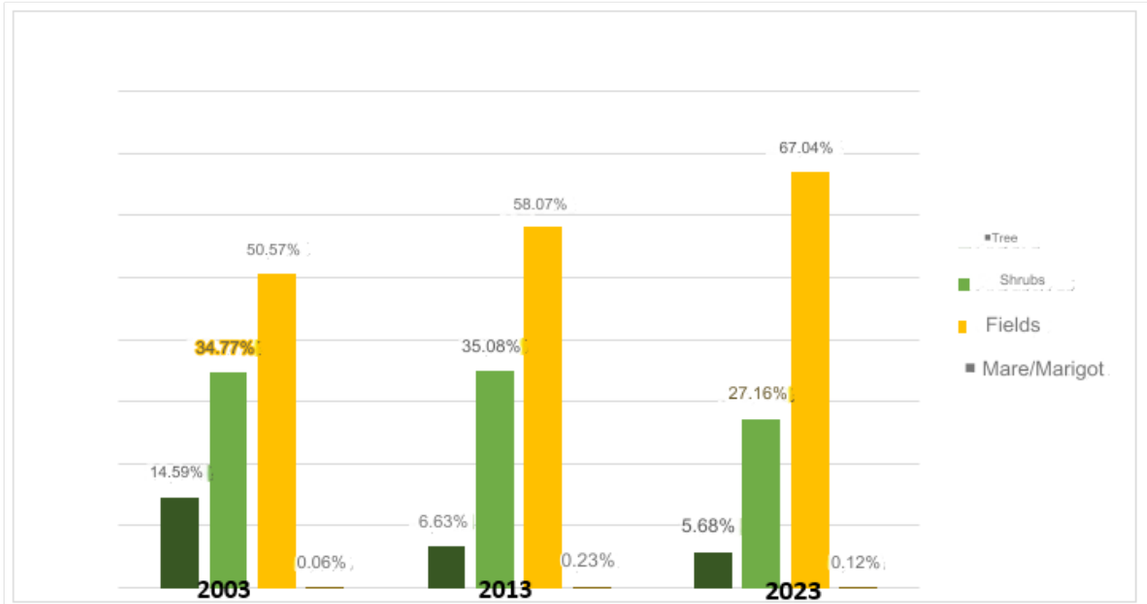
- One (1) municipal workshop to report the state of degradation of natural resources with 40 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Thirty-five (35) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved varieties of rice, millet, and corn), restoration and maintenance of soil fertility.
- Establishment of at least 6 technological demonstrations per village with maize, rainfed rice, sorghum, millet and cowpea.
- Training of 7,000 producers on the technical routes for growing improved seeds, including 200 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Close monitoring by agricultural technical services and multi-purpose advisors from the NGO AMEDD to be recruited (service contract)
- Dissemination of climate information in the form of a video in local language (target 200 producers per village), for a total of 7,000 producers including young people and women.
- Organization of 35 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 35 villages self-assessment and programming workshops each year to resize interventions in accordance with the needs of the communities.

III.5 Dynamics of land cover and land use in the commune of Djeguena









Occupancy class	Djeguena			
	2003-2013	Surface unit	2013-2023	Surface unit
Forest	37,71	Hectares transformed into other classes per year	4,5	A slight decrease in ha per year
Shrubby	1,43	A slight increase in ha per year	37,49	Hectares per year (reduction)
Field	35,5	Hectares acquired (earned) per year (speed of increase)	42,49	Hectares per year (increasing)
Pond/Back water	0,78	A slight increase in ha per year	0,18	A slight decrease in ha per year

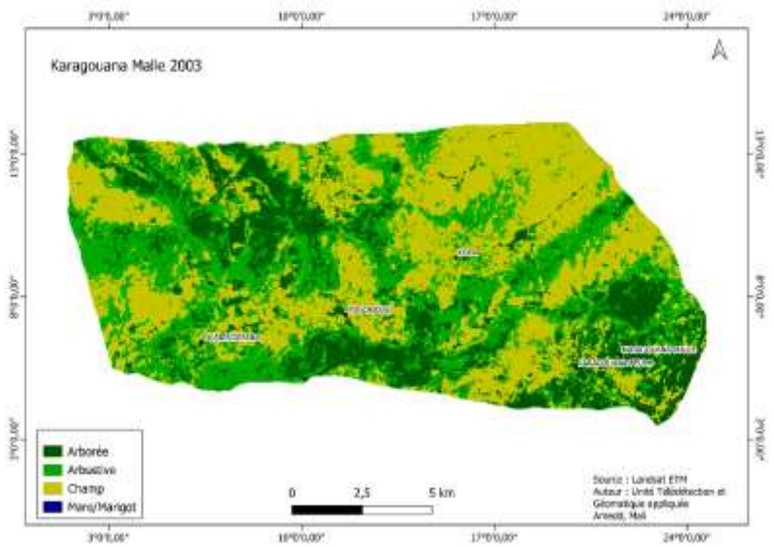
The commune of Djeguena is located in the district of San. It has 8 villages with a population of 4,009 inhabitants including 2,056 women in 2023. The analysis of the spatiotemporal evolution of land cover and land use shows that between 2013 and 2023, 4.5 hectares of forest and 37.49 hectares of Shrubby savannah are transformed into crop fields each year, for a total of 41.99 hectares of forest destruction per year. The analysis of the graph and maps shows that, only the class of agricultural areas has experienced an increase. relatively large of 35.5 ha between 2003 to 2013 and 42.49 ha between 2013 and 2023. The savannah classes have experienced a regression over the different years. Forest savannah decreased from 14.59% in 2003 to 5.68% in 2023 and Shrubby savannah decreased from 34.77% in 2003 to 27.16% in 2023. Watercourses have not experienced an important development. To alleviate the pressure on Forest and Shrubby areas, concrete actions must be taken to improve the yields of crops grown in the region. This improvement in yields can be done through the use of improved seed varieties, the practice of inter cropping and actions to conserve water and maintain soil fertility. Training farmers on cultivation techniques adapted to new crop seed varieties is essential for scaling out promising technologies. The training will take place in the 4 villages most affected by land degradation (Nesso-Bambara, Flasso-Bossoni, Nesso-Peulh, Ofienso). In addition, the development of 20 hectares in contour bunding will be carried out in each of the 8 targeted villages. A total of 160 hectares across the commune of Djeguena will be cultivated in contour bunding. To restore the equivalent of deforested land, it is necessary to carry out reforestation and/or assisted natural regeneration (RNA), on 41.99 hectares distributed among the villages. The villages concerned are: Nesso-Bambara, Flasso-Bossoni, Nesso-Peulh, Ofienso).

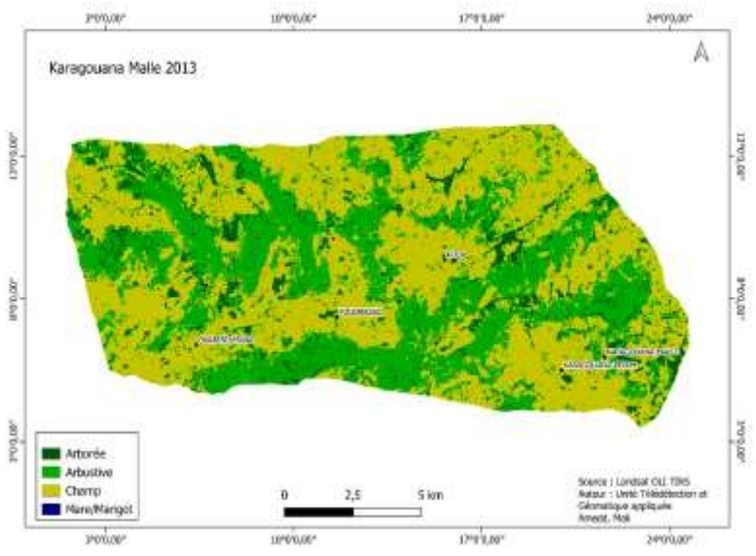
Given climatic variabilities and land occupation and use practices in the commune of Djeguena, the carrying out of certain activities is necessary:

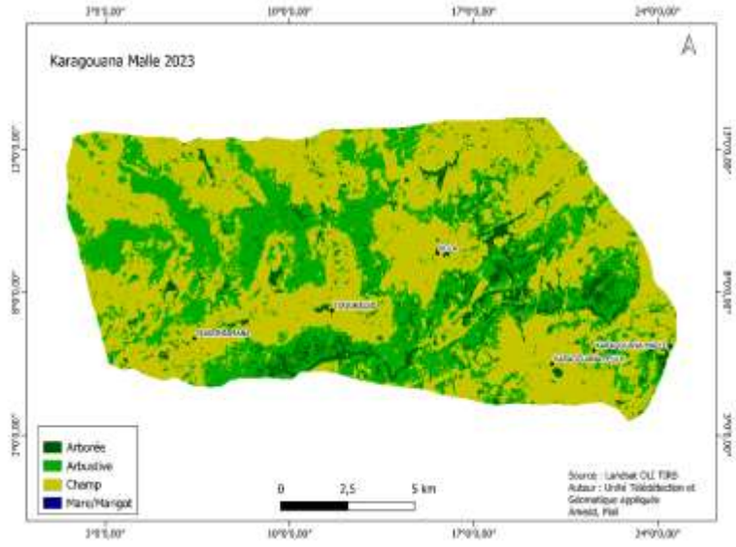
- One (1) communal workshop to report the state of degradation of spaces and natural resources with participants from villages and local management structures to discuss and share the major challenges of using promising innovations and technologies for the improving agricultural productivity and soil restoration;
- The tenuousness of 8 village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved varieties of corn, sorghum, millet, rice, cowpea, fonio) and restoration, maintenance of fertility of soils (contour bunding of Fields, RNA, reforestation).
- Purchase and distribution of 4.5 tonnes of improved seeds in the 8 targeted villages.
- The development of 9 local conventions (villages, municipalities) for the management of natural resources is necessary to preserve the existence in these different areas.
- The development of the pastoral development plan to prevent possible conflict between farmers and breeders.
- The creation of markings for pastoral trails at the village and commune level.
- Training of producers on the technical routes for growing improved seeds.

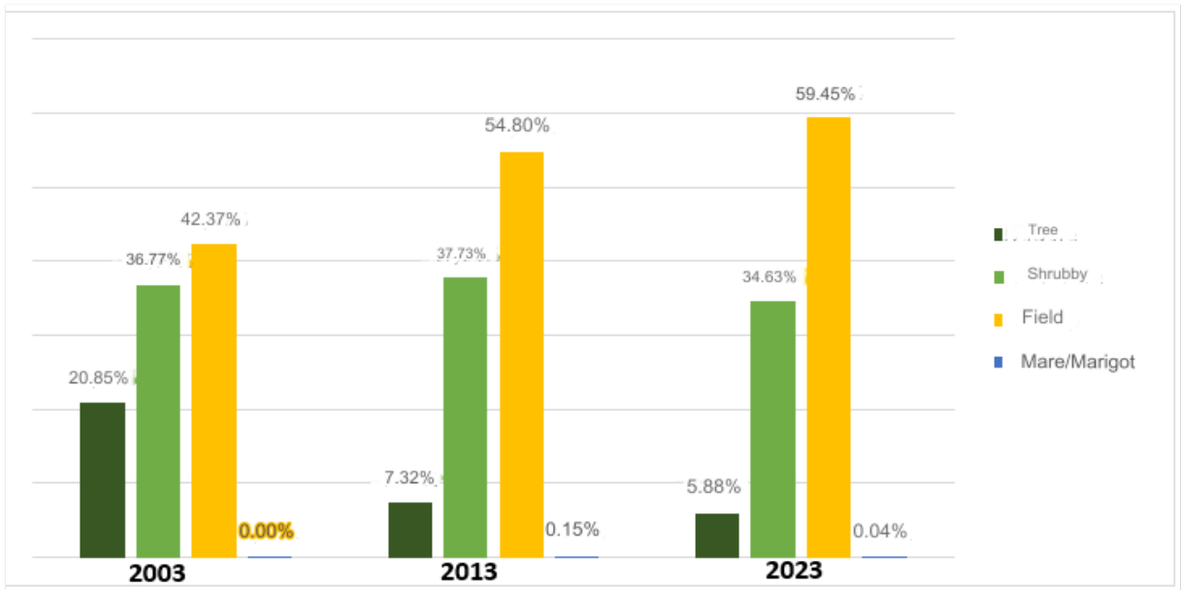
- Close monitoring by agricultural technical services in collaboration with multi-purpose advisors from the NGO AMEDD.
- Reforestation of 42 hectares and assisted regeneration of land area.
- Dissemination of climate information in video form in language.
- Organization of inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- The town has developable plains and temporary watercourses. It is recommended to develop market gardening aground permanent water points, and water retention systems (bouli, BCR, etc.) for market gardening and watering animals. It is necessary to strengthen cofos in land governance.

III.6 Dynamics of land cover and land use in the commune of Karagouana Malle









Occupancy class	Karagouana Malle			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	249,16	Hectares per year (reduction)	26,55	A slight reduction in ha per year
Shrubby	17,62	A slight increase in ha per year	56,98	A slight decrease in ha per year
Field	228,84	Hectares acquired (gained) per year (speed of growth)	85,65	A slight increase in hectare per year
Pond/Back water	2,69	A slight increase in ha per year	2,1	A slight decrease in hectares per year

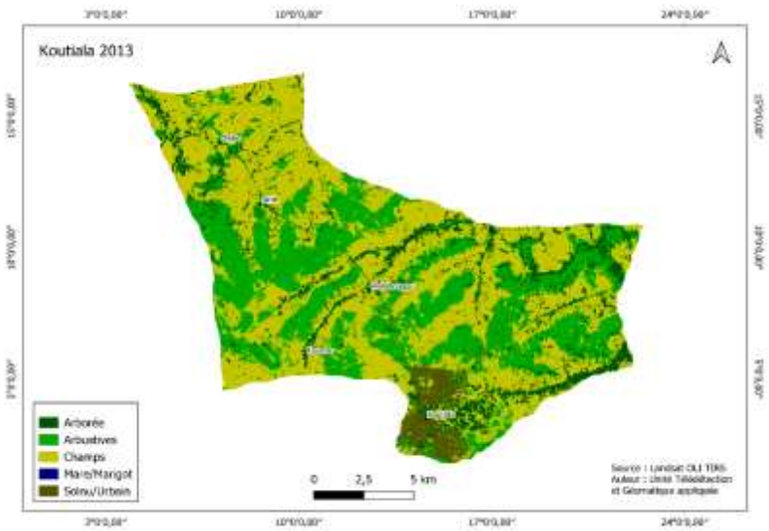
The commune of Karagouana Malle comprises 5 villages and a total population of 9,257 inhabitants, including 5,620 women. It is located in the CMDT zone, where cotton growing is highly developed. This explains the high level of land occupation by fields (70%) and low vegetation cover (24%). Analysis of the spatiotemporal evolution of land use and cover shows that between 2013 and 2023, 26.55 hectares of forest and 56.98 hectares of Shrubby savannah are transformed into cultivated fields each year. This represents 83.53 hectares of environmental degradation per year. This continuous expansion of cultivated fields is a response to the need to increase agricultural production, where cotton cultivation is highly developed.

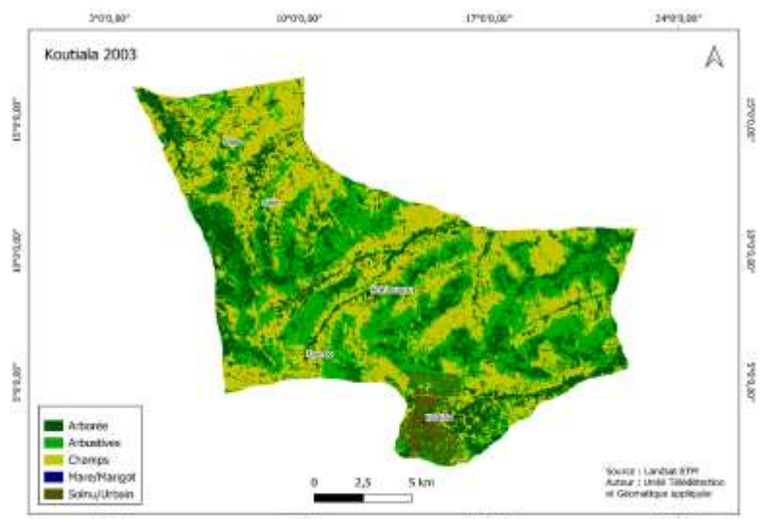
There is therefore a need to improve the yields of the crops grown in the villages through the use of improved seed varieties, the practice of intercropping and actions for water conservation and soil fertility. These actions will allow the establishment of crop fields. To reverse this trend, large-scale actions must be carried out. These include in particular:

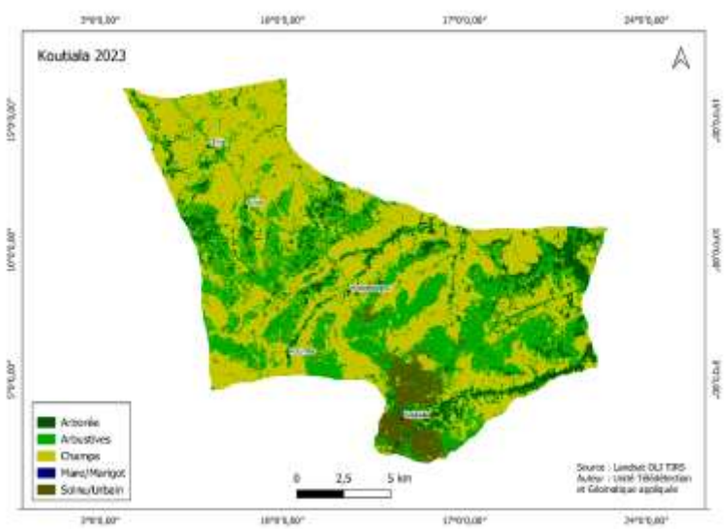
- Mass training on cultivation techniques adapted to new crop varieties;
- Use of climate information and production/use of organic manure in all villages;
- Compensation of degraded and deforested areas through reforestation and or assisted natural regeneration (RNA) at the level of all villages in the commune;
- The tenuous village workshops to inform and raise awareness on the effects of climate change;
- Support to nursery growers in the production and sale of seedlings for reforestation;
- Cascading training of rural and urban women and youth for the use of targeted improved stove models;
- Training of young women and men by village in the manufacture and sale of improved stoves (model WASA and Yèrèdèmè);
- Support for two (2) small-scale companies manufacturing improved solar stoves for households in urban and semi-urban areas to reduce wood consumption by 20% energy;
- Producer training on technical routes for improved seed crops;
- Purchase and distribution of improved seeds varieties in targeted villages;
- Local monitoring by the technical services of agriculture and the polyvalent advisers of the NGO AMEDD.
- Organization of village self-assessment and programming workshops each year to resize interventions according to community needs.
- Organisation of a communal self-assessment and consolidated action planning workshop every year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

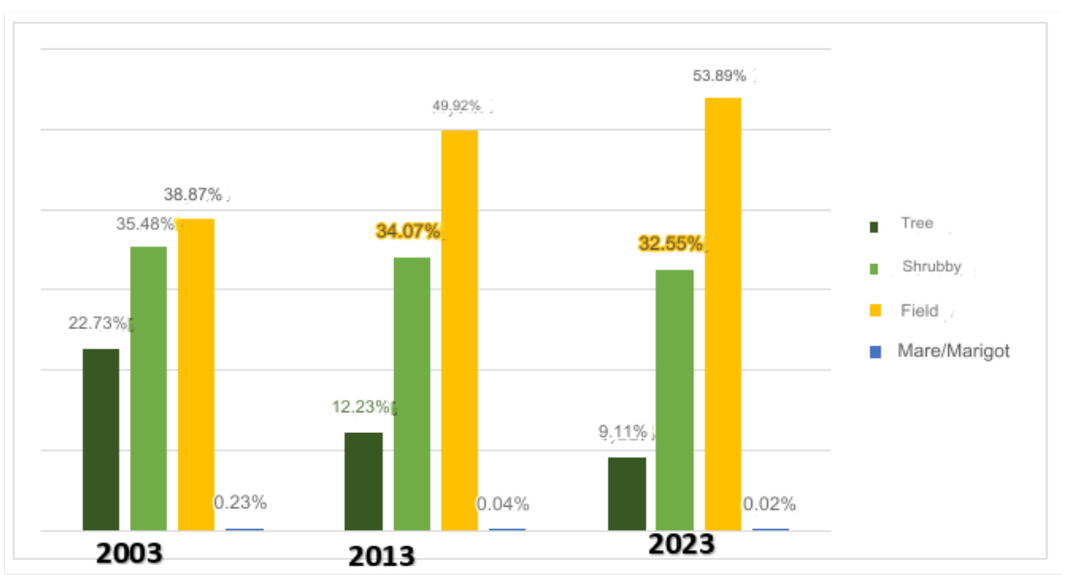
The maintenance of soil fertility and practices for the recovery of degraded land (stony cord, composting, agroforestry, forage cultivation, grass strip planting, soil dyke etc.) are necessary in the area. Similarly, sensitizations can also be undertaken to stop or reduce the abusive cutting of wood in the area. Promoting the intensification of climate-sensitive agriculture can be recommended. Livelihood diversification actions are advised in the area.

III.7 Dynamics of land cover and land use in the commune of Koutiala









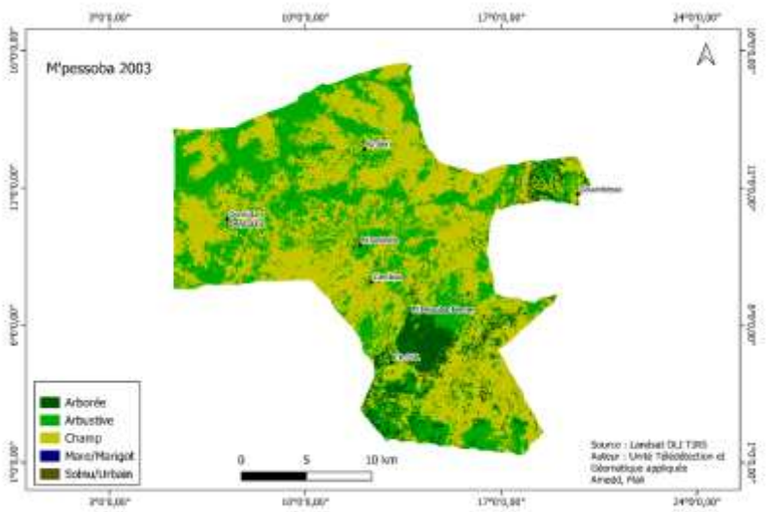
Occupancy class	Koutiala			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	275,39	Hectares converted into other classes per year	81,9	Hectares reduced per year
Shrubby	36,88	A slight reduction in ha per year	39,89	A slight reduction in ha per year
Field	290	Hectares acquired (gained) per year (growth rate)	103,96	Hectares increasing per year
Pond/Back water	5,03	A slight decrease in ha per year	0,46	A slight decrease in ha per year
Bare ground/Urban	27,27	An increase ha per year	18,32	A slight increase in ha per year

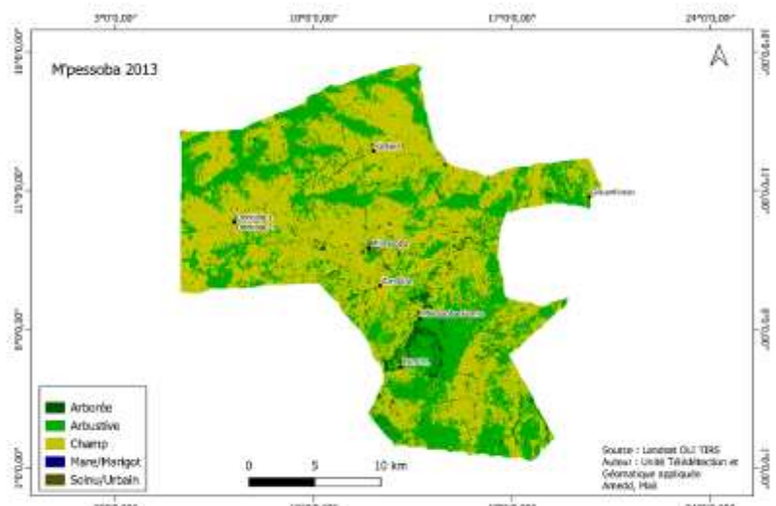
The urban commune of Koutiala has the city of Koutiala and 8 attached villages with a total population of 140,634 inhabitants including 70,539 women in 2023. The high population density and accelerated urbanization leads to the misuse of forest and the destruction of the environment. Cultivated fields rose from 38.87% in 2003 to 53.98% in 2023. Wood energy is abused by 100% of the rural and urban population. In addition, 100% of industries (oil mill, soap factory, modern bakeries, and other factories) operate exclusively on wood energy. To this is added the cultivation of cotton, which constitutes the main cash crop of the region.
Climate change and variability exacerbate the vulnerability of ecological ecosystems and community resilience.

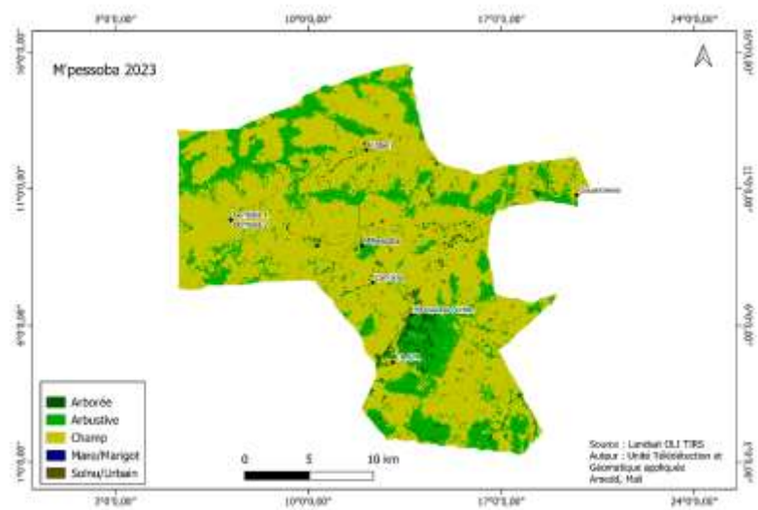
In the Koutiala district, changing the trajectory of change requires large-scale actions on the use of wood energy in households and in local and regional industries. Major concrete actions to consider include:

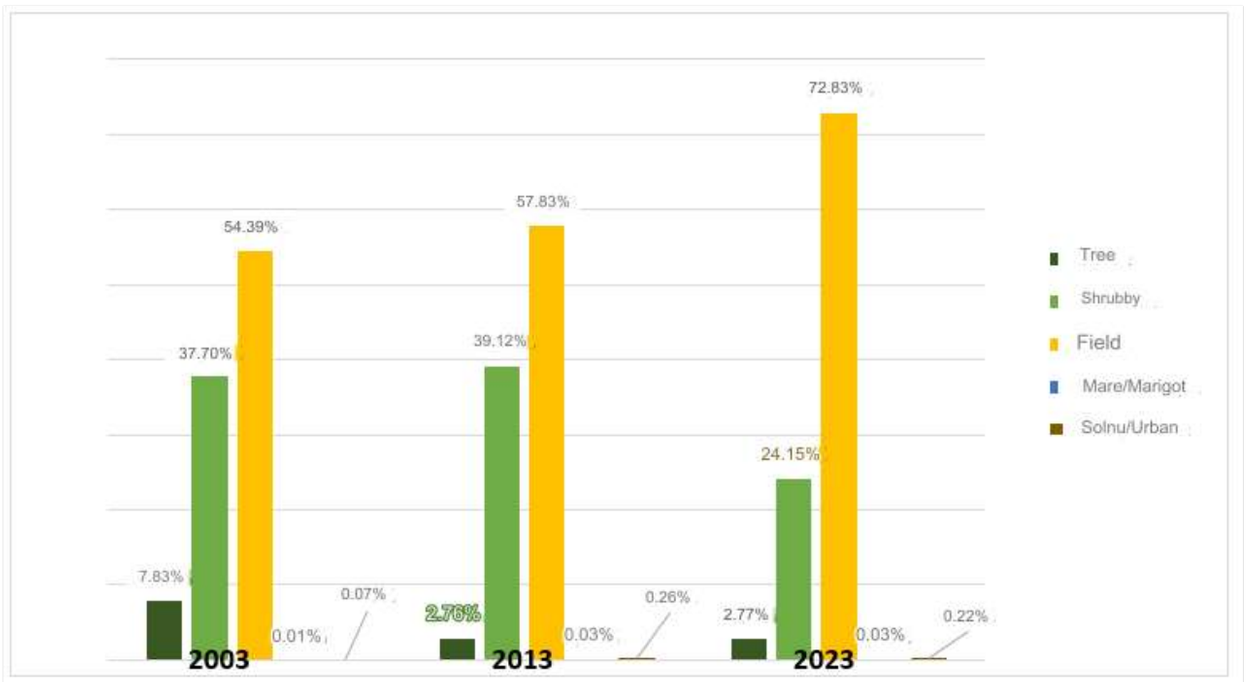
- Organization of 40 information and awareness assemblies (villages) to reach 40,000 people for optimal use of energy resources and sustainable management of natural resources; presentation of maps of the spatiotemporal evolution of the degradation of spaces and natural resources.
- Reforestation or assisted regeneration of the equivalent of deforestation of the last two (2) years or 243.58 hectares to be shared between the villages during village workshops and information and awareness district.
- Support to 20 nursery growers in the production and sale of seedlings for reforestation.
- Stunt training of 2000 rural and urban women and youth for the use of targeted improved stove models.
- Training of 300 people including 200 women and 100 young people divided between the villages of the commune in the making and sale of improved WASA and Yèrèdèmè model.
- Organization of one (1) knowledge and innovation fair per year, for 3 years, to mobilize local, regional and national institutional actors in the process of ecological and economic resilience of communities in the district of Koutiala.
- Support for five (5) small-scale companies manufacturing improved solar stoves for households in urban and semi-urban areas to reduce wood consumption by 20% energy.
- Introduction of seed varieties and demonstrations for a large-scale dissemination of climate-smart agriculture practices (maize, sorghum, millet, rice, Nièbé, Fonio). The seed varieties and quantities of seed will be chosen according to the preferences of each village population.
- Training of 15,000 producers (young and women) on the technical routes of improved seed crops.
- Training of producers (young people and women) on the rapid production of compost and use of calcium amendments, recycling each year based on the deficiencies found following self-assessment and programming by village.
- Fixing of the cultivated Fields by implementation of contour bunding : 20 hectares per village per year for 3 years, a total of 1200 hectares of cultivated Fields.

III.8 Dynamics of land cover and land use in the commune of M'pessoba









Occupancy class	Mpessoba			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	256,83	Hectares converted into other classes per year	0,68	A slight increase in ha per year
Shrubby	72,09	A slight increase in ha per year	758,41	Hectares per year (reduced)
Field	174,5	An increase in ha per year	759,55	Hectares acquired (increasing) per year
Pond/Back water	0,8	A slight increase in ha per year	0,08	A slight increase in ha per year
Bare ground/Urban	9,44	A slight increase in ha per year	1,75	A reduction in ha per year

The commune of M'Pèssoba has 20 villages and a population of 35,331 inhabitants including 18,365 women in 2023. The high density of the population and a tendency to urbanization accelerate the extension of the cultivation fields at the expense of wooded areas. Cultivated fields have evolved from 54, 39% in 2003 to 72, 83% in 2023. The Forest savannah occupied 7.83% of the area of the municipality in 2003, it rose to 2.77% in 2023 and the savannah Shrubbys went from 37.70% in 2003 to 39.12% in 2013.

The municipality of M'Pèssoba has a semi-urban trend with the misuse of wood energy. In addition, the municipality is an agricultural production area par excellence with the cultivation of cotton as the main source of income for producers. This situation generates a strong occupation of the land by the Fields of cultivation. There is therefore a need to improve the yields of the crops grown in the villages using improved seed varieties, the practice of intercropping and actions for water conservation and soil fertility. To reverse the trend in the commune, large-scale actions have been developed. Actions of assisted natural regeneration (RNA), and practices of recovery of degraded land (Composting, Agroforestry, etc.) are necessary. Similarly, sensitizations can also be undertaken to reduce the abusive cutting of wood.

The concrete needed action are:

- Organization of 40 village's information and awareness meetings to reach 2,000 households for optimal use of energy resources and sustainable management of natural resources.
- Reforestation or assisted regeneration of the equivalent of the last two (2) years deforestation: to be distributed between the commune villages during village information and awareness workshops.
- Support of nursery growers in the production and sale of seedlings for reforestation.
- Cascading training of rural and urban women and youth for the use of targeted improved stove models.
- Training of young women and men by village in the making and sale of homes improve.
- Support for two (2) small-scale companies manufacturing improved solar stoves for households in urban and semi-urban areas to reduce wood energy consumption.
- Introduction of varieties and demonstrations for widespread dissemination of climate-smart farming practices.
- Training of producers (youth and women) on technical routes of improved seed crops.
- Training of producers (young and women) on the rapid production of compost and use of amendments.
- Fixing Fields in all the villages by contour bunding implementation (20 hectares per village)

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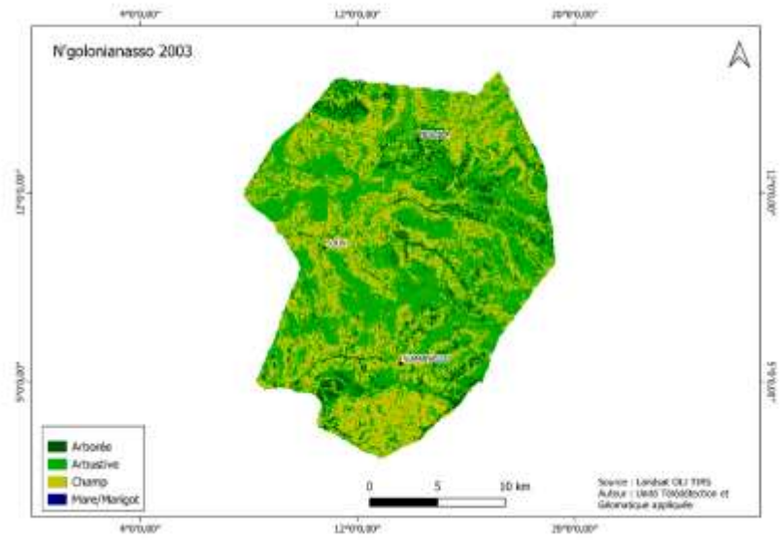
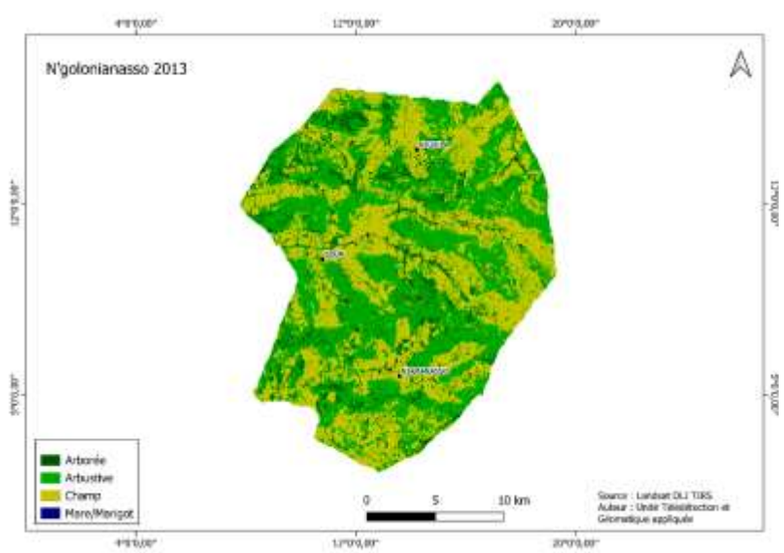
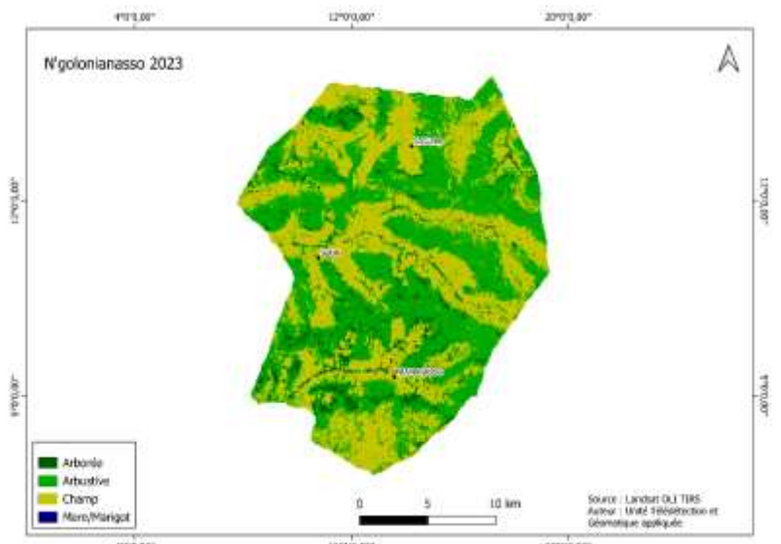
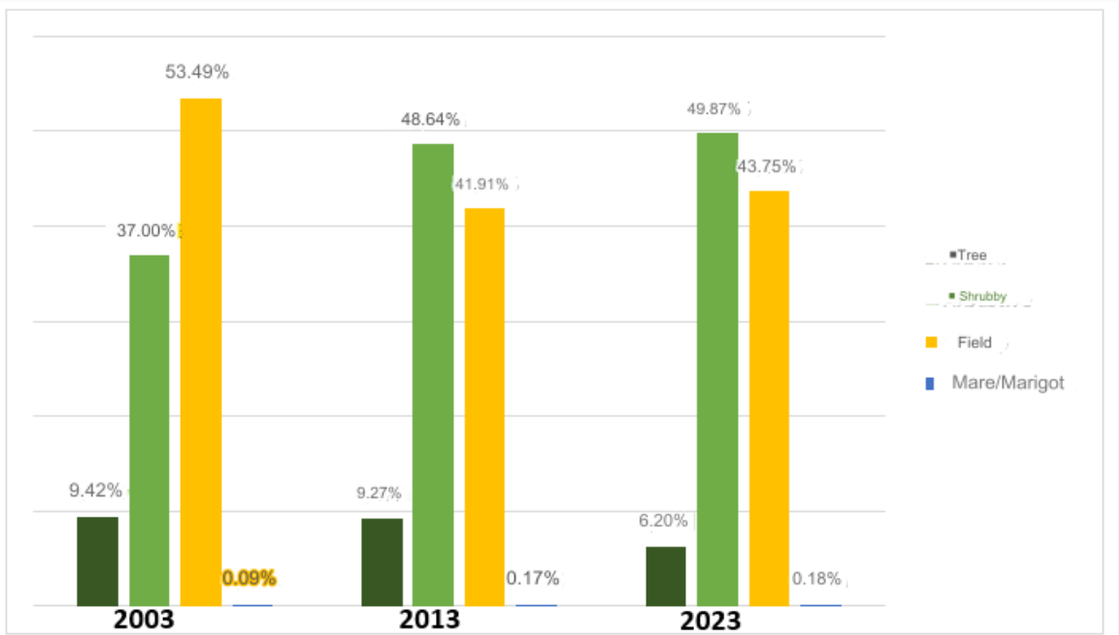
III.9 Dynamics of land cover and land use in the commune of N'golonianasso









Occupancy class	Ngolonianasso			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	6,51	A slight decrease in ha per year	138,73	A slight decrease in ha per year
Shrubby	525,25	Hectares acquired (earned) per year	55,42	A slight increase in ha per year
Field	522,4	Hectares reduced per year	82,87	A slight increase in ha per year
Pond/Back water	3,66	Hectares closed per year	0,44	Hectares closed per year

The commune of N'golonianasso has 12 villages with a population of 19,802, including 10,258 women 2023. Cultivated fields decreased from 53.49% in 2003 to 43.75% in 2023. Energy needs are based on the use of wood which leads to the destruction of the vegetation cover. The municipality of N'Golonianasso is an agricultural production area based on the cultivation of cotton and cereals. Climate change and variability exacerbate the vulnerability of ecological ecosystems.

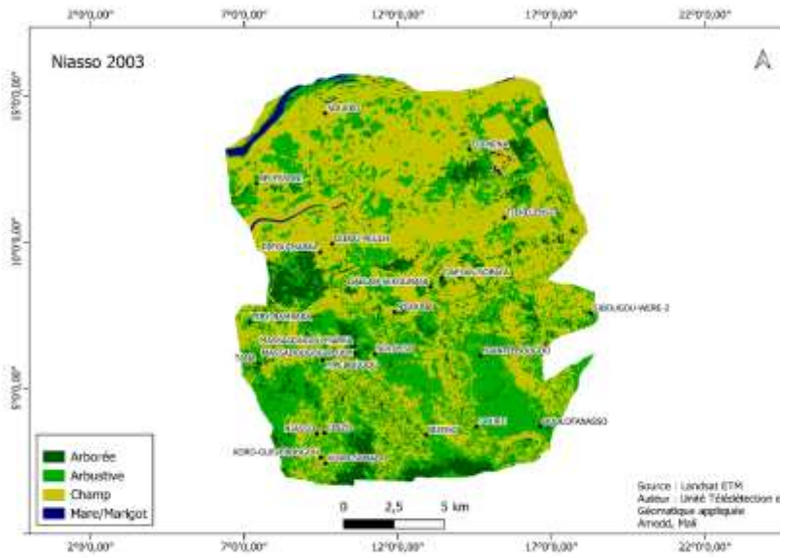
In this, major actions are needed to reverse the trends. Assisted natural regeneration (RNA) in the fields and in the Shrubby areas. Practices to recover degraded land are necessary also. Sensitizations can also be undertaken to reduce the abusive cutting of wood.

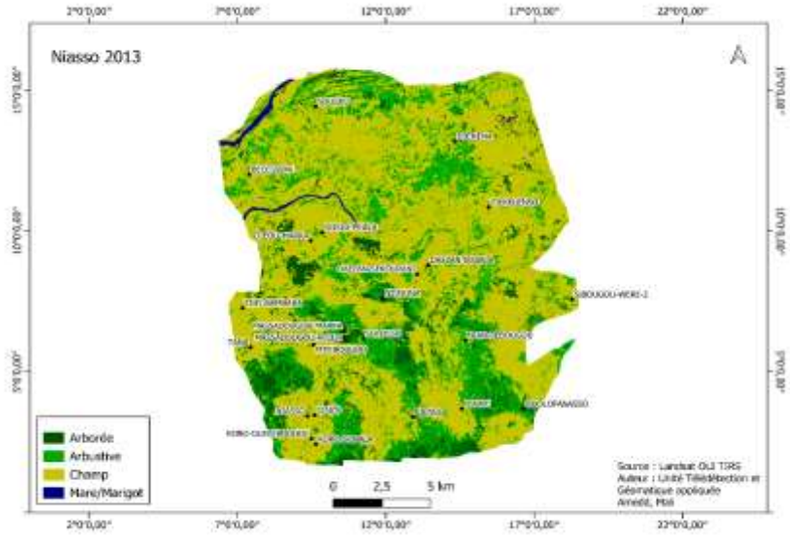
Specific actions to be undertaken include:

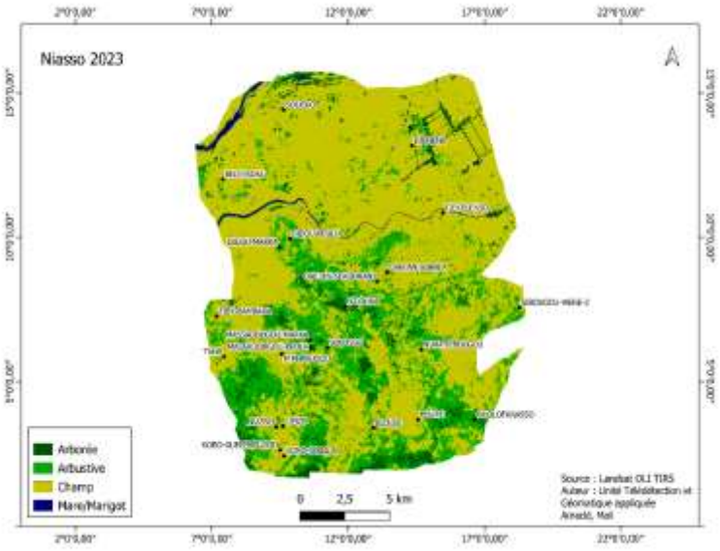
- Organization and holding of 24 villages information and awareness meetings on the misuse of wood and optimal use of energy resources and sustainable management of natural resources.
- Reforestation or assisted regeneration of the equivalent of deforestation (388.3ha) to be distributed between the commune villages.
- Support of 48 nursery farmers (two per village) in the production and sale of seedlings for reforestation.
- Training of 120 young women young men, 10 per village in making and selling homes improve
- Training of (1200) rural women and youth (100 per village) for the proper use of targeted improved stove models.
- Support for two (2) small-scale companies manufacturing improved solar stoves for semi-urban households to reduce wood energy consumption.
- Introduction of seed varieties and demonstrations for widespread dissemination of climate-smart farming practices.
- Training of 120 producers on technical routes for improved seed crops.
- Training of 1200 producers on compost production and use of amendments.
- Setting of 720 hectares of cultivation fields in all villages of the municipality by level curve improvements of 20 hectares per village and per year for 3 years.

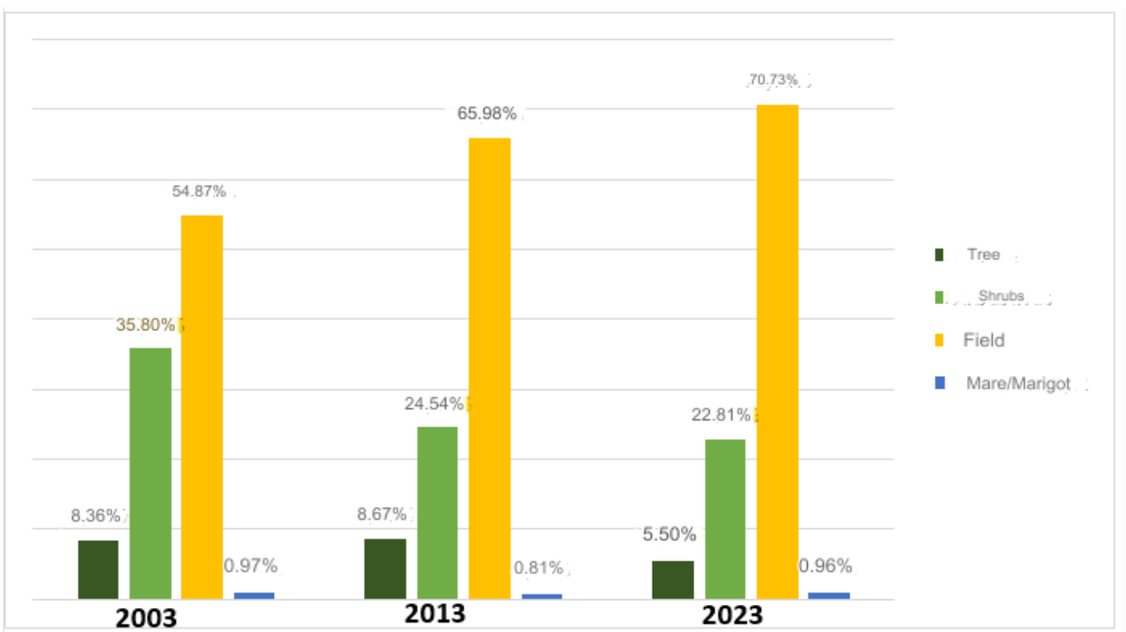
It is recommended to develop vegetable crops aground permanent water points, and water retention systems for market gardening and animal watering. It is necessary to strengthen the capacity of land governance commission. The development of local conventions (villages, communes and intercommunal) for the management of natural resources is necessary to preserve the conflict in these different areas. The implementation of the pastoral development plan to prevent possible conflict between farmers and pastoralists.

III.10 Dynamics of land cover and land use in the commune of Niasso









	Niasso			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	10,04	An increase in ha per year	100,97	A reduction in ha per year
Shrubby	358,31	Hectares reduced per year (in reduction)	54,98	A slight reduction in ha per year
Field	353,6	An increase in ha per year	151,09	Hectares acquired (earned) per year
Pond/Back water	5,33	A decrease in ha per year	4,86	An increase in ha per year

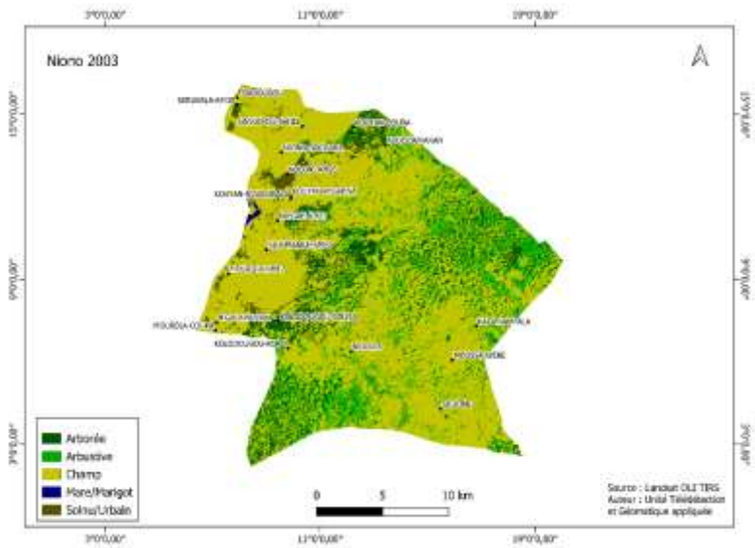
The commune of Niasso has 27 villages and a total population of 13,172 inhabitants, including 6,750 women in 2023. The analysis of the spatiotemporal evolution of land cover and land use shows that between 2013 and 2023, 100.97 hectares of forest and 54.98 hectares of Shrubby savannah are transformed into Field of cultivation each year. This represents 155.95 hectares of environmental degradation per year. To reverse the trend, it is necessary to carry out awareness campaigns and training of stakeholders on cultivation techniques adapted to new crop varieties. The use of climate information, the use of organic manure and the strengthening of agroforestry in the 18 villages most affected by vegetation degradation are also essential practices. Maintaining soil fertility requires planting trees in cultivated fields. Over the next two years, it should be planted at least 1,705 feet of trees in the municipality of Niasso.

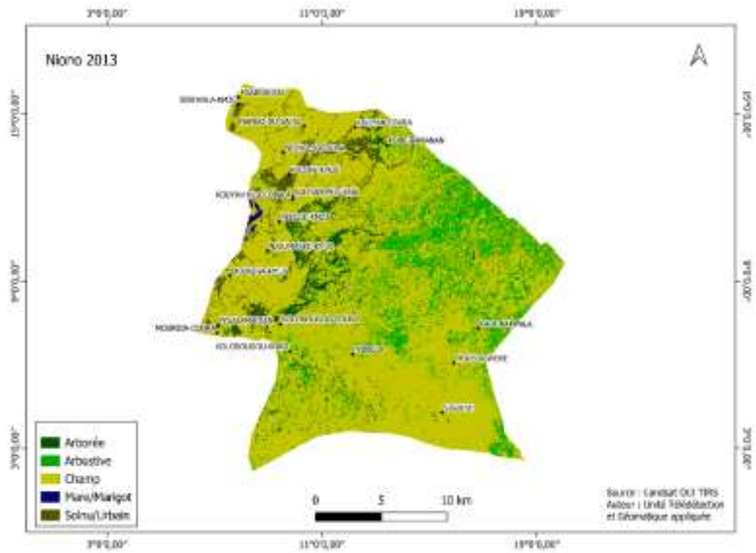
The pre-identified villages are: Soucko, Djenena, Belessoni, Tiekelenso, Dieou-Peulh, Dieou-Marka, Daelan-Sobala, Daelan-Sekourani, Tybi-Bambara, Tana, M'pebougou, Sibougou-Were, Poure, Bienso, Niasso , Cinzo, Koro-Guelebougou and Koro-Sobala. Community mobilization for engagement in the soil restoration process should be done through municipal self-assessment workshops and planning of reforestation and assisted regeneration activities (RNA).

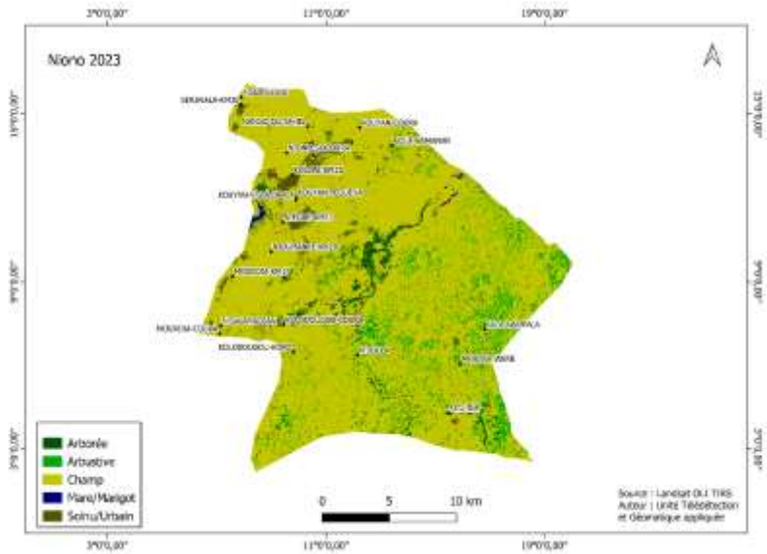
Given climatic variabilities and the experience of land occupation and use practices in the commune of Niasso, the activities mentioned below are necessary:

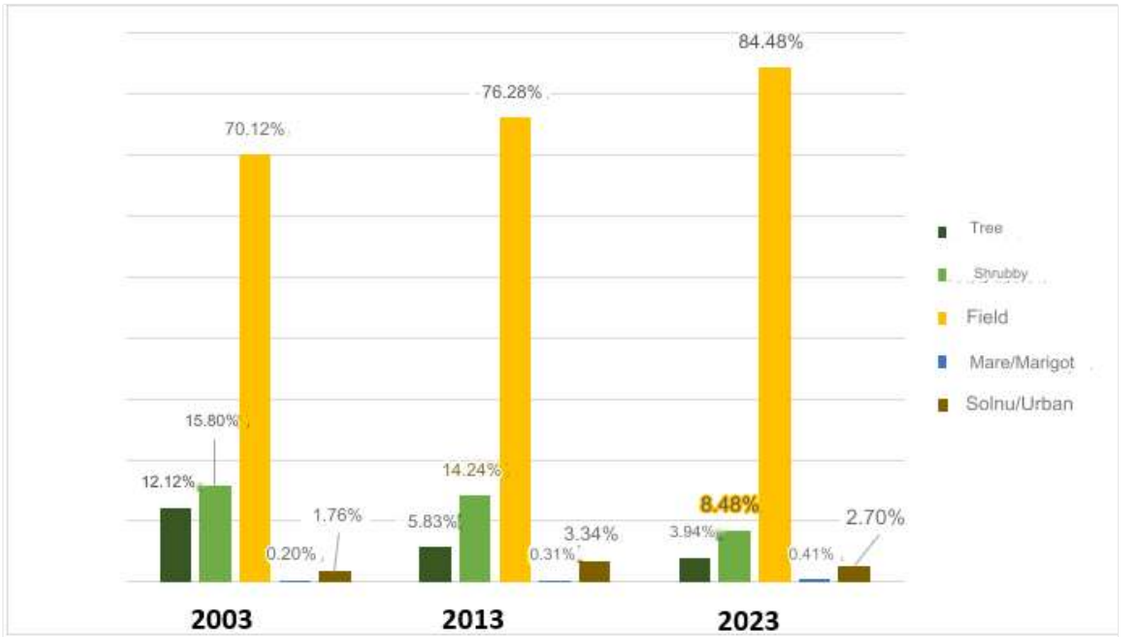
- One (1) communal workshop to report on the state of degradation of spaces and natural resources with 50 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Fifteen (15) villages workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved seed varieties of corn, sorghum, millet, rice, cowpea, fonio) and restoration, maintenance of fertility of soils (contour bunding of Fields, RNA, reforestation);
- Purchase and distribution of tree seedlings in targeted villages:
- Training of 1,800 producers on the technical routes for growing improved seeds, including 100 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village;
- Planting of 1705 trees on 155.95 hectares;
- Dissemination of climate information in the form of a video in local language (target 100 producers per village), for a total of 1,800 producers including young people and women;
- Organization of 18 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 18 villages self-assessment and programming workshops each year to resize interventions in accordance with the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.11 Dynamics of land cover and land use in the commune of Niono









Occupancy class	Niono			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	300,47	Hectares transformed into other classes per year	90,1	Hectares transformed into other classes per year
Shrubby	74,45	A slight reduction in ha per year	275,48	A slight reduction in ha per year
Field	294,09	A slight increase in ha per year	391,55	Hectares increasing per year
Pond/Back water	5,29	An increase in ha per year	4,85	An increase in ha per year
Bare ground/Urban	75,53	Hectares increasing per year	30,8	A slight decrease in ha per year

The commune of Niono has 22 villages and a total population of 81,643 inhabitants including 41,174 women in 2023. The analysis of the spatiotemporal evolution of land occupation and use shows that between 2013 and 2023, 97 .1 hectares of forest and 275.48 hectares of Shrubby savannah are transformed into cultivation fields each year. This represents 372.58 hectares of environmental degradation per year. The degradation is located in the northwest and south of the commune of Niono. Forest and Shrubby are the most affected by this degradation. The commune of Niono is a rice growing area so it is recommended to improve crop yields using improved rice seed varieties, good water management and soil fertility.

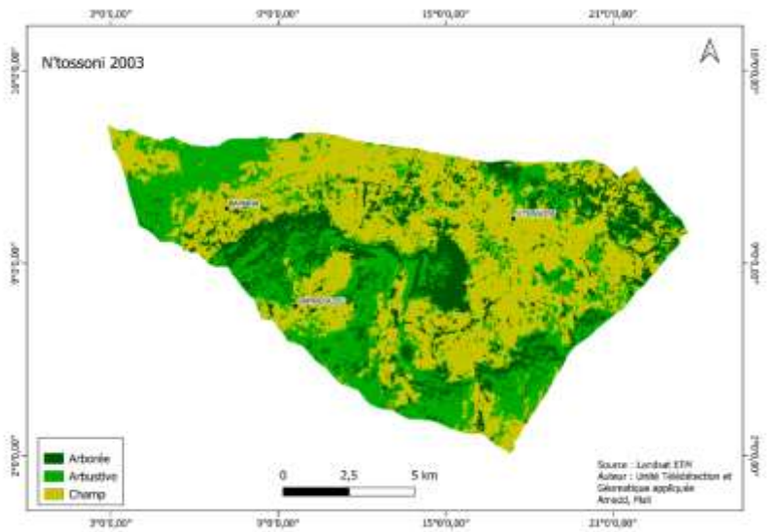
To reverse the trend, it is necessary to popularize new seed varieties of rice adapted to climate change, the use of compost, the introduction of Boscia senegalensis in the commune of Niono to strengthen agroforestry and improve the fertility of soils in rice-growing areas in the North-West, South part. At least 4,092 trees should be planted in the most affected villages in the commune of Niono. The establishment of these plantations and the popularization of new seed varieties will be carried out by technical teams so that the technique is widely mastered and disseminated in the villages.

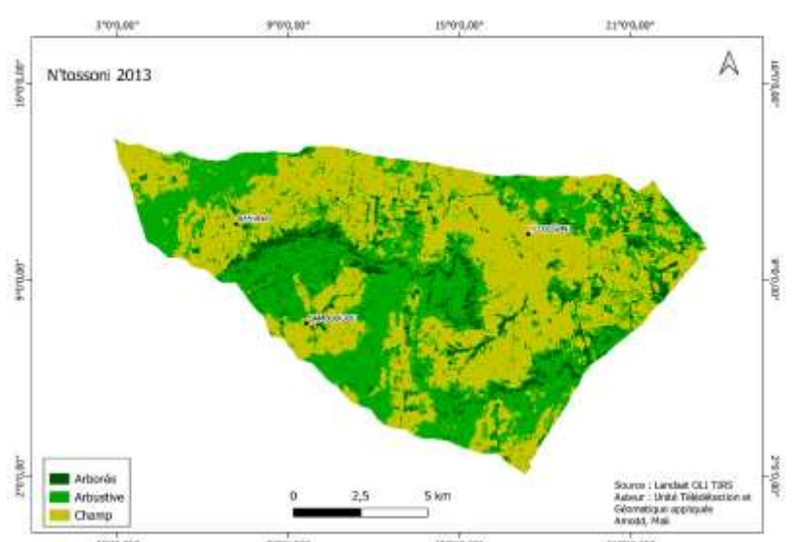
The pre-identified villages are: Foabougou, Seriwala Km30, Nango du Sahel, Niono Socoura, Koloni Km26, Kouyan peguena, Kouya N'golobala, Niegue Km23, Nioumanke Km20, Mourdia Km20, Siguine, N'dolla, Moussa were.

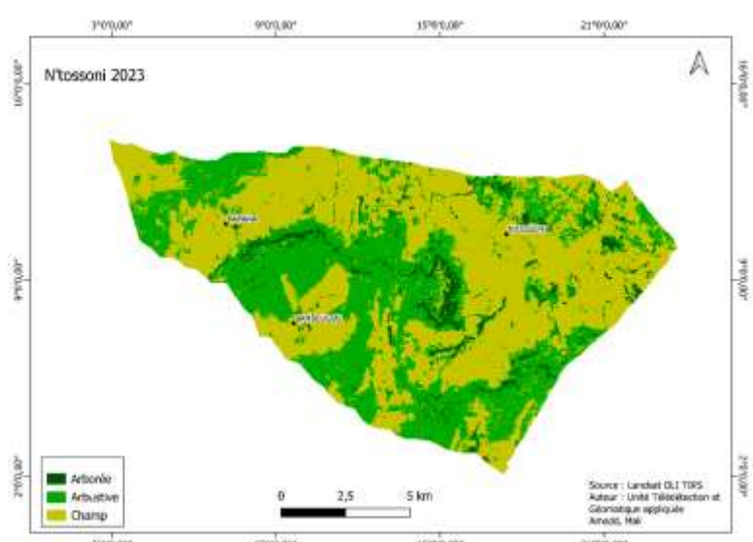
Community mobilization for engagement in the soil restoration process should be done through communal self-assessment workshops and planning of reforestation activities.
In view of climatic variabilities and the experience of land occupation and use practices in the commune of Niono, the activities mentioned below are necessary:

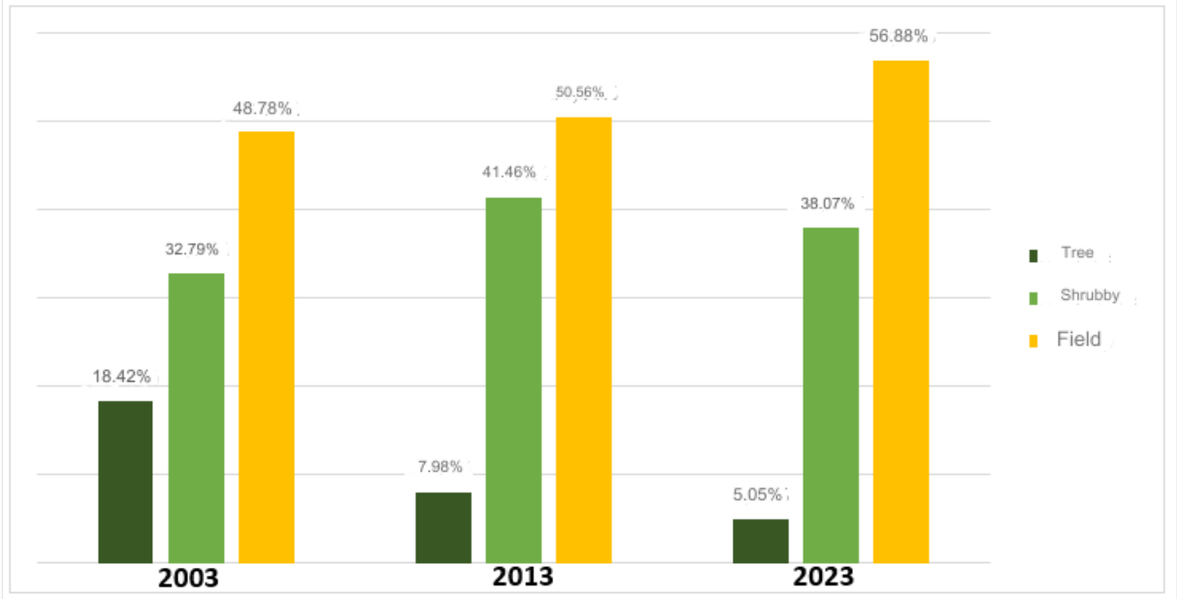
- One (1) municipal workshop to report the state of degradation of natural resources with 50 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Thirteen (13) villages workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved seed varieties of rice) and restoration, maintenance of soil fertility (reforestation).
- Purchase and distribution of tree seedlings in targeted villages.
- Training of 1,300 producers on the technical routes for growing improved seeds, including 100 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Planting of 4,092 trees on 372.58 hectares.
- Dissemination of climate information in the form of a video in local language (target 100 producers per village), for a total of 1,300 producers including young people and women.
- Organization of 13 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 13 villages self-assessment and programming workshops each year to resize interventions complying the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.12 Dynamics of land cover and land use in the commune of N'Tossoni









Occupancy class	N'tossoni			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	163,7	Hectares per year (reduction)	45,88	A slight reduction in ha per year
Shrubby	135,83	An increase in ha per year	53,16	A reduction in ha per year
Field	27,86	A slight increase in ha per year	99,04	Hectares per year (an increase)

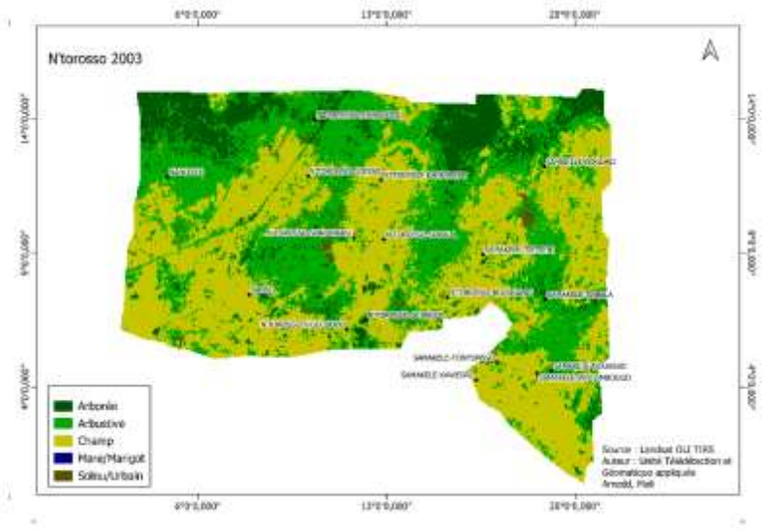
The commune of N'tossoni has 5 villages and a total population of 6,742 inhabitants, including 3,511 women. The analysis of the spatiotemporal evolution of land occupation and use shows that between 2013 and 2023, 45.88 hectares of forest and 53.16 hectares of Shrubby savannah are transformed into crop fields each year. This represents 99.04 hectares of environmental degradation per year. The degradation is located to the east and north of the commune. The savannahs and forests are the most affected by this degradation in the villages of: Bamanan, Bambougou and N'tossoni.

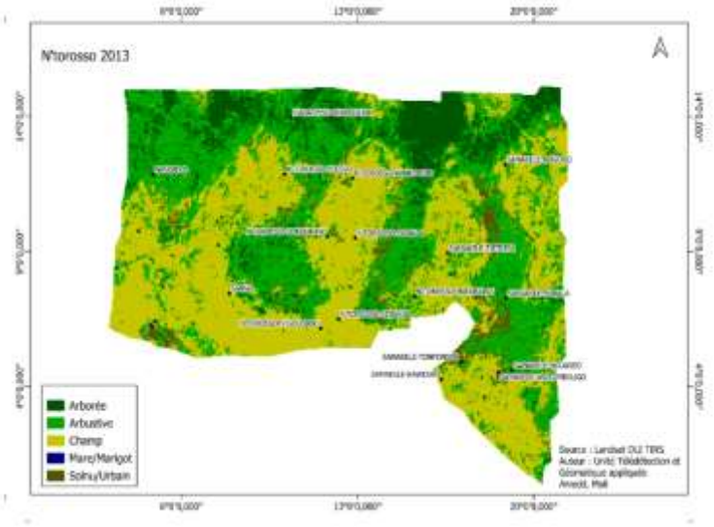
Agro-ecological practices are recommended to reduce this degradation, it is necessary to popularize new seed varieties adapted to climate change, improving soil fertility through agroforestry practices in the three most affected villages. At least 1089 trees should be planted. Community mobilization for engagement in the soil restoration process should be done through communal self-assessment workshops and the planning of reforestation activities.

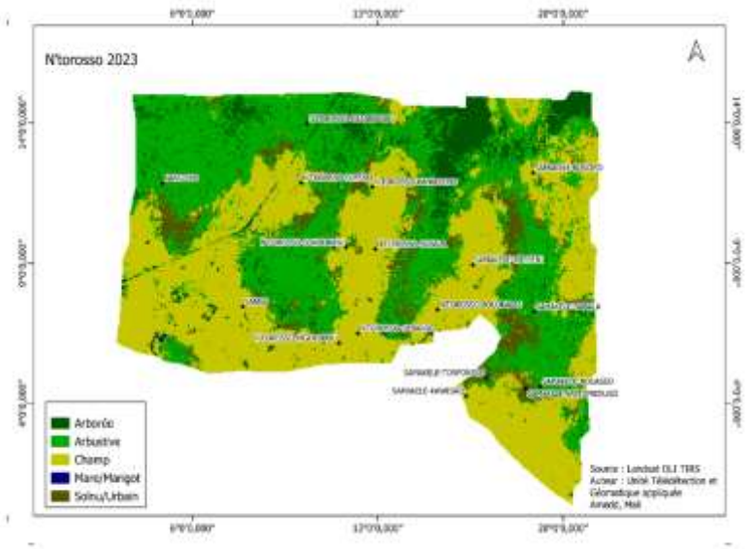
Given environmental degradation and spatiotemporal variations in land occupation and use in this commune, the activities mentioned below are necessary:

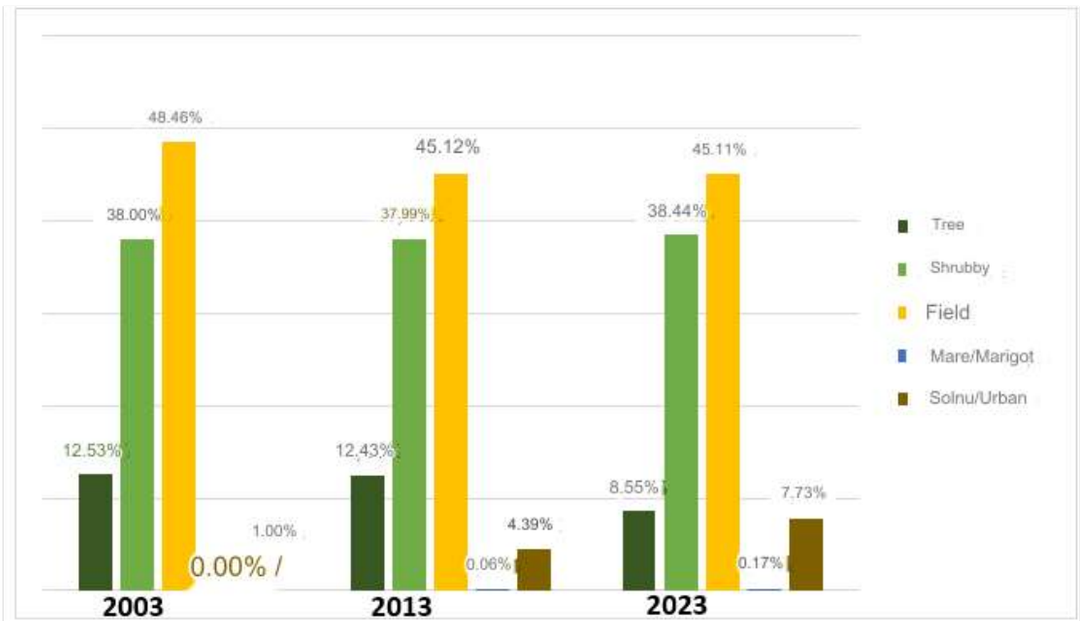
- One (1) municipal workshop to report the state of degradation of natural resources with 30 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Three (3) villages workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved cowpea and corn varieties) and restoration, maintenance of soil fertility (reforestation).
- Purchase and distribution of tree seedlings in targeted villages:
- Training of 300 producers on the technical routes for growing improved seeds, including 100 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Close monitoring by agricultural technical services and multi-purpose advisors from the NGO AMEDD to be recruited (service contract).
- Planting of 1089 trees on 99.04 hectares.
- Dissemination of climate information in the form of a video in local language (target 100 producers per village), for a total of 300 producers including young people and women.
- Organization of 03 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 03 village self-assessment and programming workshops each year to resize interventions in accordance with the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.13 Dynamics of land cover and land use in the commune of N'torosso









Occupancy class	Ntorosso			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	1,06	A slight reduction in ha per year	42,3	A reduction in ha per year
Shrubby	0,17	A slight reduction in ha per year	4,98	A slight increase in ha per year
Field	36,34	Hectares per year (reduction)	0,17	A slight reduction in ha per year
Pond/Back water	0,66	A slight increase in ha per year	1,18	A slight increase in ha per year
Bare ground/Urban	36,9	Hectares per year (increasing)	36,29	Hectares per year (increasing)

The commune of N'torosso has 17 villages and a total population of 10,199 inhabitants including 5,132 women in 2023. The analysis of the spatiotemporal evolution of land occupation and use shows that between 2013 and 2023, 42.03 hectares of forest and 04.98 hectares of Shrubby savannah are transformed into cultivation fields each year. This represents 47.01 hectares of environmental degradation per year.

The degradation is located in the center and south of the commune of N'torosso. The forests are the most affected by this degradation. This can be explained by the fact that the forests are fertile, rich in humus; this fuels a permanent desire among farmers to clear these spaces to plant annual crops. The most affected villages are: N'torosso-Dlesso, N'torosso-kankelebo, N'torosso-sokurani, N'torosso-sobala, Sanso, N'torosso-golobou, N'torosso-sebanso, N'torosso-Bolokalas , Samakele Kawesro, Samakele Wotombougo.

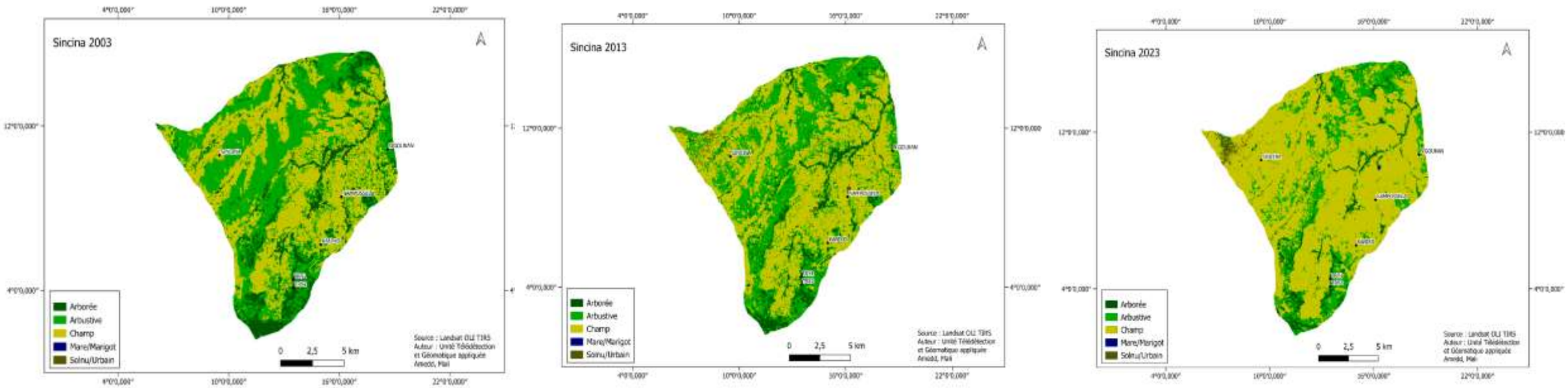
It is recommended the popularization of new improved seed varieties to increase agricultural production and natural regeneration practices to assist in improving biodiversity and maintaining soil fertility. At least 48 hectares should be regenerated in the most affected villages. Technical teams in conjunction will carry out the implementation of new seed varieties and natural regeneration practices with producers.

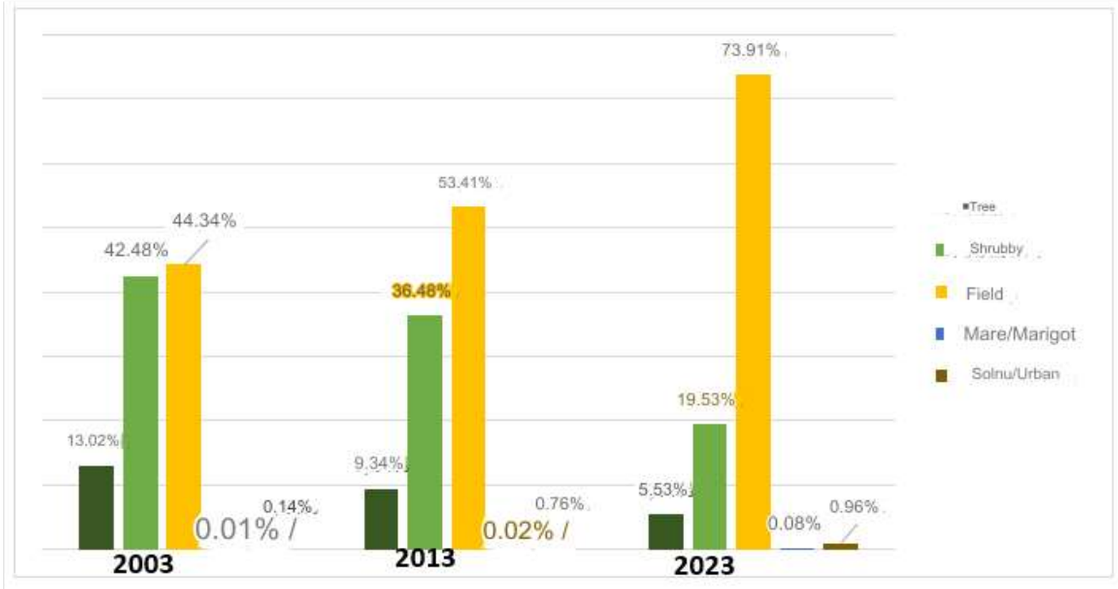
Community mobilization for engagement in the soil regeneration and restoration process should be done through municipal self-assessment workshops.

The activities listed below are necessary:

- One (1) municipal workshop to report the state of degradation of natural resources with 50 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Ten (10) villages workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved cowpea and corn varieties, sorghum) and restoration, maintenance of soil fertility.
- Training of 1000 producers on the technical routes for growing improved seeds, including 100 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Dissemination of climate information in the form of a video in local language (target 100 producers per village), for a total of 1,700 producers including young people and women.
- Organization of 10 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 10 village self-assessment and programming workshops each year to resize interventions complying with the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.14 Dynamics of land cover and land use in the commune of Sincina





Occupancy class	Sincina			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	78,93	Hectares transformed into other classes per year	81,64	Hectares per year (decreasing)
Shrubby	128,67	Hectares per year (reduction)	363,11	A reduction in ha per year
Field	194,15	An increase in ha per year	439,37	Hectares per year (an increase)
Pond/Back water	0,17	A slight increase in ha per year	1,21	A slight increase in ha per year
Bare gground/Urban	13,27	Hectares per year (increase)	4,16	Hectares per year (increase)

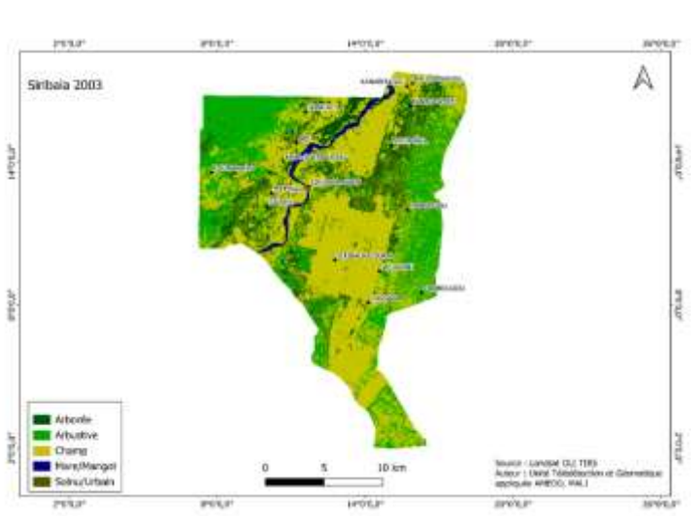
The municipality of Sincina has 7 villages and a total population of 19,046 inhabitants, including 9,675 women. The analysis of the spatiotemporal evolution of land occupation and use shows that between 2013 and 2023, 81.64 hectares of forest and 363.11 hectares of Shrubby savannah were transformed into crop fields each year. This represents 444.75 hectares of environmental degradation per year.

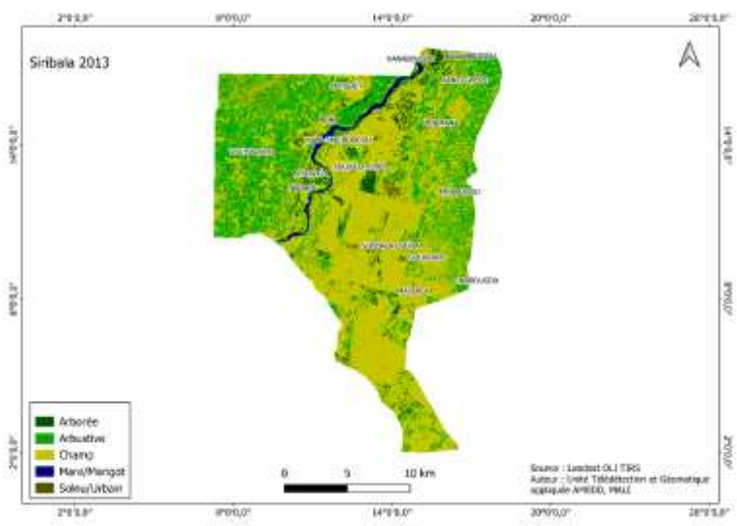
The deterioration is located in the center-east, south and west of the municipality of Sincina. The savannah is the most affected by this degradation and this is due to urbanization in the village of Sincina and a desire to increase agricultural production in the villages of: Nampossela, Try 1 and 2, Kaniko and Ngoukan. It is recommended to improve crop yields in the villages using improved seed varieties and the strengthening of agroecological practices. Community mobilization for engagement in the soil restoration process should be done through municipal self-assessment workshops.

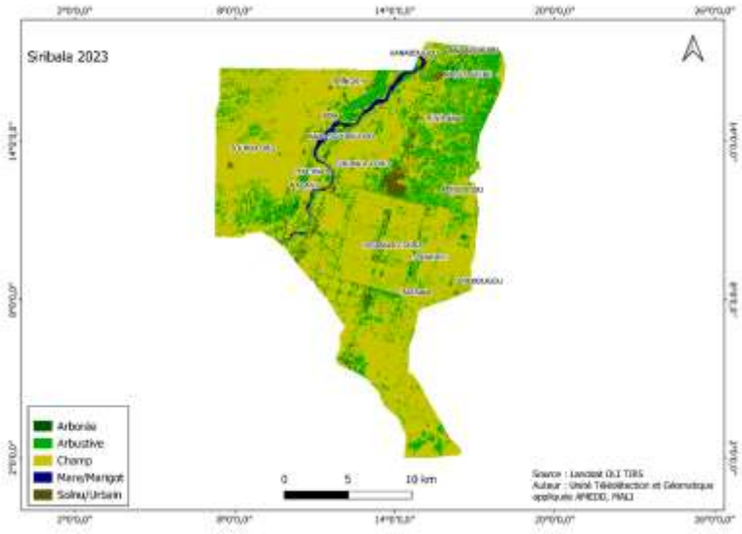
Given environmental degradation and changes in land occupation and use in the municipality of Sincina, the activities mentioned below are necessary:

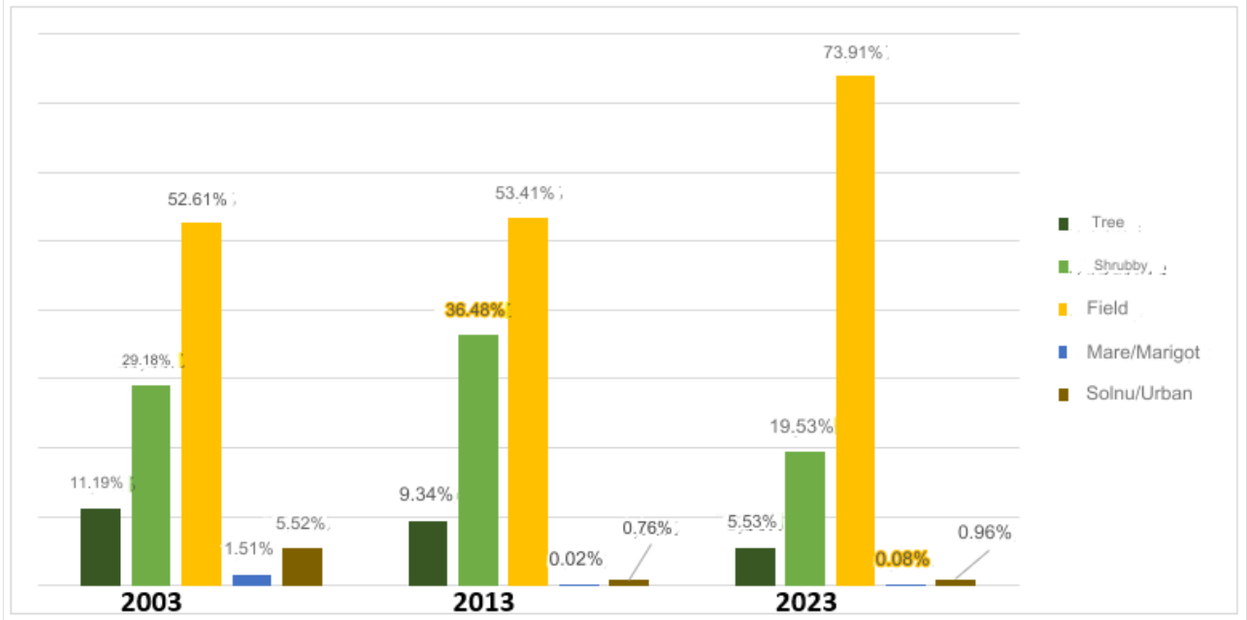
- One (1) municipal workshop to report the state of degradation of natural resources with 30 participants from villages and local management structures; sharing the major challenges of using innovations and promising technologies for improving agricultural productivity and soil restoration;
- Six (6) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved seed varieties of soybean, cowpea, and corn) and the restoration and maintenance of soil fertility.
- Training of 600 producers on the technical routes for growing improved seeds, including 100 producers per village; recycling each year based on the inadequacies noted following self-assessments and programming by village.
- Dissemination of climate information in the form of a video in local language (target 100 producers per village), for a total of 600 producers including young people and women.
- Organization of 6 inter-farmer visits (one visit organized per village) focusing on planted crops and other innovations for adapting the production system to climate change and variability.
- Organization of 6 village self-assessment and programming workshops each year to resize interventions complying the needs of the communities.
- Organization of a municipal self-assessment workshop and consolidated programming of actions each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.15 Dynamics of land cover and land use in the commune of Siribala









	Siribala			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	269,74	Hectares per year (a reduction)	81,64	A slight reduction in ha per year
Shrubby	443,57	Hectares acquired (earned) per year (increase)	363,11	Hectares per year (reduction)
Field	164,65	A slight increase in ha per year	439,37	Hectares per year (an increase)
Pond/Back water	63,11	Hectares per year (reduction)	1,21	A slight increase in ha per year
Bare gground/Urban	215,3	Hectares per year (reduction)	4,16	Hectares per year (increasing)

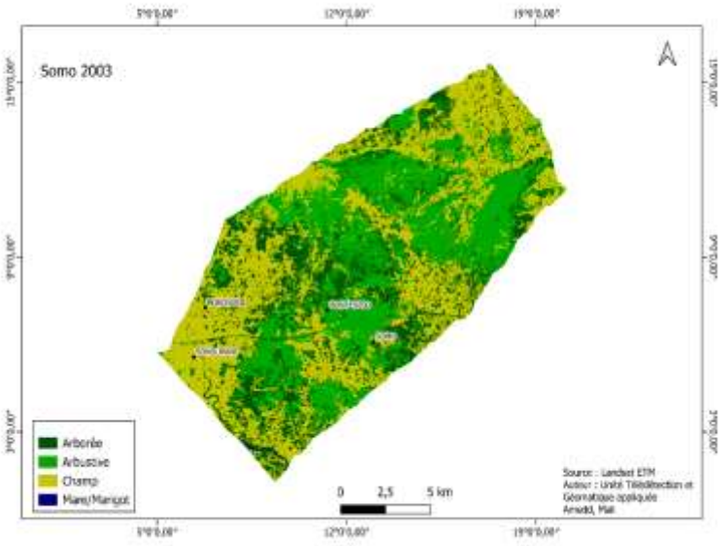
The commune of Siribala has 18 villages with a total population of 37,766 inhabitants including 18,665 women in 2023. It is characterized by a high occupation of space by the hydro-agricultural developments of the “Office du Niger” (74%). The high population density accelerates the expansion of crop fields to the detriment of wooded areas. Cultivated fields increased from 52.61% in 2003 to 73.91% in 2023.

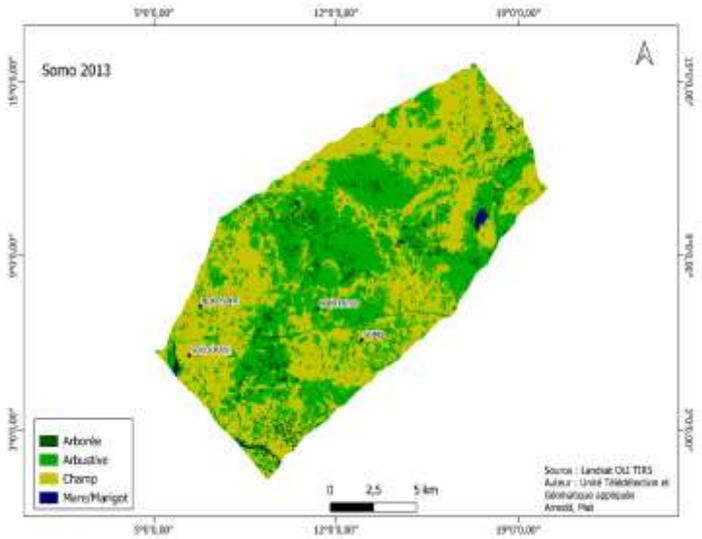
Climate change and variability aggravate the vulnerability of ecological ecosystems and community resilience. In the commune of Sibirila, important decisions from the Niger office are necessary to reverse this dramatic situation of forest destruction to the detriment of the fields.

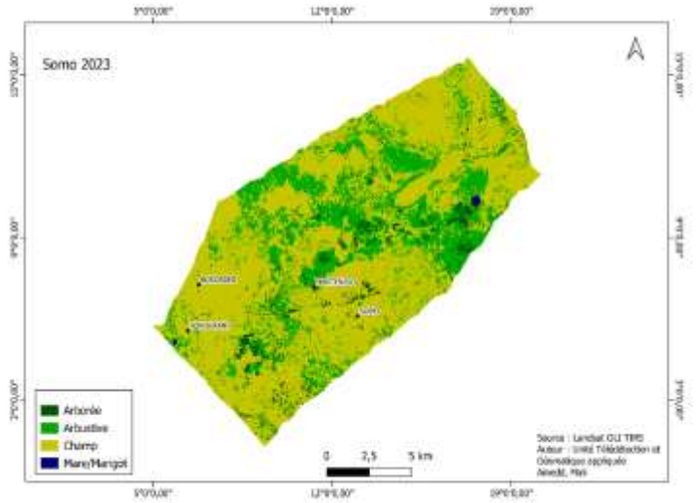
The 11 villages strongly affected by the degradation are: Toumacoro, M'Pewala, Nadani, Siribala coro, Siribala coura, Soualani, Massala, Chobougou, Kala soubougou, BDH, and Dongaly). The large-scale concrete actions to be considered include, among others:

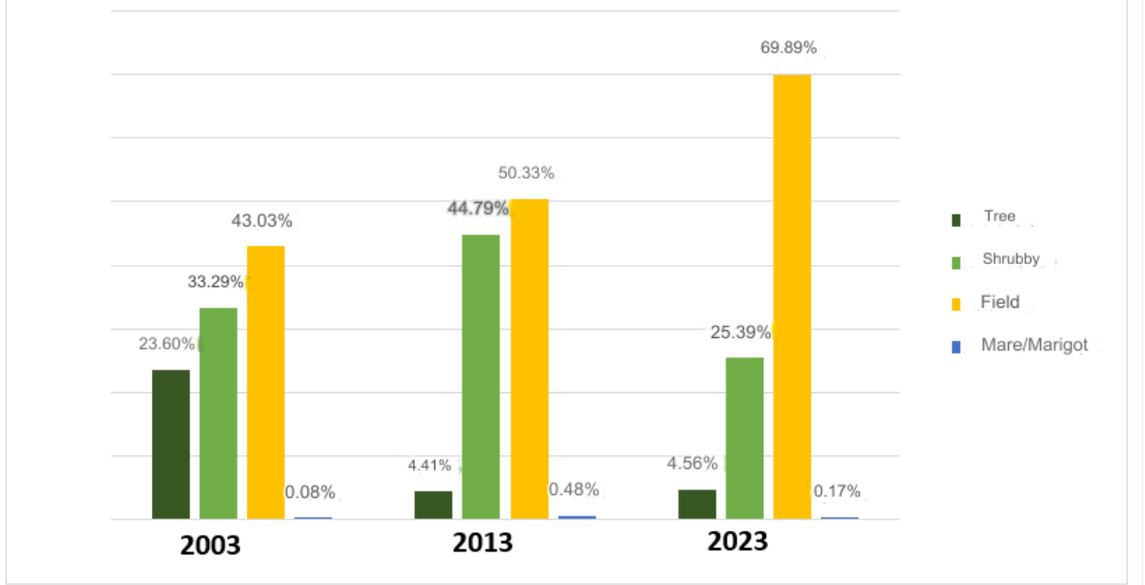
- Organization of 22 villages information and awareness assemblies in order to reach 22,000 people (11 villages * 2 assemblies) for optimal use of resources and sustainable management of natural resources; presentation of maps of the spatiotemporal evolution of the degradation spaces and natural resources.
- Reforestation or assisted regeneration of the equivalent of the deforestation of the last two (2) years, i.e. 444.75 hectares to be distributed among the villages during village information and awareness workshops.
- Support for 22 nursery growers (planters from the most affected villages in the production and sale of plants for reforestation).
- Organization of 3 municipal exchange workshops between local partners, stakeholders and the “Office du Niger” aground smart climate actions.
- Introduction of seed varieties and demonstrations for large-scale dissemination of climate-smart agriculture practices:
    - Rice: 10 hectares (demonstration) * 11 villages * 50 kg/ha, or 5500 kg of rice seeds (20cm by 20 cm spatial arrangement).
    - Cowpea: 2 hectares (demonstration) * 11 villages * 20 kg/ha, or 440 kg of cowpea seeds, variety Acar 1 or wilibali (75cm between rows and 30 between pockets).
    - Fonio: 2 hectares (demonstration) * 11 villages * 50 kg/ha, or 1100 kg of fonio seeds, Kassamara or Niatia variety (sowing by hand).
    - Sesam: 2 hectares (demonstration) * 11 villages * 50 kg/ha, or 1100 kg of sesame seeds, (sowing by hand).
- Training of 2,200 producers (young people and women) on technical routes for growing improved seeds, including 200 producers per village.
- Organization of 22 inter-farmer learning visits (two per village) to demonstration plots which will affect 220 people.
- It is necessary to undertake the creation of non-agricultural employment for young people and women in 11 villages (cutting and sewing, mechanics, carpentry).
- Creation or Strengthening of 11 land management commission.

III.16 Dynamics of land cover and land use in the commune of Somo









	Somo			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	467,03	Hectares per year (decreasing)	3,63	A slight increase in ha per year
Shrubby	279,81	Hectares per year (an increase)	472,02	A reduction in ha per year
Field	177,52	An increase in ha per year	475,97	An increase in ha per year
Pond/Back water	9,69	A slight increase in ha per year	7,58	A slight decrease in ha per year

The commune of Somo has 3 villages and a total population of 8,433 inhabitants, including 8,756 women. The analysis of the spatiotemporal evolution of land occupation and use shows a strong degradation of savannah trees of the order of 467 ha loss between 2003 to 2013 and a slight increase of 3.63 ha between 2013 and 2023 This represents 475.65 hectares of environmental degradation per year between 2013 and 2023. Shrubby savannahs increased by 279.81 ha between 2003 and 2013 and experienced a regression of 472 ha between 2013 and 2023. Watercourses have not undergone significant development. Agricultural areas have experienced a continuous increase over the years, increasing from 43% in 2003 to 50.33% in 2013 and reaching 69.89% of the area of the municipality in 2023.

This means a need to improve the yields of crops grown in the villages of the commune using improved seed varieties, the practice of intercropping, and actions to conserve water and soil fertility. To reverse the trend, it is necessary to carry out mass training on cultivation techniques adapted to new crop varieties, the use of climate information, and the production and use of organic manure in the villages. Maintaining soil fertility requires carrying out contour bunding in cultivated fields.

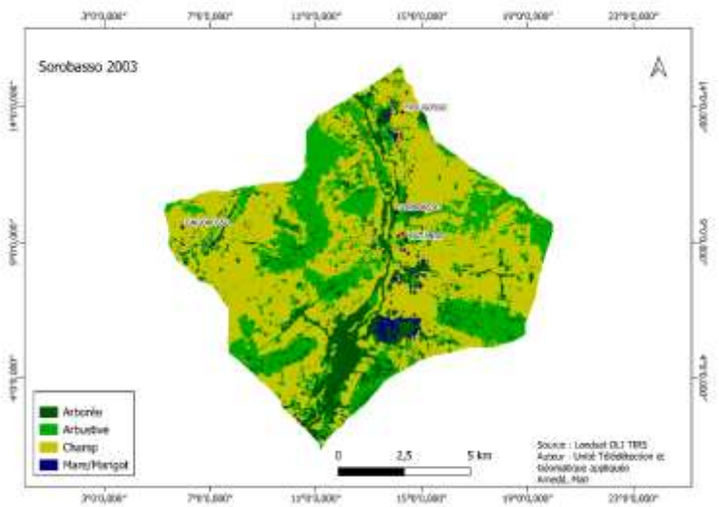
The commune has plains and ponds that can be developed, as well as temporary watercourses. This is an opportunity to develop market gardening aground permanent water points. As a result, 6 workshops on market-garden production will be held, reaching 300 people, or 100 per village. In addition, 60 women and young people are to be trained and supported in the production of improved vegetable seeds. To achieve this, at least 1 hectare of seed should be planted. These actors will be trained in the production and processing of biological products for market garden crops. Water retention systems (4) (bouli, BCR etc.) for market gardening and animal watering need to be built. Land commissions (Cofos) need to be strengthened in land governance. Local (village, commune and inter-commune) natural resource management agreements need to be drawn up to preserve existing resources in these different areas. Drawing up a pastoral development plan in each commune to prevent potential conflicts between farmers and herders.

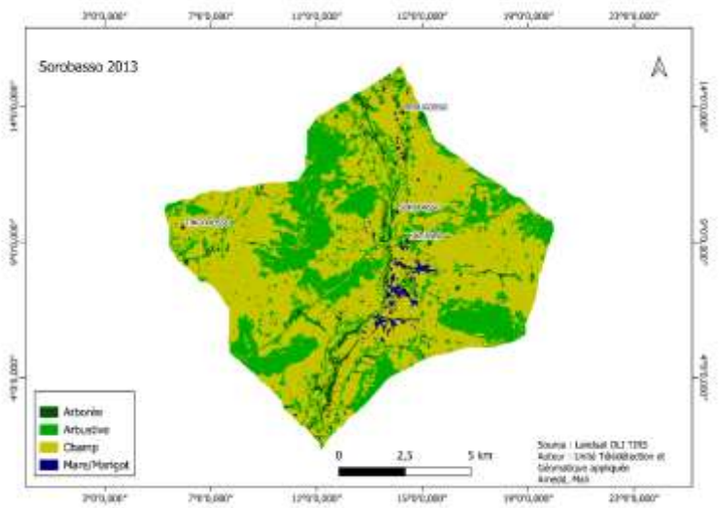
The 475.65 hectares of land cleared over the last two years are to be restored by reforestation and/or assisted natural regeneration (ANR). These areas will be divided between the commune's 3 villages.
Community mobilization for involvement in the soil restoration process should be achieved through communal workshops for self-assessment and planning of reforestation and assisted regeneration (RNA) activities.
To sum up, given climatic variability and the experience of land occupation and use practices in the commune of Somo, the following activities are necessary:

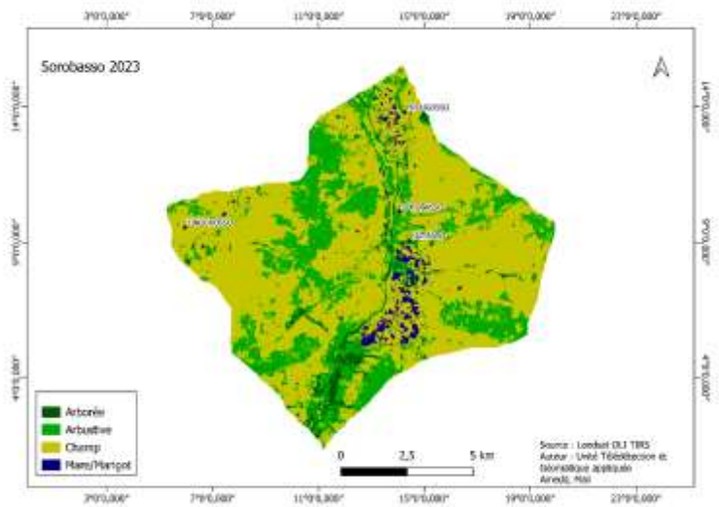
- One (1) communal workshop to share the state of degradation of natural areas and resources, with 30 participants from villages and local supervisory bodies; sharing of key issues in the use of promising innovations and technologies to improve agricultural productivity and soil restoration;
- Six (6) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved seed varieties of maize, sorghum, millet, rice, cowpea, fonio) and restore and maintain soil fertility (contour bunding of fields, RNA, reforestation, etc.).
- Purchase and distribution of improved seeds in targeted villages:
    - Corn: 5 hectares (demonstration) * 3 villages * 25kg/ha, i.e. 375 kg of yellow corn seed (Brico variety), 70 days, with a production capacity of 4 tonnes per hectare.
    - Sorghum: 5 hectares (demonstration) * 3 villages * 10kg/ha, i.e. 150 kg of dual-purpose sorghum seed (Diakounbè variety) early, 70 days, yield 2.5 tons per hectare.

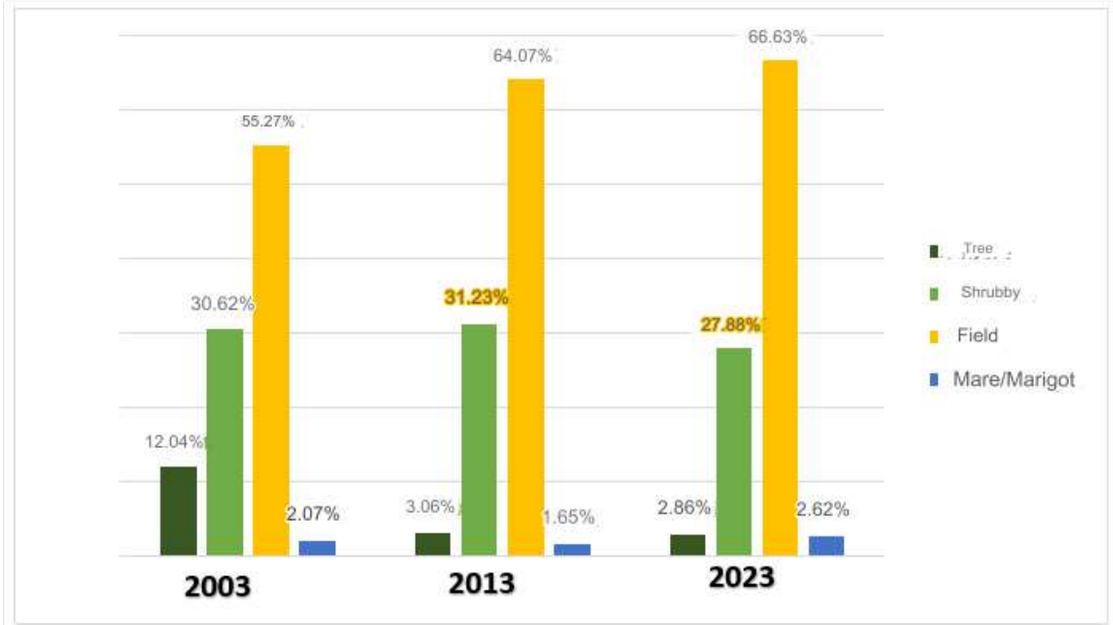
    - Millet: 5 hectares (demonstration) * 3 villages * 10 kg/ha, i.e. 150 kg of millet seed, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tonnes per hectare.
    - Rice: 5 hectares (demonstration) * 3 villages * 50 kg/ha, i.e. 3750 kg of rice seed, rainfed variety Nerika 8 (20cm by 20cm spatial arrangement).
    - Cowpea: 5 hectares (demonstration) * 3 villages * 20 kg/ha, i.e. 300 kg of cowpea seed, variety Acar 1 or wilibali (75cm between rows and 30 between bunches).
    - Fonio: 2 hectares (demonstration) * 3 villages * 50 kg/ha, i.e. 300 kg of fonio seed, variety Kassamara or Niatia (flap sowing).
    - Sesam: 2 hectares (demonstration) * 3 villages * 50 kg/ha, i.e. 300 kg of sesame seed, (sowing by flap).
- 300 growers trained in improved seed cultivation techniques, including 100 growers per village;
- Local follow-up by technicians.
- Creation of agriculture contour bunding: 30 ha (10 ha per village) in the form of demonstrations and training of independent teams to provide contour bunding cultivation technic using optical or water levels.
- Reforestation of 475.65 hectares and assisted regeneration of 1,000 hectares of land.
- Dissemination of climatic information in the form of a video in the local language (target 200 producers per village), i.e. a total of 600 producers including young people and women.
- Organization of 3 inter-farmer visits (one visit organized per village) focusing on crops planted and other innovations for adapting the production system to climate change and variability.
- Organization of 6 villages self-assessment and programming workshops each year to resize interventions in line with community needs.
- Organization of a communal self-assessment and consolidated programming workshop each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.17 Dynamics of land cover and land use in the commune of Sorobasso









	Sorobasso			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	97,14	Hectares converted to other classes per year	2,1	Hectares converted to other classes per year
Shrubby	6,58	Slight increase in ha per year	36,14	A slight decrease in ha per year
Field	95,13	Hectares acquired (gained) per year (rate of increase)	27,72	Hectares acquired (gained) per year (rate of increase)
Pond/Backwater	4,57	Hectares per year (decreasing)	10,52	Hectares clogged per year

The commune of Sorobasso comprises 4 villages and a total population of 5,716 inhabitants, including 2,916 women. Analysis of the spatiotemporal evolution of land use and occupation shows strong degradation of the Trees and Shrubby savannahs, with 38.24 hectares per year of environmental degradation between 2013 and 2023. This area was occupied by agricultural rights-of-way, which increased from 55% in 2003 to 64% in 2013, and reached 69.89% of the area in 2023.

This increase in agricultural land requires an improvement in crop yields in the villages of the commune. To reverse this trend, we need to promote crop association practices, water and soil fertility conservation and the use of improved varieties. Mass and cascade training in cultivation techniques adapted to the new crop varieties is also needed, as is the involvement of local producers and communities in the production of improved seeds. The use of climatic information and the production and use of organic manure in all villages affected by soil degradation. Maintaining soil fertility requires the implementation of contour farming in cultivated fields.

It is crossed by a large developable plain. This provides an opportunity for the area's population to develop market garden crops aground permanent water points. Furthermore, we can see a decrease in surface water between 2013 and 2023, i.e. 10ha per (1.6% to 2.6). This calls for major precautions to be taken to recover water lost to off-season and rain-fed activities on the plain. This will require the over-digging of water stagnation areas, as well as water retention systems (bouli, BCR, etc.) for market gardening and animal watering.

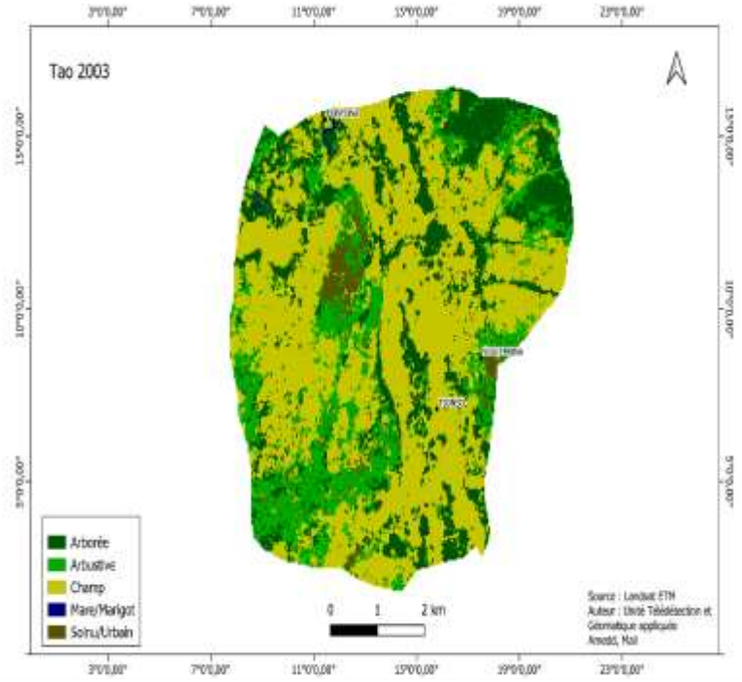
To better organizing the intervention in the commune, 8 evaluation and planning workshops will be held with the communities. These workshops will involve 400 people, i.e. 100 per village. In addition, 80 women and young people are to be trained and supported in improved vegetable seed production. To achieve this, at least 2 hectares of market garden seed should be planted. These actors will also be trained in the production and processing of biological products to treat market garden crops. Identification and marking of 10 pastoral trails. Drawing up a pastoral management plan for each village to prevent potential conflicts between farmers and herders.

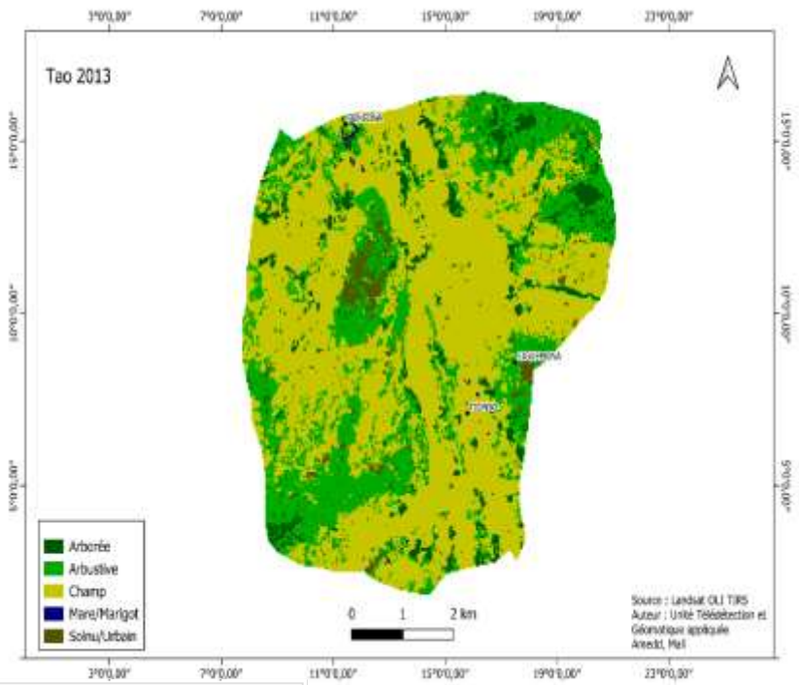
The areas deforested over the last two years (76.48 ha) are to be restored by reforestation and/or assisted natural regeneration. The pre-selected villages are: Sorobasso, Zingorosso, Kasianso and Frougosso. Actions based on market gardening should be emphasized in the villages of Sorobasso and Zingorosso.
Community mobilization for involvement in the soil restoration process will be achieved through communal self-evaluation and planning workshops for reforestation and assisted regeneration (RNA) activities each year.
The following activities could help reverse the situation of environmental degradation concerning climate variability and land occupation and use practices in the commune of Sorobasso:

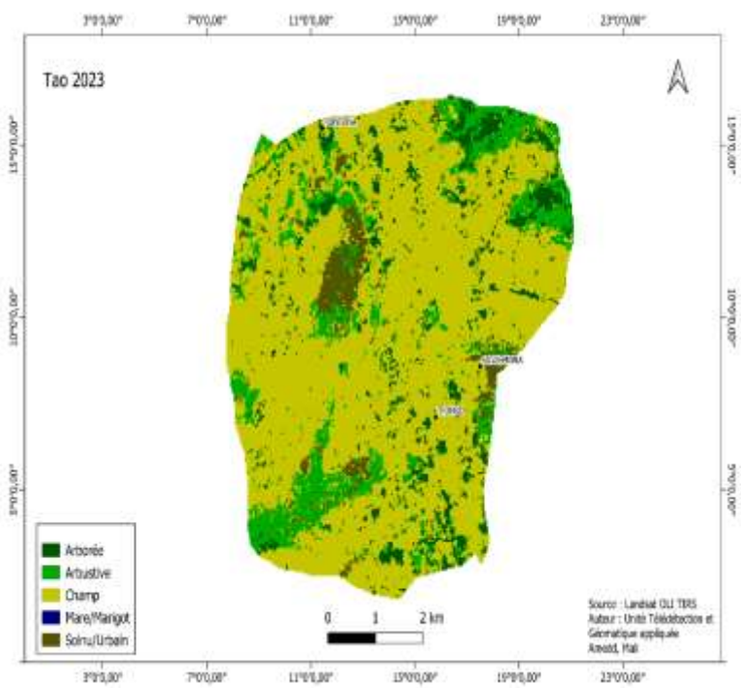
- One (1) communal workshop to assess the state of degradation of areas and natural resources, with 40 participants from villages and local monitoring bodies; sharing of key issues in the use of promising innovations and technologies to improve agricultural productivity and soil restoration;
- Fifteen (8) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved varieties of maize, sorghum, millet, rice, cowpea, fonio) and restore and maintain soil fertility (contour bunding of fields, RNA, reforestation, etc.).
- Purchase and distribution of improved seeds in targeted villages:
    - Tomato: 1 hectare (demonstration)
    - Oyon: 1 hectares (demonstration)
    - Pepper: 2 hectares (demonstration)
    - Shallot: 1 hectare (demonstration)

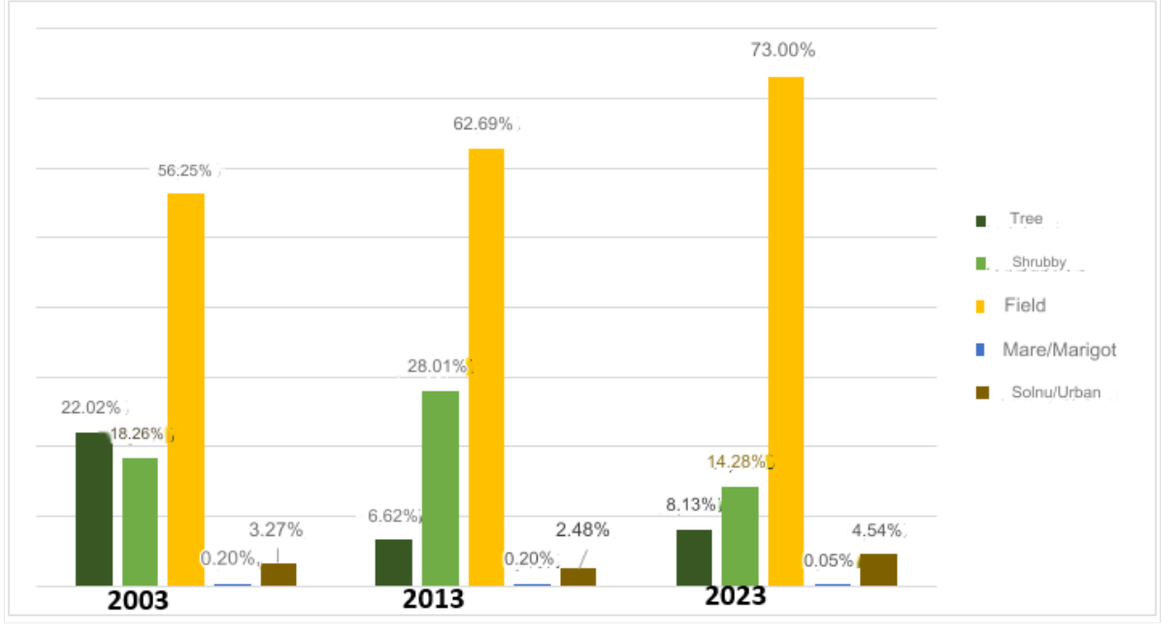
    - Potato without fertilizer: 1 hectare (demonstration)
    - Okra: 2 hectares (demonstration) saselon variety
    - Maize: 5 hectares (demonstration) * 15 villages * 25kg/ha, i.e. 1,875 kg of yellow maize seed (Brico variety), 70 days, with a production capacity of 4 tons per hectare.
    - Sorghum: 5 hectares (demonstration) * 15 villages * 10kg/ha, i.e. 750 kg of dual-purpose sorghum seed (Diakounbè variety), early, 70 days, yield 2.5 tons per hectare.
    - Millet: 5 hectares (demonstration) * 15 villages * 10 kg/ha, or 750 kg of millet seed, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tonnes per hectare.
    - Rice: 5 hectares (demonstration) * 15 villages * 50 kg/ha, i.e. 3750 kg of rice seed, rainfed variety Nerika 8 (20cm by 20cm spatial arrangement).
    - Cowpea: 5 hectares (demonstration) * 15 villages * 20 kg/ha, i.e. 1,500 kg of cowpea seed, variety Acar 1 or wilibali (75cm between rows and 30 between bunches).
    - Brachiaria: 10 kg of seed 1.5 per village
    - Elephant grass 600 cuttings 150 per village.
- Training of 5 nurserymen to produce tree nurseries (Moringa, cashew...);
- 40 people trained in sheep fattening, 10 per village.
- Training of 400 producers in technical itineraries for improved seed crops, including 100 producers per village;
- Local monitoring by AMEDD's specialized technicians.
- Creation of contour bunding: 400 ha (100 ha per village).
- Reforestation of 76.48 hectares and assisted regeneration of 1000 hectares of land.
- Dissemination of climatic information in the form of videos in Bambara and other local languages (target 200 producers per village), i.e. a total of 800 producers including young people and women.
- Organization of 8 inter-farmer visits (two visits organized per village) focusing on crops planted and other innovations for adapting the production system to climate change and variability.
- Organization of 8 village self-assessment and programming workshops each year to resize interventions in line with community needs.
- Organization of a communal self-assessment and consolidated programming workshop each year.
- Assessment of changes in the bio-geophysical and socio-economic environment at the end of the project.

III.18 Dynamics of land cover and land use in the commune of Tao









	Tao			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	68,5	Reduction in ha per year	6,71	A slight increase in ha per year
Shrubby	43,38	Hectares per year (increase)	61,1	Hectares per year (decrease)
Field	28,65	A slight increase in ha per year	45,86	Increase in hectares
Pond/Back water	0,009	Hectares per year a slight increase	0,66	Hectares per year a slight decrease
Bare ground/Urban	3,54	Hectares per year (a decrease)	9,19	Hectares per year (an increase)

Tao is a small commune in terms of surface area, with 3 villages and a total population of 9,090 inhabitants, including 5,947 women. Examination of the results of land use dynamics in the commune of Tao follows a similar trend to that of the commune of Sorobasso. Fields increased by 28.65 ha from 2003 to 2013 and 45.86 ha between 2013 and 2023. Tree savannah lost 68.5 ha between 2003 and 2013, with a slight increase of 6.71 ha between 2013 and 2023. Shrubby savannah acquired 43.38 ha between 2003 and 2013 and lost 61 ha between 2013 and 2023. Watercourses are almost non-existent in the commune.

An analysis of the spatial and temporal evolution of land use and occupation reveals significant environmental degradation. Agricultural land has increased steadily over the years, rising from 56.25% in 2003 to 62.69% in 2013, and will account for 70% of the commune's surface area by 2023. The commune of Tao is located in the CMDT area, where cotton growing is highly developed. This explains why the land is heavily occupied by Fields (70%). The absence of vegetation cover leads to the stripping of fertile and vegetal layers in the savannahs, resulting in bare soil, which has risen from 3.5 ha between 2003 and 2013 to 9.19 ha per year between 2013 and 2023.

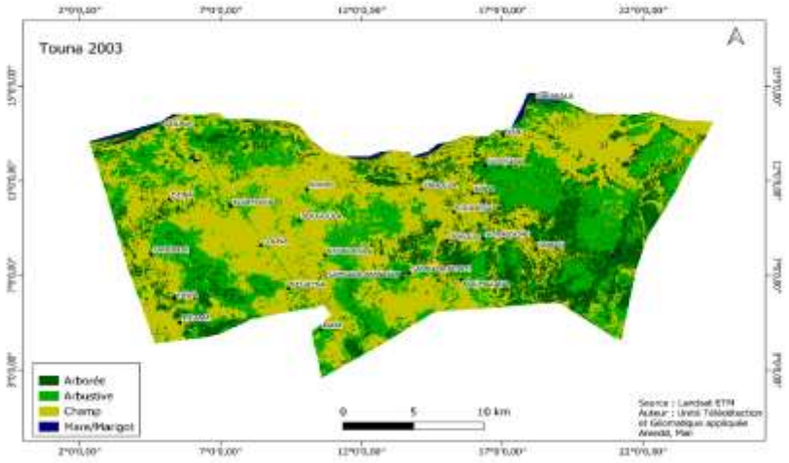
This situation calls for concrete action not only to regenerate wooded but also herbaceous areas, in order to restore the 203.43 hectares of land deforested over the last two years. Reforestation, assisted natural regeneration (ANR), and practices to reclaim degraded land (ACN, cordon pierreux, Composting, Agroforestry, fodder crops, planting grass strips, earthen bunds, etc.) are needed in the area. Awareness-raising campaigns can also be undertaken to reduce abusive cutting of energy wood. The promotion of climate-sensitive agricultural intensification is recommended. Actions to diversify sources of livelihood are recommended. Mass training in cultivation techniques adapted to new crop varieties, the use of climate information and the production and use of organic manure in the villages of the commune are an absolute necessity. Maintaining soil fertility requires the creation of contour bunding in cultivated fields. These various actions will have a greater impact on the central and southern parts of the commune.

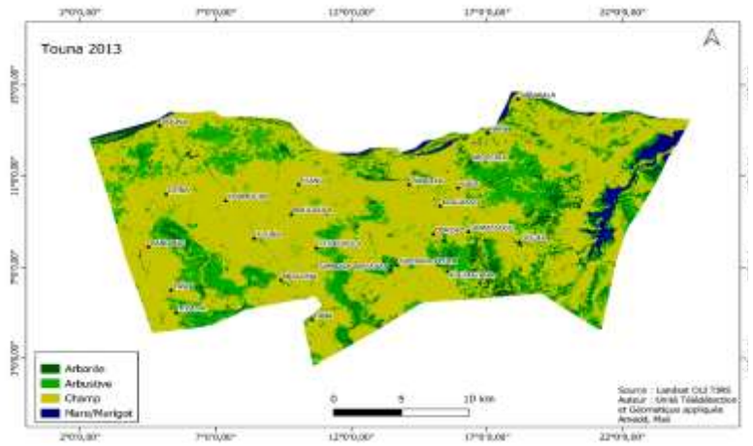
Given climate variability and the experience of land occupation and use practices in the commune of Tao, the following activities are necessary:

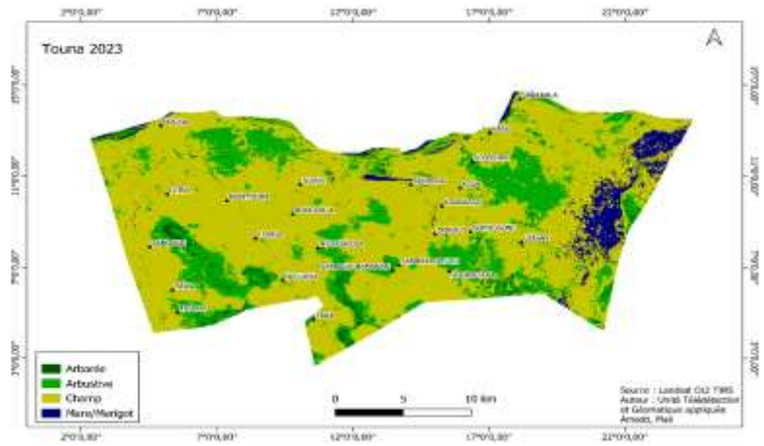
- One (1) communal workshop to assess the state of degradation of natural areas and resources, with 20 participants from villages and local supervisory bodies; sharing of key issues in the use of promising innovations and technologies to improve agricultural productivity and soil restoration;
- Three (3) village workshops for self-assessment and programming of concrete actions to improve agricultural productivity (improved varieties of maize, sorghum, millet, rice, cowpea) and restore and maintain soil fertility (contour bunding of fields, RNA, reforestation).
- Planting of 1,500 seedlings, i.e. 500 per village (500 Moringa, 500 cashew, 500 other dual-use species).
- Production of 300 hectares, i.e. 150 hectares of brachiation, 150 hectares of elephant grass for forage.
- Promotion and cultivation of wild grasses on the 22.41% of savannahs with areas such as andropogon, gayanus.

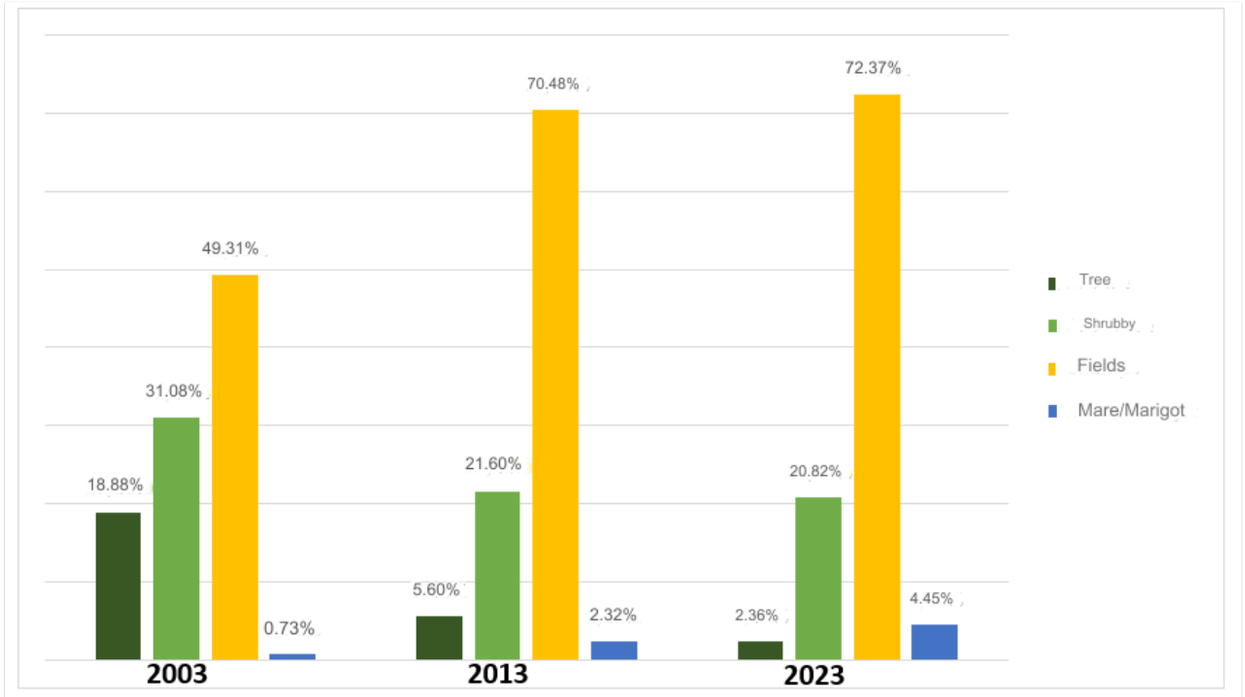
- Purchase and distribution of improved seeds in targeted villages:
    - Corn: 3 hectares (demonstration) * 3 villages * 25kg/ha, i.e. 225 kg of yellow corn seed (variety, soden),
    - Sorghum: 3 hectares (demonstration) * 3 villages * 10kg/ha, or 90 kg of dual-purpose sorghum seed (Diakounbè variety,) early, 70 days, yield 2.5tonnes per hectare, and grikan.
    - Millet: 3 hectares (demonstration) * 3 villages * 10 kg/ha, or 90 kg of millet seed, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tons per hectare.
    - Cowpea: 3 hectares (demonstration) * 3 villages * 20 kg/ha, i.e. 180 kg of cowpea seed, Acar 1 or wilibali variety (75cm between rows and 30 between bunches).
    - Soya: 3 hectares (demonstration) * 3 villages * 20 kg/ha, i.e. 180 kg.
- 300 growers trained in improved seed cultivation techniques, including 100 growers per village;
- Local monitoring by agricultural technical services and multi-purpose advisors from the NGO AMEDD
- Creation of contour bunding: 300 ha (100 ha per village)
- Reforestation of 203.43 hectares and assisted regeneration of 500 hectares of land.
- Dissemination of climate information in the form of a video in the local language (target 200 producers per village), i.e. a total of 800 producers including young people and women.
- Organization of 3 inter-farmer visits (one visit organized per village) focusing on crops planted and other innovations for adapting the production system to climate change and variability.
- Organization of 3 village self-assessment and programming workshops (one per village) each year to resize interventions in line with community needs.
- Organization of a communal self-assessment and consolidated programming workshop each year.
- Assessment of changes in the bio-geophysical (using satellite imagery) and socio-economic environment at the end of the project.

III.19 Dynamics of land cover and land use in the commune of Touna









	Touna			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	865,84	Hectares converted to other classes per year	211,44	Hectares converted to other classes per year
Shrubby	618,27	Hectares acquired (decreasing) per year	50,72	Hectares, a slight decrease
Field	1380,99	Hectares acquired (gained) per year (rate of increase)	122,89	Hectares, a slight increase per year
Pond/Back water	103,12	Hectares per year (an increase)	139,28	Hectares per year (an increase)

Touna is a rural commune neighbouring Bla. It has 24 villages and a population of 30,399 inhabitants, including 15,586 women. The high population density and a trend towards urbanization are accelerating the expansion of crop fields to the detriment of wooded areas. Cultivated fields increased from 49.31% in 2003 to 72.37% in 2023. Climate change and variability aggravate the vulnerability of ecological ecosystems and community resilience.

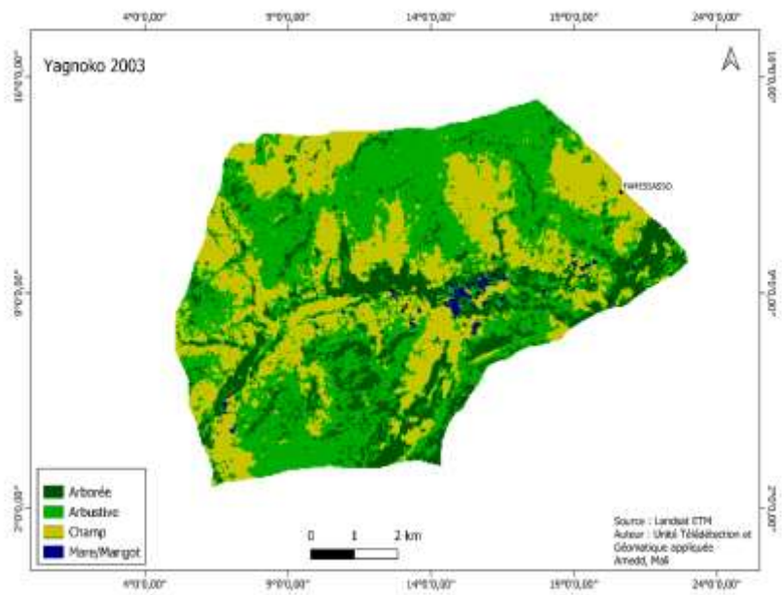
The municipality of Touna has an abundance of water potential (Bani river) which runs the length of the municipality from west to east, occupying 4.45% of the area in 2023. Action will be taken to exploit the water to reduce the degradation of the 262.16 ha lost per year. It is necessary to develop market garden crops around permanent watering points, and water retention systems (bouli, BCR etc.) for market gardening and animal watering. Many activities will be carried out within the framework of market gardening and income-generating activitie.

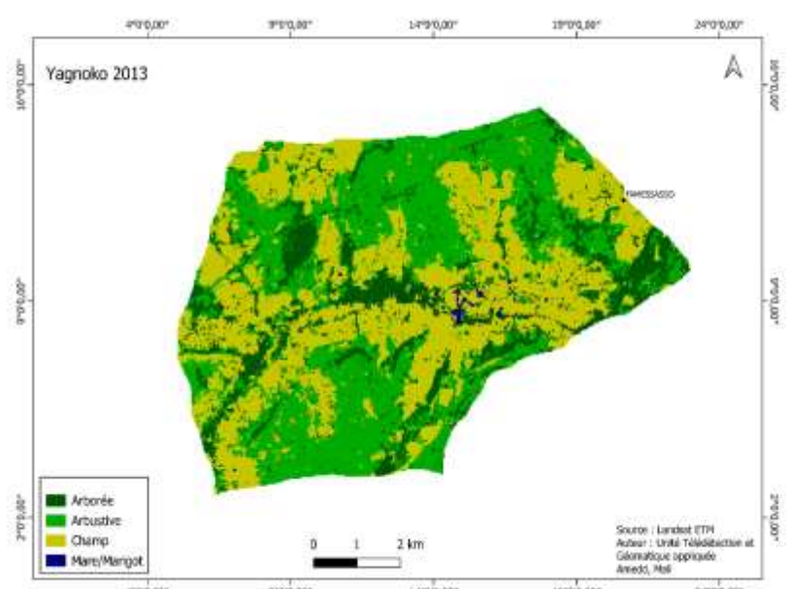
In the commune of Touna, for example, major changes are needed to reverse the trends associated with severe environmental degradation:

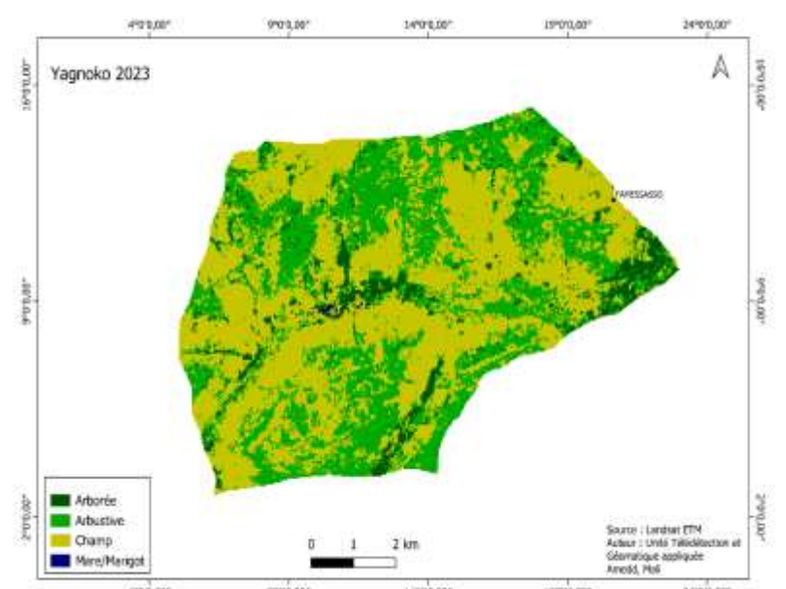
- Organization of 48 village assemblies to inform and raise awareness of the state of resource degradation in each village, reaching 2,400 people (24 villages * 2 assemblies per village and 50 participants per assembly, presentation of maps showing the spatiotemporal evolution of the degradation of spaces and natural resources).
- Organization of reforestation or assisted regeneration actions equivalent to the deforestation of the last two (2) years, i.e. 524.32 hectares to be distributed among the villages during village information and awareness-raising workshops.
- Training 24 market garden cooperatives in water management (one per village).
- Support for 10 nursery planters in the production and sale of seedlings for reforestation,
- Cascade training for 2,400 rural and urban women and young people in the use of targeted improved stove models (100 women and young people per village * 24 villages).
- Launch of a "sigida kura" (new living environment) competition between the 24 participating villages to promote the use of improved stoves and the sustainable management of energy resources.
- Organization of one (1) knowledge and innovation fair per year, for 3 years, to mobilize local, regional and national institutional players in the process of ecological and economic resilience of communities in the commune of Touna.
- Support for two (2) small-scale manufacturers of improved solar stoves for urban and semi-urban households, with a view to reducing wood energy consumption by 20%.
- Establishment of a protocol for measuring the reduction in GHG emissions from the improved stoves used.
- Introduction of varieties and demonstrations for large-scale dissemination of climate-smart agricultural practices:
    - Tomato: 1 hectare (demonstration)
    - Oyon: 1 hectares (demonstration)

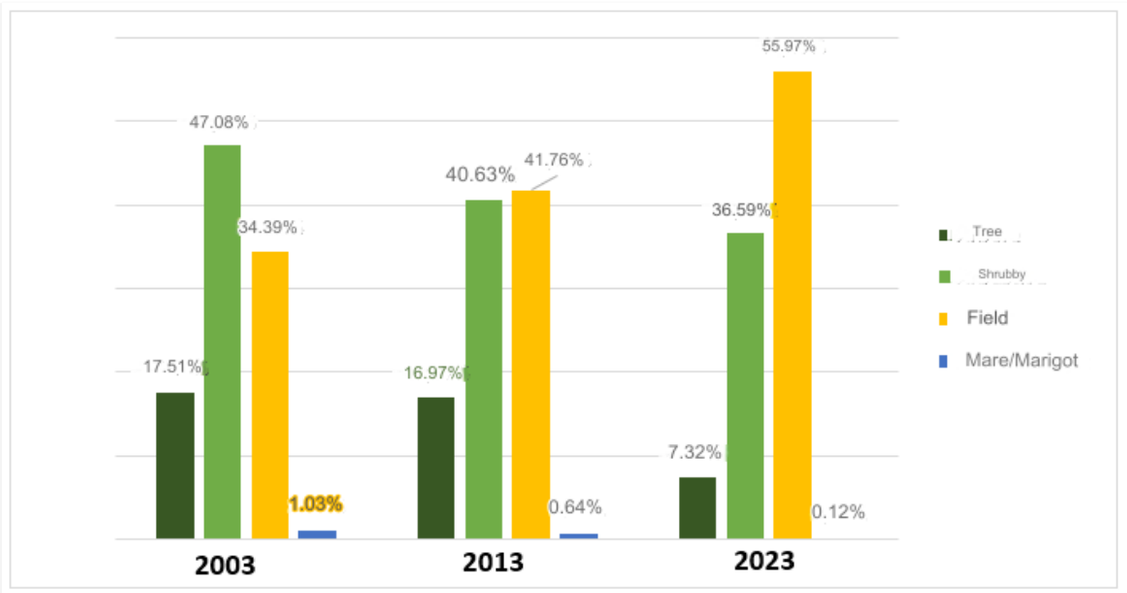
  - Pepper: 2 hectares (demonstration)
  - Shallot: 1 hectare (demonstration)
  - Potato without fertilizer: 1 hectare (demonstration)
  - Okra: 2 hectares (demonstration) saselon variety
  - Rice: 10 hectares (demonstration) * 24 villages * 50 kg/ha, i.e. 12,000 kg of rice seed, rainfed variety Nerika 8 (20cm by 20 cm spatial arrangement).
  - Corn: 2 hectares (demonstration) * 24 villages * 25kg/ha, i.e. 600 kg of corn seed
  - Sorghum: 2 hectares (demonstration) * 24 villages * 10kg/ha, or 1,200 kg of dual-purpose sorghum seed (Diakounbè variety) early, 70 days, yield 2.5 tons per hectare.
  - Millet: 5 hectares (demonstration) * 24 villages * 10 kg/ha, or 1,200 kg of millet seed, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tons per hectare.
  - Cowpea: 5 hectares (demonstration) * 24 villages * 20 kg/ha, i.e. 2,400 kg of cowpea seed, Acar 1 or wilibali variety (75cm between rows and 30 between bunches).
  - Fonio: 2 hectares (demonstration) * 24 villages * 50 kg/ha, i.e. 2,400 kg of fonio seed, variety Kassamara or Niatia (flap sowing).
  - Sesam: 2 hectares (demonstration) * 24 villages * 50 kg/ha, i.e. 2,400 kg sesame seed, (flap sowing).
- Training of 4,800 producers (young people and women) in improved seed cultivation techniques, including 200 producers per village; refresher training each year based on the shortcomings identified following self-assessment and programming by village.
- Creation of level-cut fields (ACN) 40 hectares per village per year for 3 years, i.e. a total of 2,880 hectares of cultivated fields by 2027.
- Training of 24,000 farmers in contour field management (learning by doing),
- Training of 4,800 producers (young people and women) in the rapid production of compost and the use of calcium-based soil improvers.

III.20 Dynamics of land cover and land use in the commune of Yognoko









	Yognoko			
	2003_2013	Surface unit	2013_2023	Surface unit
Forest	3,42	Hectares, a slight decrease per year	61,34	Hectares, a slight decrease per year
Shrubby	41,03	Hectares per year (decreasing)	25,65	Hectares per year (in reduction)
Field	46,88	Hectares per year (increase)	90,32	Hectares per year (increase)
Pond/Backwater	2,42	Hectares, a decrease per year	3,32	Hectares, a decrease per year

The commune of Yognoko comprises 3 villages and a total population of 4,768 inhabitants, including 2,371 women. Analysis of the spatiotemporal evolution of land occupation and use shows a strong degradation of the Trees and Shrubby savannahs from 86.99 ha per year of environmental degradation between 2003 and 2013 to 86.99 ha from 2013 to 2023, i.e. a decrease in vegetation space from 56% in 2013 to 43% in 2023. Savannah areas are located in the northern and southern parts of the commune. This loss is made up of agricultural land, which has increased from 34.39% in 2003 to 41.76% in 2013, reaching 55.97% of the surface area in 2023. The commune has some temporary watercourses.

The dynamic degradation of land to Fields from 34% to 60% between 2003 and 2023 calls for concrete action to restore the 173.98 hectares of land deforested over the last two years. Good agricultural practices must be prioritized to reclaim degraded land. These best practices include contour cultivated fields (ACN), composting, agroforestry, forage crops, planting grass strips, etc.

A series of awareness-raising campaigns can be undertaken to reduce abusive cutting of energy wood. Promotion of intensification of climate-sensitive agriculture can be recommended. Income diversification actions are recommended. Cascading training in cultivation techniques adapted to new crop varieties and the use of climate information are an absolute necessity.

Sub-mentioned activities are essential for the resilience of ecological ecosystems in the commune:

- One (1) communal workshop to assess the state of degradation of natural areas and resources, with 45 village participants (15 people per village);
- Community mobilization in the soil restoration process through 2 communal workshops to plan reforestation and assisted natural regeneration (ANR) activities in the various village terroirs.
- Three (3) village workshops to identify tree seedling and surface requirements for reforestation and ANR;
- Planting of 1,500 seedlings, i.e. 500 per village (500 Moringa, 500 cashews, 500 other dual-use species).
- Training of 300 producers in improved seed cultivation techniques, including 100 producers per village;
- 300 ha of contour bunding (100 ha per village).
- Reforestation of 86.99 hectares and assisted regeneration of 173.98 hectares of land.
- Production and distribution of multimedia climate information in the form of videos in the local language (target 200 producers per village), i.e. a total of 600 producers including young people and women.
- Organization of 3 inter-farmer visits (one visit organized per village) focusing on crops planted and other innovations for adapting the production system to climate change and variability.
- Three (3) village workshops (one per village), programming concrete actions to improve agricultural productivity (improved varieties of maize, sorghum, millet, rice, cowpeas, soybeans, etc.);

  Purchase and distribution of improved seeds in targeted villages:
  - Corn: 3 hectares (demonstration) * 3 villages * 25kg/ha, i.e. 225 kg of yellow corn seed (variety, Soden, others).),
  - Sorghum: 3 hectares (demonstration) * 3 villages * 10kg/ha, or 90 kg of dual-purpose sorghum seed (Diakounbè variety,) early, 70 days, yield 2.5tonnes per hectare, and grikan.
  - Millet: 3 hectares (demonstration) * 3 villages * 10 kg/ha, or 90 kg of millet seed, Chacti variety, rich in zinc, iron and manganese, 60-day cycle, yield 1.5 tons per hectare.
  - Cowpea: 3 hectares (demonstration) * 3 villages * 20 kg/ha, i.e. 180 kg of cowpea seed, Acar 1, or wilibali variety (75cm between rows and 30 between bunches).
  - Soya: 3 hectares (demonstration) * 3 villages * 20 kg/ha, i.e. 180 kg.

IV. Conclusion

The dynamics of change observed in the working communes indicate a very strong degradation of spaces and natural resources over the years. These changes are accelerated by climate variability and change, in addition to demographic and pastoral pressure. A degradation of the social fabric following several decades of incoherent superposition of positive law and traditional rules of spaces and natural resources management. Is at the root of the birth and persistence of intra- and inter-community conflicts. A paradigm shift through the construction of a coherent dialogue and the strong dominance of community management rules in the governance of natural resources is essential for the sustainability and resilience of ecological ecosystems.

Initiating such a change requires firstly a pictorial restitution of the mapped results of the evolution of spaces and natural resources to the communities and local technical services in the villages. Then comes a phase of proposing several options and technological innovations for each local context as specified in the case studies for each commune. All solutions must be discussed with the communities involved in the detailed planning of action implementation.

In this process, it Is not a question of sprinkling, but of a real dynamic to revive local economies in an improved production system that guarantees the sustainable management of spaces and natural resources. The level of degradation is such that changing trends requires strong, sustained action over time.

In each village, a Farmer Research Network (FRN) should be set up, i.e. a networked learning system for farmers around agroecological intensification options. This farmer learning network interacts with scientific and technical researchers, including NGOs and social scientists, intending to improve agricultural practices for adaptation to climate change and variability. The system is evaluated annually to collectively introduce changes or modifications in the implementation of new technologies for managing spaces and natural resources adapted to the specific local context of each village.

Local village and communal conventions should be drawn up to ensure that they are properly articulated with the management rules of positive law. Village and communal land commissions should complete the governance process for local management of natural spaces and resources, including pastoralism.

An assessment of performance in improving the resilience of ecological ecosystems and communities should include the following indicators:

- Changes in land cover and land use (health of vegetation and plant cover),
- Change in agricultural biodiversity (improved diversity of cultivated species and varieties),
- Change in plant biodiversity (diversity in agroforestry species),
- Change in yields of major crops,
- Change in the adoption of technological innovations to adapt to climate change.